FLUKE AND PHILIPS – THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE®

PHILIPS

PHILIPS

- Oscilloscopes
- Multimeters
- Logic Analyzers
- Board Testers & Troubleshooters
- Calibration & Systems
- Signal Sources
- Counters/Timers
- Instrumentation Systems
- Recorders & Plotters
- Data Acquisition
- Operator Interfaces
- Digital Thermometers
- Video Test Equipment
- Power Supplies
- Customer Support Services

Catalog 1990

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T&M EXPRESS LINE

T&M Express Line: *A selected range of Fluke/Philips products, available via distributors, will provide you with major benefits in supply and service. These Selected products are easily identified by the "T&M Express Line" label on the specific product pages. Call your local Philips organization to receive a complete overview of the "T&M Express Line" and the T&M Express Line distributors.*



How to use this catalog

The section numbers listed in the above table of contents outline the broad product groupings you will find in this catalog. You can reference each of these sections by simply thumbing to the appropriate number shown on the outer margin of each product page.

When looking for a specific product or type of product within each product section, first refer to the divider page for the section.

Here you will find a handy table of contents, along with pictures of several key products featured in that section. Directly following most divider pages is a selection guide that compares key features and specifications of all products in the section, and lists page numbers.

The front of the catalog also includes three master-reference page indexes. One is an alphabetized functional listing of all products and services in the catalog, the other two are numerical listings for both the Fluke and Philips product lines.

When you have found the product you want, you may request more information by directly contacting your nearest Fluke or Philips office as listed in the last section of this catalog.

New Products

Fluke and Philips. The momentum builds into the 1990's.

This catalog marks the start of the third year of the strategic alliance between John Fluke Mfg. Co. of the United States and N.V.Philips of the Netherlands. Since its inception, well over 50 new products have been introduced, and the momentum is building as we prepare to tackle the 1990's with even greater test solutions for the next decade of test requirements.

All of us at Fluke and Philips recognize that the science of measurement is an evolutionary discipline capable of huge potential in future generations of test and measurement instrumentation. This is reflected in the many technological advancements incorporated into our products over the years, and is evident in our new product offerings brought to you in this catalog. These products span most all our major product categories, and greatly expand the solutions we can now bring to your test and measurement problems.

To increase your convenience in obtaining the products you need, a broad line of Fluke and Philips instruments are available off-the-shelf from some 800 distributors throughout Europe under the "Express Line" label. These include digital multimeters, timer/counters, function and LF generators, oscilloscopes and many other compact items of test and measurement equipment. As with all our products, we also offer application assistance, training, systems integration, parts, services and support to ensure you maximize your productivity from our products and realize the best return on your investment.

As you refer to this catalog throughout the year, we invite you to "put us to the test". We're confident that our products can meet or exceed your performance requirements, while keeping your cost of ownership low.

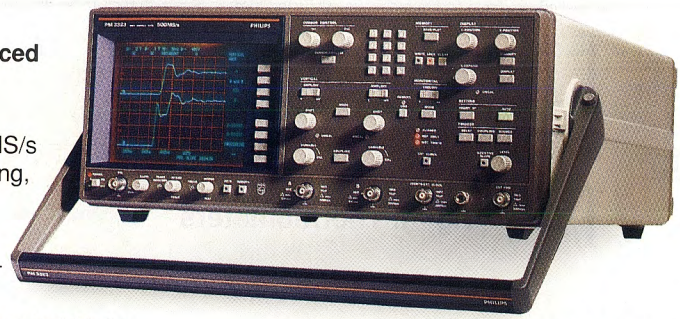


Fluke World Headquarters, Everett, WA, U.S.A.



Philips Research Labratories, Eindhoven, The Netherlands

PM 3323 High-Frequency Advanced Digital Storage Oscilloscope



- Very high 500 MS/s real-time sampling, plus repetitive sampling
- Fast 2 ns single-shot resolution
- Wide 300 MHz bandwidth for repetitive signals
- Glitch capture to 3 ns
- Precise 10-bit vertical resolution with up to 1000X vertical offset
- AUTOSET, and front panel setup memories
- Advanced cursor facilities for mathematics, calculations, and extensive analysis capabilities
- Save/stop on difference mode for automatic testing
- Four 4k deep memories

The PM 3323 provides truly exceptional DSO performance. Signal acquisition extends to 300 MHz for repetitive signals, and the fast 500 MS/s real-time sampling captures single-shot signals to a full 50 MHz (at 10 samples per period). With 10-bit resolution, exact signal detail can be examined, even when the signal is expanded on the display. Following signal acquisition, advanced built-in intelligence allows the PM 3323 to extract in-depth details of the signal—not only with measurements like RMS or mean voltage, or time measurements like pulse width or frequency, but also with mathematic functions like addition and subtraction of signals, and analysis functions like differentiation, integration, or even FFT. With extensive front panel setup and signal reference memories as well as full RS-232 or IEEE-488 interface facilities, the PM 3323 is well suited to both bench and system applications.

See page 27 for detailed information.



PM 5138 10 MHz Function Generator plus Arbitrary Waveforms

- Menu-driven operation, backlit LCD
- 0.1 mHz to10 MHz frequency range
- Arbitrary waveform function
- Sine, square, triangle, positive and negative pulses and ramps
- 1 mV to 20V p-p output level
- A variety of modulation modes
- Optional GPIB/IEEE-488 interface

The PM 5138 makes precision function generation easier than ever. This high performance instrument introduces a new concept to waveform generation and frequency synthesis - menu-driven operation. Just a few fingertip-action pushbuttons and step-through menus let you select the functions you want, while a single, large rotary control allows precise setting of all numeric values. Precise, reproducible performance is assured for a variety of waveforms. A unique arbitrary waveform function is also provided.

See page 292 for detailed information.

45 Dual Display Multimeter



- Multifunction vacuum fluorescent dual display
- True rms voltage and current, including ac + dc
- RS-232 interface standard, GPIB/ IEEE-488.2 option
- Frequency measurements to 1 MHz
- dB measurements
- Compare (Hi/Lo/ Pass) function for quick in-tolerance tests
- Touch Hold, Relative and Min Max
- Audible continuity and diode test
- Closed-case calibration

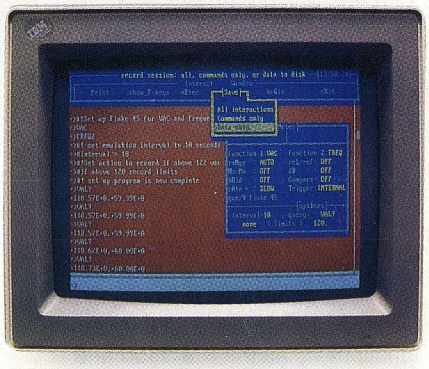
The Fluke 45 is a feature-rich 5-digit, 100,000 count DMM with a unique multifunction dual display. It is particularly useful in applications requiring two different measurements of the same signal; i.e. power supply testing, where the V dc output can be viewed on the primary display while the V ac ripple is shown on the secondary display.

The Fluke 45 offers high performance and versatility for manufacturing test, depot and field service, and research and development. A standard RS-232 makes it ideal for PC instrument applications.

See page 55 for detailed information.

QuickStart 45 Software.

QuickStart 45 PC software helps you put the computing power of your PC to work with the measurement capabilities of the Fluke 45. With it, you can set up tests to run on an IBM PC or compatible, take readings from the Fluke 45 and file them in .PRN format allowing access from Lotus 1-2-3 and other popular personal computer applications programs. QuickStart also has a chart mode which converts the data to a chart recorder-style presentation.



See page 59 for detailed information.

Fluke 900 Dynamic Troubleshooter

- High speed in-circuit test
- Tests SSI to VLSI, PALs, gate arrays and more
- 10 ns fault detection resolution
- Built-in test sequencing
- Failure tracking

This digital troubleshooter provides easy fault isolation to the component level, using Dynamic Reference Comparison (DRC) technology. This unique chip-to-chip comparison technique uses a known-good replacement component as a model. It compares the dynamic performance of this reference device to the performance of the suspect device under test.

Timing, intermittent, and static faults are captured with a fault



detection resolution of 10 nsec, at data rates of up to 20 MHz.

The 900 is equally effective in testing a wide range of component types whether on a bus or in a feedback loop.

The 900 also monitors logic activity on each pin of the device under test to ensure that sufficient logic stimulus has been supplied for a valid comparison test. Test parameters for each component on a UUT may be saved in a Test Sequence.

Extended µP Support.

To maintain their leadership position in supporting the growing number of complex microprocessors entering the market, Fluke introduced the 9132 memory emulation module in 1989.

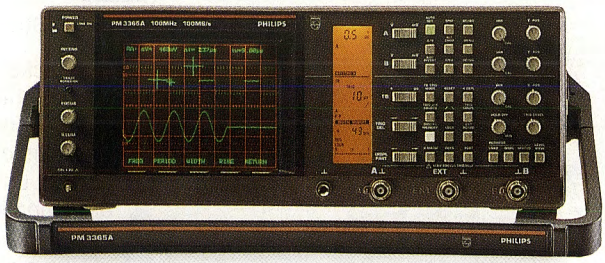
Through patented techniques, Fluke has eliminated the problems of traditional memory emulation: dead Kernels.

Microprocessors supported by memory emulation are: 64180, 80286, 80386, 80386 SX, 68020, 68030, and 7810. This complements the support for over 50 processors with our traditional processor emulation technique.

See page 172 for detailed information.

New Products

PM 3375 & PM 3365A Advanced Medium-Frequency Digital Storage Oscilloscopes

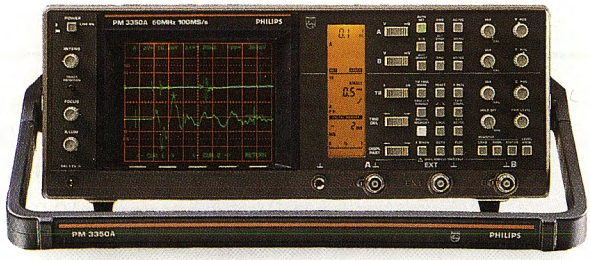


- Advanced combination analog and digital scopes
- High real-time sampling rate to 250 MS/s, plus repetitive sampling
- Analog and digital repetitive bandwidth to a full 100 MHz
- Triggering to 150 MHz
- Multifunction AUTOSET gives instant display of signals
- 64 front panel setup memories
- Advanced automatic cursor measurements
- Average and envelope modes
- Delayed time referencing, with Autozoom
- Optional RS-232/IEEE interface

These combined analog and digital oscilloscopes provide all the same functionality as the PM 3355 and PM 3350A, plus they add repetitive sampling techniques to extend that performance to a full 100 MHz digital and analog bandwidth for repetitive signals. For single-shots, the 250 MS/s and 8-bit conversion on each channel reveals the smallest and fastest transients. To zoom in on details, the delayed time referencing mode offers the digital equivalent of delayed time base mode in an analog scope. Extensive cursor facilities and math functions allow direct measurements, and reference memories are available for signal comparisons. Full AUTOSET instantly displays the waveform in just 2 seconds.

See page 33 for detailed information.

PM 3355 & PM 3350A Medium-Frequency Digital Storage Oscilloscopes



- Combination of analog and digital scopes
- High real-time sampling rate to 250 MS/s on each channel, simultaneously
- 60 MHz analog bandwidth
- Triggering to 100 MHz
- Multifunction AUTOSET gives instant display of signals
- 64 front panel setup memories
- Advanced automatic cursor measurements
- Average and envelope modes
- Delayed time referencing, with Autozoom

The PM 3355 combines the best of familiar analog scopes with outstanding digital oscilloscope performance. It brings a new level of acquisition performance to medium frequency DSOs, with fast 250 MS/s real-time sampling to capture single-shot events with a resolution of just 4 ns. In addition, along with the newly enhanced PM 3350A, it provides a 60 MHz analog bandwidth, and a variety of features for improved signal acquisition and measurement. These include not only simple direct cursor measurements of amplitude and time, but also RMS and mean voltages, pulse widths, frequencies, and much more. Three reference memories are also included for easy comparison of signals.

See page 37 for detailed information.

792A AC/DC Transfer Standard

- 10 ppm total uncertainty
- Traceable to national standards
- 10 mV to 1000V voltage range
- 10 Hz to 1 MHz frequency range



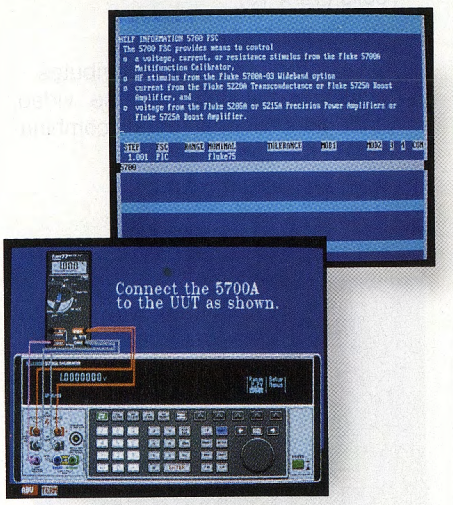
This new reference standard provides direct traceability to national standards, and is also designed for use as a working standard for calibration of your high performance alternating voltage sourcing and measuring instrumentation. It is based on the patented Fluke solid-state rms sensor. Compared to a traditional thermal voltage converter, the Fluke rms sensor settles faster, exhibits negligible reversal error, and has a large signal-to-noise ratio.

The 792A consists of a transfer unit, a power supply and a range tester.

See page 240 for detailed information.

MET/CAL Automated Calibration Software

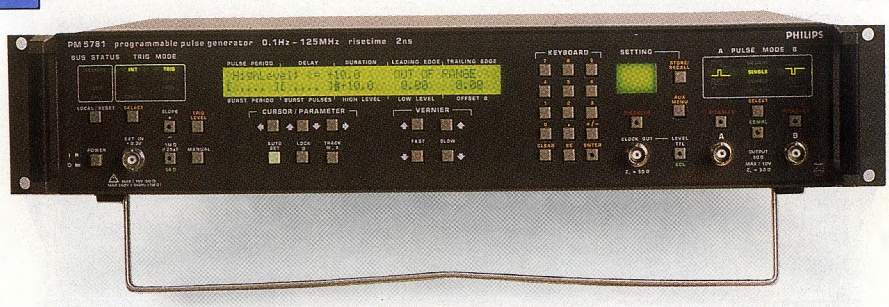
New MET/CAL calibration software brings the power and flexibility previously available only with a dedicated IEEE-488 instrument controller into the PC-compatible environment. Calibration procedures are written using calibration-oriented terminology that is both flexible and simple to learn



for users with little or no programming experience. Yet MET/CAL can meet virtually all of a calibration lab's DC and low-frequency digital multimeter workload requirements, including closed-case, closed-loop calibration, as well as oscilloscope calibration. Also provided are procedures for a number of widely-used DMMs and oscilloscopes.

MET/CAL has a demo mode that implements a simulated execution of procedures without having the systems instruments present. It also features four levels of system security for MIL audited users.

See page 228 for detailed information.

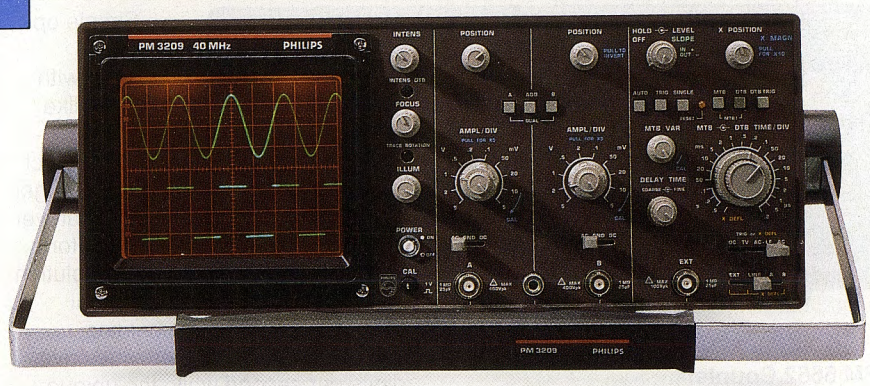


PM 5781 125 MHz Programmable Pulse Generator

- Wide 0.25 mHz to 125 MHz range
- 2 ns to 100 ms rise- and fall-times
- 0.2V to 10V amplitudes
- Dual pulse outputs
- Preset burst with external or internal generator
- External triggering, gating, and shaping
- High-speed programming via IEEE-488
- Optional autocal function

The PM 5781 is a fully programmable pulse generator designed primarily for automatic test systems, but with advanced, microcomputer-based operation for easy bench-top use. The high speed, wide amplitude range and functional versatility of the PM 5781 make it ideal for a very wide variety of analog circuits, as well as fast digital circuit testing, including TTL, BiCMOS, or ECL. Also, a wide choice of internal/external trigger and gate functions make set-up of special test signals extremely easy.

See page 313 for detailed information.



PM 3208 and PM 3209 General Purpose Analog Oscilloscopes

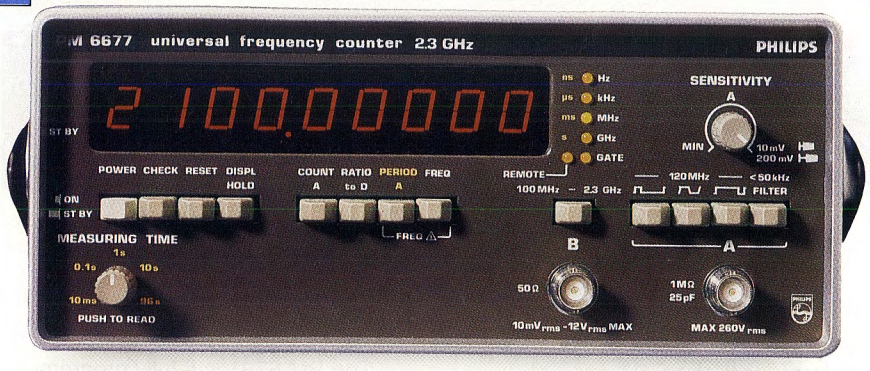
- 20 MHz bandwidth single timebase (PM 3208)
- 40 MHz bandwidth dual timebase (PM 3209)
- Variable hold-off trigger delay
- Z-input and Y-output
- TV line and frame triggering

These dual channel oscilloscopes have complete specifications that meet virtually all the demands of general-purpose portable and benchtop applications, yet their price tag is within reach of hobbyists.

The high 1 mV sensitivity helps you find disturbances, noise, overshoot and glitches on small signal amplitudes. In brief, the PM 3208 and PM 3209 are scopes with totally professional performance in the low-budget price range.

See page 19 for detailed information.

New Products

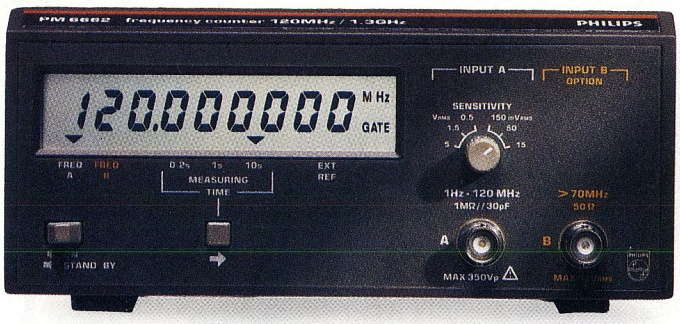


PM 6677 Universal Frequency Counter

- High resolution (7 to 9 digits)
- Wide frequency range to 2.3 GHz
- Error-free triggering, with noise suppression
- High stability crystal oscillators
- High 10 mV sensitivity
- Flexible arming facilities
- Battery operation (optional)

The PM 6677 extends the range of our PM 6670 family to a full 2.3 GHz. Combined with superior accuracy and powerful measuring features, they are ideal for maintenance, research and development in telecommunication, broadcast, TV, radio control, and navigation equipment. Reciprocal counting provides excellent resolution, with advanced front-end circuitry for error-free, automatic triggering. In addition, a wide variety of crystal oscillators are available, for superior stability. Portable battery operation is available as an option.

See page 357 for detailed information.



PM 6662 Counter

- Unrivalled price/performance
- High resolution reciprocal counting
- Fool-proof automatic triggering
- High stability, with MTCXO timebase
- Excellent RFI suppression
- 1.3 GHz option
- Battery operation (optional)

Economical and easy to use, the PM 6662 meets stringent demands for high-precision measurements, reliability and durability. Simple operation is assured with features like AUTO TRIGGER to select the right trigger level, whatever the waveform. High resolution reciprocal counting provides over 7 digits per second, while the unique MTCXO (mathematically temperature compensated oscillator) is available to give the high stability of oven-stabilized oscillators, at a fraction of the cost. Wide band x1 to x300 noise suppression is also provided. And the standard 120 MHz frequency range can be extended to a full 1.3 GHz for added versatility in this high value package.

See page 365 for detailed information.

1034 ScanTouch Shop Terminal.

- Shop terminal designed for production transaction systems
- Integrated bar code reader
- Optional high-grade stainless steel wand
- Designed for harsh, industrial environments
- Touch panel consists of 120 touch cells (12 x 10)
- Rack/panel mountable
- Selectable character attributes - highlight, blinking, reverse video, underline, conceal (or any combination of these)
- High contrast 12" CRT
- Full one-year warranty



Touch Screen technology eliminates the need for a keyboard in this new shop terminal for computer-based manufacturing systems. The 1034 ScanTouch Shop Terminal also offers an integral bar code reader that accepts input from any number of bar code devices, making the terminal a complete production data collection and control interface for shop floor personnel. No special training is required to use the terminal; the operator responds to commands from the host computer by simply touching a desired choice of action presented on the screen. The 1034 ScanTouch Shop Terminal connects to a host computer via RS-232, RS-422, or RS-485 multidrop. In a multidrop configuration, up to 32 terminals can be connected to one serial interface port.

See page 438 for detailed information.

2286A Data Logger

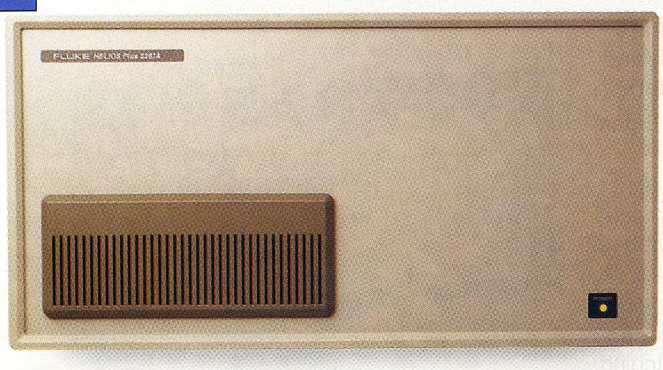
- Precision measurements and control
- Expandable to 1500 channels
- 3.5" floppy drive, MS-DOS compatible
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software



The new programmable 2286A Data Logger features an MS-DOS compatible internal microfloppy drive that collects up to 1.4 megabytes of measurement information on a 3.5" disk. Then, data reduction on a PC is possible, using Lotus 1-2-3 or other compatible analysis programs.

The 2286A is expandable from a simple 20 channel data logger to a distributed 1500 point data acquisition system. A wide range of analog and digital inputs can be measured by the 2286A, including dc voltage and current, temperature, BCD, binary and contact closure, resistance, strain, frequency and event totalizing. The 2286A also maintains high accuracy and provides common mode rejections of 170 dB at 50 and 60 Hz.

See page 407 for detailed information.



2287A Helios Plus Data Acquisition Front End

- Measurement speed up to 1000 readings per second
- Special features for autonomous scanning, data buffering and alarm checking
- Wide range of measurement and control options
- PC application software available for a complete system
- Ruggedized dc power version for remote/mobile applications

This new PC-based data acquisition system extends the current Helios product line into higher speed applications. Helios Plus provides a choice of analog to digital converters, which allows the mixing of higher speed channels of up to 1000 readings per second with high accuracy channels that have 17-bit resolution. It also accepts the complete array of Helios options for a wide range of measurement types and is compatible with a number of popular data acquisition PC software packages.

Designed for use in production testing, process monitoring, remote site data acquisition and equipment health monitoring, Helios Plus has the capability to measure a wide range of sensor types, including built-in signal conditioning for thermocouples, RTDs, and strain gages, while binary and analog channels provide control capability.

See page 413 for detailed information.



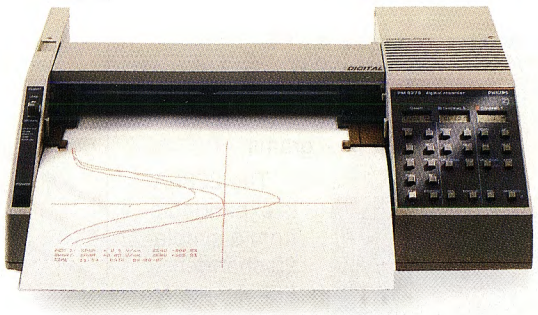
Test leads and accessories

As the multimeter finds its way into more and more applications and industries, new, multi-purpose test leads are needed to address unique test situations and product designs. For 1990, a wide assortment of new test lead variations are featured in this catalog, ranging from large jaw alligator clips to 5 Way Multipoint Test Lead Sets. Add these to our already large line of test leads and accessories and you'll see why the multimeter is one of the most widely used tools in electronic design, manufacturing and service.

See page 137 for detailed information.

New Products

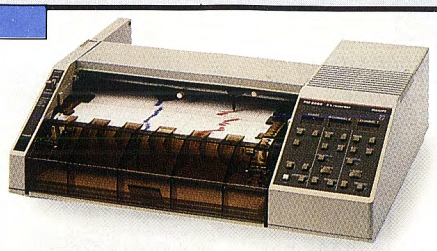
PM 8277 & PM 8278 XY and Xt Recorder



- Multi-format XY and Xt (line) analog recorder
- Digital enhancements for easy chart annotation
- Choice of z-fold or sheet paper to 11 x 17 in.
- Fast dynamic response
- Precise 0.25% accuracy, digitally controlled
- Wide sensitivity range
- IEEE-488 or RS-232
- Ideal for DSO hard copy output

These two analog recorders have digitally enhanced performance that combines valuable extra control and recording functions with significantly increased precision. The single pen PM 8277 and dual pen PM 8278 provide unbeatable versatility, with both XY and Xt recording on either z-fold paper or sheet paper. Full chart annotation (including time stamp) is provided at the touch of a button, and can be customized through a PC or controller. Instrument settings can be remotely controlled in systems use, and data can even be up-loaded to a separate controller. In addition, these recorders can be easily connected to Philips DSOs for quick and easy hard-copy documentation.

See page 480 for detailed information.

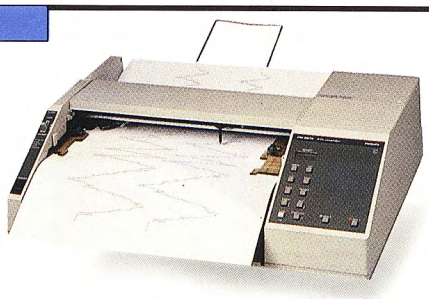


PM 8261 & PM 8262 Single and Dual-pen Chart Recorders

- Sensitivity range from 1 mV to 50V
- Chart speed range form 10 mm/h to 1200 mm/min
- Standard remote control unit; GPIB and RS-232 interfaces optional
- Rack-mountable
- 24 Vdc power input standard
- Auto-zero function

The new PM 8261 and PM 8262 horizontal chart recorders with one and two pens, respectively, offer economic solutions to the need for reliable, high-precision registration of one or two parameters against time.

See page 472 for detailed information.

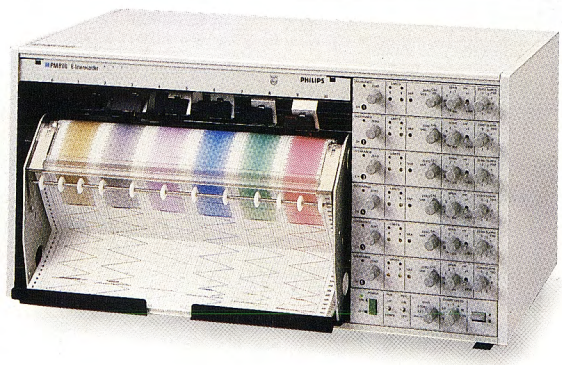


PM 8071 and PM 8072 XY and Xt Recorders

- High versatitlty: multi-format XY and line recording, and sheet or z-fold paper handling
- Durable, high quality engineering in every aspect of electronic and mechanical construction
- Standard logic interface; RS-232 and GPIB optional
- Versatile rack mounting facilities available

These fixed-input sensitivity recorders offer optimum and competitively priced solutions to meet a wide range of application requirements. In addition to accurate XY recording capability, they also offer continuous line (Xt) registration.

See page 478 for detailed information.



PM 8104, PM 8114, PM 8106 and PM 8116 4- and 6- line Chart Recorders

- Choice of 4- or 6-pen models
- Base models PM 8104 and PM 8106 for economic general-purpose chart recording
- PM 8114 and PM 8116 incorporate zero suppression, limit switching and pen offset compensation functions
- Input sensitivities variable from 1 mV to 10V
- Variable input gain from 100% to 250% of selected range
- Remote control of chart transport and penlift by TTL-level signals

This new family of chart recorders offers economic and effective solutions for the simultaneous registration of up to 6 parameters like temperature or other low-frequency phenomena against time.

These instruments have a vertical design concept which is ideal for both free-standing use and mounting in 19-inch instrumentation rack systems. The most recently drawn traces can always be seen clearly at the front of the instrument, allowing convenient visual monitoring.

The four models comprise two distinct lines: the basic models PM 8104 and PM 8106, with 4 and 6 pens respectively, and the PM 8114 and PM 8116 incorporating enhancements in the electronic control circuits.

Each input channel has a standard floating voltage-measurement input with adjustable sensitivity and variable gain.

See page 474 for detailed information.

Alphabetical

A

Abbreviations & Symbols 568
AC Calibrator 195, 201, 207
AC Current Probes 48, 148, 149
AC Millivoltmeter 100, 103
AC Reference Standard 250
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**Not described but listed with any relevant instrument
• IEEE-488
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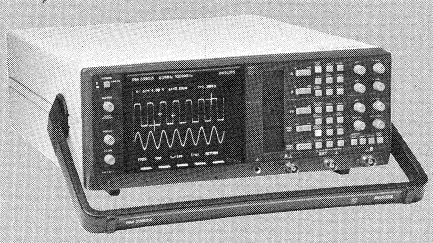
NEW



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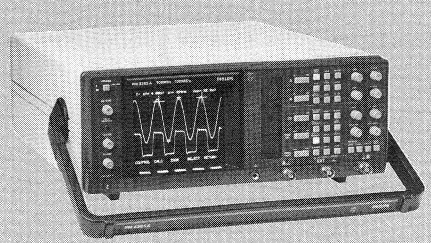

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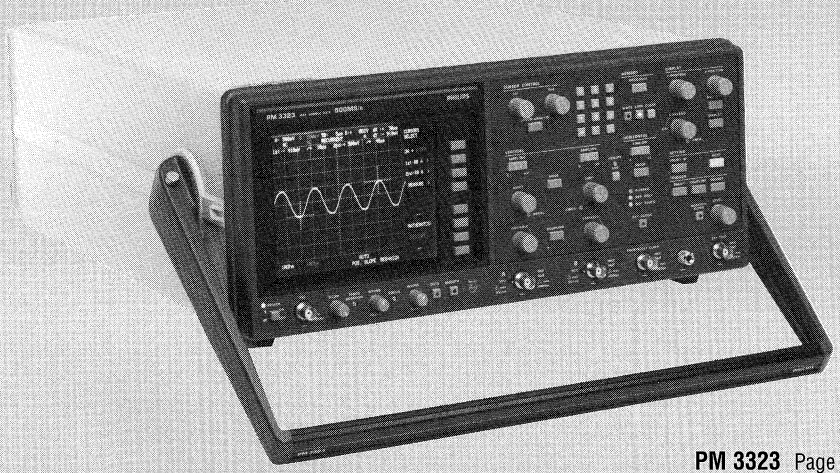

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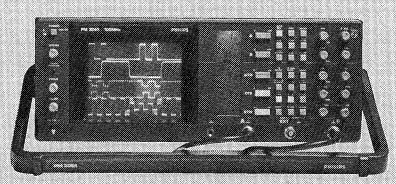

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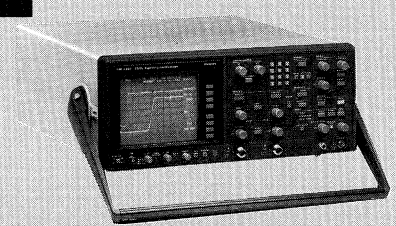

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The range of oscilloscopes detailed in this section covers R&D, production, and service applications.

It includes a complete range of 60, 100, 200 and 400 MHz analog oscilloscopes, all featuring Philips' innovative AUTOSET capabilities. This sets channel amplitude, time base and triggering to give fast, single button measurements of unknown signals. This range also offers GPIB/IEEE-488 interface capabilities.

In addition, advanced digital storage oscilloscopes (DSOs) range up to 2 GHz response, and feature the fast 500 MS/s, 300 MHz PM 3323, with advanced measurement, calculation and analysis functions built-in. Also, the new PM 3375 provides not only powerful signal capturing performance of 250 MS/s and 100 MHz, but also includes a familiar, fully functional analog scope – added versatility for the beginning DSO user, or even for more advanced applications. This dual functionality is provided in several models, including the very cost effective model PM 3335.

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Analog Oscilloscope Selection Guide

Model	Bandwidth (Risetime)	Timebase	Trigger Bandwidth	Acceleration Voltage	Channels	Dual Timebase	Cursors	GPIB	Autoset
PM 3295A/96A	400 MHz (0.875 ns)	1 ns/div.	400 MHz	24 kV	2 + 1	YES	YES	YES (95A OPT.)	YES
PM 3285A/86A	200 MHz (1.75 ns)	2 ns/div.	250 MHz	16 kV	2 + 1	YES	YES	YES (85A OPT.)	YES
PM 3070	100 MHz (3.5 ns)	5 ns/div.	150 MHz	16 kV	2 + 1	YES	YES	YES (OPT.)	YES
PM 3065	100 MHz (3.5 ns)	5 ns/div.	150 MHz	16 kV	2 + 1	YES	NO	YES (OPT.)	YES
PM 3055	60 MHz (5.8 ns)	5 ns/div.	100 MHz	16 kV	2 + 1	YES	NO	YES (OPT.)	YES
PM 3050	60 MHz (5.8 ns)	5 ns/div.	100 MHz	16 kV	2	NO	NO	YES (OPT.)	YES
PM 3209	40 MHz (8.8 ns)	20 ns/div.	40 MHz	12.5 kV	2	YES	NO	NO	NO
PM 3208	20 MHz	20 ns/div.	20 MHz	2 kV	2	NO	NO	NO	NO

Digital Oscilloscope Selection Guide

Models	Bandwidth (Risetime)	Sample Rate	Max. Stored Frequency	Acquisition Memory	Ref. Memory (Waveforms)	Vertical Resolution	Channels	Waveforms On Screen	Cursors	GPIB	RS-232
PM 3340	2 GHz (175 ps)	N.A.	2 GHz	0.5k (4k)	12 k (6)	10-bit	2	8	YES	STD	STD
PM 3323	300 MHz (1.17 ns)	500 Ms/s	300 MHz	4k	12k (6)	10-bit	2	8	YES	OPT	OPT
PM 3320A	200 MHz (1.75 ns)	250 Ms/s	200 MHz	4k	12k (6)	10-bit	2	8	YES	OPT	OPT
PM 3375	100 MHz (3.5 ns)	250 Ms/s	100 MHz	4k	12k (6)	8-bit	2	4	YES	OPT	OPT
PM 3365A	100 MHz (3.5 ns)	100 Ms/s	100 MHz	4k	12k (6)	8-bit	2	4	YES	OPT	OPT
PM 3355	60 MHz (5.8 ns)	250 Ms/s	25 MHz	4k	12k (6)	8-bit	2	4	YES	OPT	OPT
PM 3350A	60 MHz (5.8 ns)	100 Ms/s	10 MHz	4k	12k (6)	8-bit	2	4	YES	OPT	OPT
PM 3335	60 MHz (5.8 ns)	20 Ms/s	2 MHz	8k	8k (2)	8-bit	2	4	YES	OPT	OPT

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Oscilloscopes - A general Introduction

Oscilloscopes are available from a wide variety of sources and manufacturers. The number of sources available however, becomes limited, when such elements as design innovation, excellence of engineering and worldwide service and parts support are evaluated.

Philips oscilloscopes are the products of one of the world's largest electronics' companies, with annual sales in excess of $ 30 Billion, and annual budgets of over $ 1 Billion spent on basic research. These total capabilities in analog and digital electronics, manufacturing and fabrication techniques, in addition to worldwide service and support, make the choice of a Philips oscilloscope in many applications a prudent decision.

Analog or Digital Oscilloscope?

Most oscilloscope users grew up with and became used to using analog oscilloscopes, which offer excellent measurement solutions for a wide variety of applications, providing the signals are repetitive. When the signal is present at the instrument's input, the instrument can display it. When the signal dissappears so does the display.

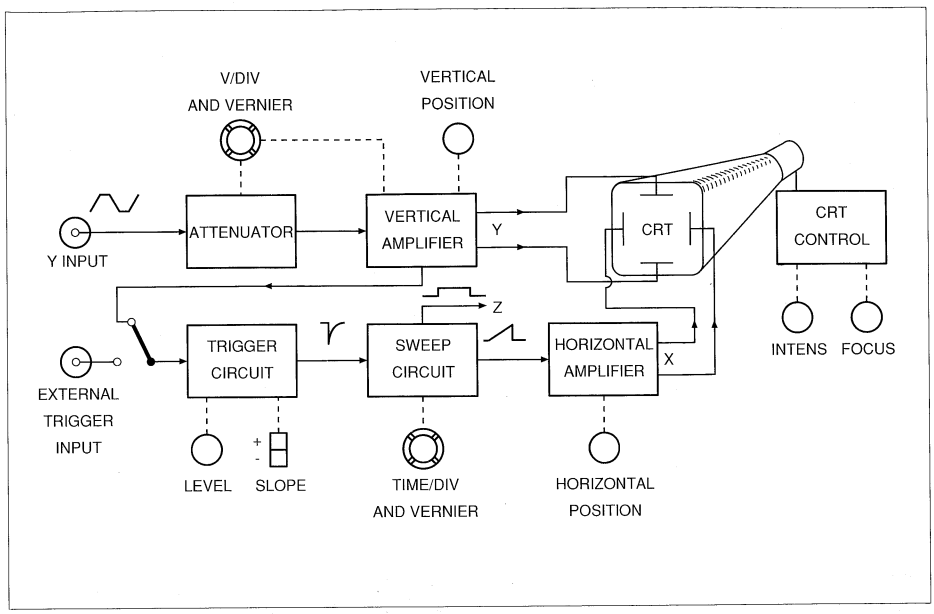
Analog Storage oscilloscopes can display signals of very low frequencies, low repetition rates or even single fast events. Such instruments were able to temporarily store waveforms in their display tubes for extended visual analysis.

Because of the high cost of analog storage display tubes, and the advent of fast and accurate Analog to Digital Conversion (A/D Conversion) processes, Digital Storage Oscilloscopes (DSOs) have become an alternative offering much more than just signal capturing advantages. The modern and powerful Digital Storage Oscilloscopes described in this catalog offer many measurement solutions and make full use of the digital capabilities to store, process and output the captured signals. In this introduction a review of analog oscilloscope functions, along with the selection criteria for each, is discussed. This is followed by a section specifically addressing Digital Storage Oscilloscope criteria.

Selection criteria for analog Oscilloscopes

The Basic Functions of an Analog Oscilloscpe

The block diagram of an analog scope is basically very simple : Input circuitry, attenuators, preamplifiers, channel switch, delay line, and output amplifier for vertical deflection, Trigger selection, trigger circuits, timebase(s) and horizontal output amplifier for horizontal deflection. (Plus, of course, the power supply and CRT.)



Vertical Input Channels

The vertical input channel attenuates or amplifies the input signal so that it can be displayed on the CRT. It usually contains the following functions:

- Coupling selection for AC or DC coupling
- Selection of input impedance (only in VHF scopes)
- Attenuation or sensitivity adjustment
- Position control
- Display invert switch, DC-offset, if available

What Amplifier criteria are most important to the user?

- Bandwidth. Specified as the frequency range between DC and the point where the signal amplitude has fallen to its -3 dB point. Philips analog oscilloscopes are available with bandwidths beginning at 20 MHz, up to 400 MHz.
- Risetime.The risetime determines the ability of the instrument to deal with short events, such as rise times of components, glitches etc.

The risetime and bandwidth of an oscilloscope have a known relationship to each other :
Risetime (in ns) x Bandwidth (in MHz) = 350.

To determine the risetime requirement (or Bandwidth) for an oscilloscope to perform a particular measuring task, the following may be helpful:

$T(observed) = T(signal)^2 + T(oscilloscope)^2$

Philips oscilloscope rise times are always specified at the tip of the probe delivered with the instrument.

- Maximum sensitivity, expressed in mV/div to be able to cope with spurious signals: crosstalk, power supply ripples, faulty components.
- Minimum sensitivity, expressed in V/div, to include direct measurements of high amplitudes, such as line, high voltage power, etc.
- Accuracy, in %.
- Maximum input (overload) voltage permissible at the input without causing damage, to reduce cost of ownership.
- Choice of input impedance. Most oscilloscopes are equipped with inputs of 1 MΩ, in parallel with their input capacitance. Philips oscilloscopes have unusually low input capacitances (only 9 pF in the 200 MHz and 400 MHz models).

In addition, all Philips oscilloscopes with bandwidths of 200 MHz and higher also offer the choice of 50Ω inputs. This serves two purposes : To provide a convenient and proper termination to coaxial cables when working in a 50 Ohm environment. To allow the use of low impedance passive 10x and 100x probes with extremely low input capacitances of 1 pF. (See PM 8911/09 and PM 8912/09).

Multiple Input Channels

Many oscilloscope applications require the ability to compare two or more waveforms to show amplitude differences, distortion, or time differences. Dual Beam oscilloscopes allow the comparison of waveforms by using a CRT with two electron guns and two deflection systems, to display two completely independent oscillograms on the same screen. However they require two completely independent and matched amplifier systems so not to introduce distortion or time differences and are prohibitively expensive for

Introduction

most applications. Most analog oscilloscopes therefore operate on the Dual Trace principle.

(Note :Digital storage oscilloscopes with synchronous Analog to Digital conversion on each channel prove to be excellent replacements for the Dual Beam oscilloscope.)

For dual trace instruments the two input signals are connected to a single output amplifier and CRT deflection system in turn using an electronic switch. This switch is either free running at a high frequency (CHOP mode) or changes channels at the end of every sweep (ALTERNATE mode). Philips oscilloscopes feature the highest CHOP frequencies in their respective bandwidth class, so as to ensure proper displays at the highest possible sweep rates, without visible interference of channel switching.

Some oscilloscopes are designed to display more than two channels in this fashion, either by having more than two full vertical input channels, or by allowing a trigger signal to be displayed.

Triggering

Triggering is the mechanism which defines the starting point of every successive sweep of the displayed trace. It defines the stability of the display and is usually the most prominent characteristic of the user friendliness of the entire instrument. Trigger signals are obtained from either a vertical channel (Internal triggering), or an external source.

What Triggering characteristics are most important to users?

- Choice of trigger sources, to help find and set up the most stable trigger and display condition for each application. Philips oscilloscopes invariably offer a full complement of trigger source selection to tackle the most demanding and complex waveforms.
- Maximum triggerable frequencies, also defining the ability to trigger on small signal details and glitches. Philips oscilloscopes trigger well beyond their rated vertical bandwidth.
- Automatic trigger level adjustment or manual adjustment between automatically detected signal limits. This translates to ease of operation. Thanks to the innovate AUTOSET function on all Philips oscilloscopes above 50 MHz, trigger source , trigger level, timebase speed and vertical sensitivity are all automatically set for instant signal viewing.
- TV triggering capabilities to deal with Video signals as are found in TV sets, cameras, VCR's, but also Radar, Medical and Computing equipment. In such applications, Philips video triggering capabilities are exceptional.
- In order to permit viewing the triggering edge of a waveform, all Philips oscilloscopes are equipped with a delay line in the vertical amplifier chain.
- Trigger jitter, or rather the lack thereof, to assure stability of display.
- Added features such as High or Low pass filters, Trigger view.

Timebases

An analog oscilloscope's timebase generator produces a linear voltage ramp, which is time calibrated, to control the horizontal trace deflection. The timebase generator does not start its sweep until triggered by a trigger signal. When each successive sweep is triggered at the same level and slope of an incoming repetitive signal, sweeps will always start at the same point of the signal, and a stable, jitter free display is obtained.

What Timebase criteria are most important to the user?

- Minimum sweep speed, expressed in s/div.
- Maximum sweep speed, expressed in µs/div or ns/div
- Accuracy (Typically 3 %)
- Linearity (Typically 3 %)

Dual Timebase / Delayed Sweep

To resolve signal details in time and to allow for more accurate timing measurements, many oscilloscopes with bandwidths of 50 MHz or more are available with two timebases, so that one serves as a delay generator for the other. The signal details of interest are identified with an intensified portion of the display of the main timebase (MTB), and can then be expanded across the entire screen width, using the delayed timebase (DTB). The delay is calibrated in divisions, which can be converted into time, taking the timebase speed of the main timebase (MTB) into account.

Modern Philips microprocessor operated scopes perform this calculation automatically and present calibrated delay values in time.

What Delayed Sweep criteria are most important to the user?:

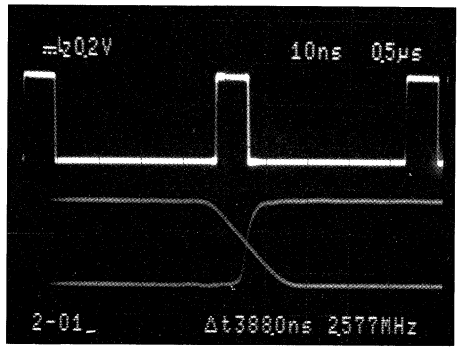
- Choice of models with, or without delayed sweep. Sometimes, single timebase models are preferred to save money but especially in training requirements of personnel.
- User friendliness. Philips delayed sweep oscilloscopes are always easy to use with their clear, and uncluttered layout and separate control areas for main and delayed timebases. Cursor assisted Zoom functions are perhaps the fastest and easiest to understand way to set up a delayed sweep.
- Direct readability of delay in time. All Philips microprocessor operated oscilloscopes offer this convenience.
- Triggering capabilities of the delayed timebase. All Philips delayed sweep oscilloscopes offer a full, and independent choice of trigger settings for their main- and delayed timebases: A MUST for every type of measurement in the digital field.

Dual Delayed Sweep

By alternating the delay times between successive sweeps of the main timebase generator, TWO equally long details of the same signal can be identified. Once expanded the delay times can be adjusted and the difference between them accurately measured. This capability is referred to as dual delayed sweep or delta-time capability. Some Philips oscilloscopes permit the measurement of time delays between one detail in one channel, and another detail in another channel.

What Dual Delayed Sweep criteria are most important to the user?:

- User friendliness
- Readability of delta time
- Capability to read the inverse of time, expressed as frequency
- Ability to measure between channels.



Accurate time readouts are easily obtained with the PM 3296A's delta time dual delayed sweep arrangement.

CRT'S

In an oscilloscope Cathode Ray Tube (CRT) the deflection is electrostatic which enables a wide range of voltages and frequencies to be displayed with a minimum of distortion.

What CRT criteria are most important to the user?

- Accelerating potential, determining light output and writing rate, important when viewing low repetition rate signals at high sweep speeds. Philips oscilloscopes offer the highest acceleration potentials in each bandwidth/price class, ensuring maximum visibility of the signals under the most demanding measurement circumstances.
- Screen size, usually measured in centimeters.
- Graticule, external or (mostly) internal, to avoid parallax. * Graticule illumination for photographic recording.
- Uncluttered display format.

All Philips analog oscilloscopes have additional, dedicated LCD and LED readouts for instrument settings, so that more screen area can be used for the waveforms. Philips is a recognized leader in CRT technology and electron-optics. CRT's used in Philips oscilloscopes are glass enveloped, high lead content, low radiation types. Philips oscilloscopes meet or exceed even the tough West-German requirements on X-ray radiation. Excellent display sharpness and intensity are obtained by such elements as high acceleration potentials, dynamic focusing, TDR adjusted helix deflection systems and internal magnetic correction.

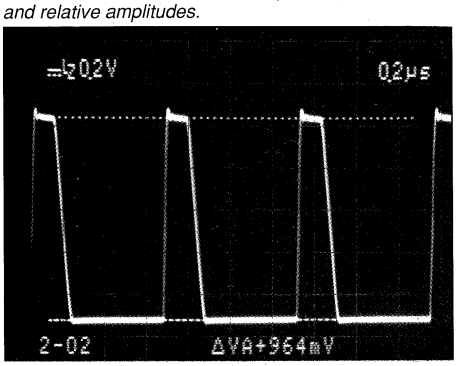
Cursor Measurements on Analog Oscilloscopes

Cursors on analog scopes are operator movable lines, replacing the role of the graticule lines. The distances between the cursors is displayed in alphanumerics and represents amplitude or time. Even though cursors do not add to the accuracy of a measurement, they add convenience to oscilloscope operation.

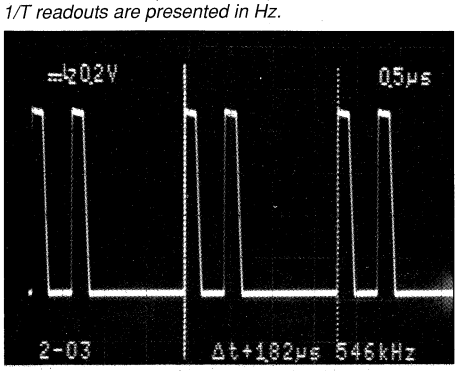
Voltage accuracy is determined by the accuracy of the overall attenuator and amplifier chain.

Timing accuracy is determined by the accuracy of the Main timebase. When small timing increments are to be measured, measurements using delta-time facilities as described above offer better accuracy.

The PM 3296A's cursors allow easy readouts of absolute and relative amplitudes.



Cursors can be used for time readouts as well. Time intervals are presented in (fractions of) seconds. 1/T readouts are presented in Hz.



Cursors and Delayed Timebase

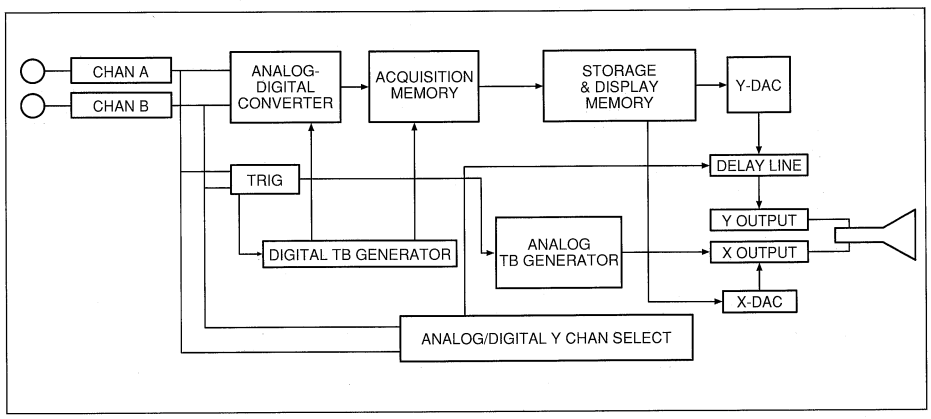
Cursors can sometimes be used to measure details of a complex waveform by taking the actual measurement from the section displayed by the delayed time base itself. In addition, an innovative ZOOM function as on the Philips PM 3070 family permits the user to use the cursors to indicate which portion of a complex waveform needs to be expanded with the delayed sweep.

Automatically, the delay time and delayed time base speed are set to match the area of interest between the cursors. This area is then intensified, and displayed by the delayed sweep. The scope even permits the simultaneous display of the Main timebase, with the cursors indicating the area of interest, and Delayed timebase.

Digital Storage Oscilloscopes

Digitizing - A block diagram

The functional block diagram of a Digital Storage Oscilloscope (DSO) shows many differences when compared with that of an analog instrument. In a DSO the input circuitry plays essentially the same signal conditioning role as in an analog scope, and is often constructed with similar attenuators and preamplifiers. The conditioned signal is fed to an Analog to Digital conversion process and the momentarily sampled digital values are stored in memory. Basic trigger facilities of DSOs are the same as those of analog oscilloscopes, however, for DSOs the trigger moment defines when the acquisition of information will stop. This is the opposite to what happens in an analog scope where the triggering defines where the display of the trace will start. Because of the different triggering behavior of a DSO a delay line is not usually required. After acquisition the digital values stored in the memory are used to rebuild the captured signal usually by means of a Digitalto Analog Convertor, and displayed on a scope-type CRT.



Some Advantages of Choosing a DSO

- DSOs can capture a wide variety of repetitive and single event signals, and can display them long after the signal has been "recorded".
- Built-in measurement and analysis functions provide instant answers to measuring tasks that were never attainable in analog instruments.
- All displays of single events and repetitive signals are at the same brightness, regardless of sweep speed, and signal duty cycle.

Consequently, there is no need for continuous readjustment of focus, or intensity controls.

- Cursors can be moved freely over any waveform on the display, whether stored in memory as a single event, or as a repetitive signal.
- With a Digital Storage Scope, display parameters can be changed after a signal has been captured.
- Signals can be made available for external data processing, or the production of hard copies, using recorders, or plotters.
- Timing measurements are clock-based, and are more accurate than for analog oscilloscopes.
- Amplitude measurements can be more accurate as well, because of the limited influence of CRT and final amplifier non-linearities.
- Storage times are virtually unlimited. With non-volatile memories, multiple waveforms can be stored for a period of many months after the instrument is switched off.
- Because of the long storage time capabilities, Digital Storage Oscilloscopes can wait for an unlimited time period for a signal to occur, to capture single events that may occur at unpredictable moments. This translates into unlimited "babysitting".

Important User Criteria

- The sampling technique, to indicate if the scope is oriented towards capturing repetitive signals (as with an analog scope), or if it is capable to capture fast single shot phenomena.
- Real time sampling speed, determining the time resolution with which single events can be recorded and stored. Sampling speed is expressed in Megasamples/sec (MS/s)
- Digital bandwidth for repetitive signals, maximum stored frequency (MHz), and maximum single shot frequency.
- Vertical resolution, expressed in bits, affecting an important aspect of achievable accuracy.
- Number of datapoints per record, and per channel.
- Number of memories, available for signal comparisons and reference.
- Measuring and signal analysis capabilities.
- I/O capabilities.
- Ease of use.

Introduction

Despite the many application advantages of DSOs, the decision to make the transition from analog scopes to digital can sometimes be a difficult one. One major reason for this can be confusion as to how to measure one of the main advantages of this class of instrument ,its real signal capturing performance.

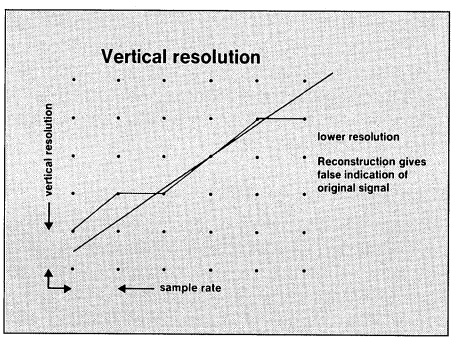
Bandwidth and Sampling Rate

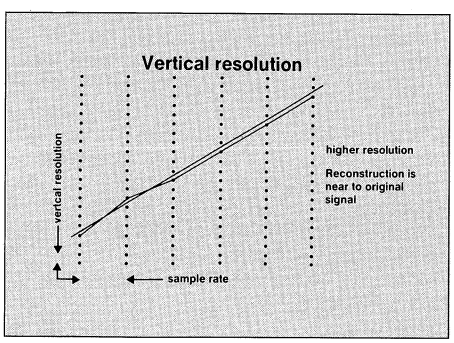
Up until the advent of digital scopes, the most important specification point considered when evaluating a scope was "bandwidth". This referred to the maximum frequency that the scope could display a signal with an attenuation of no more than 3 dB. Further, for an analog scope, the signal has to be a repetitive one. With this definition users easily understood the signal capturing performance they could expect from a 100 MHz bandwidth analog oscilloscope.

But bandwidth alone does not provide a complete or adequate measure of what a DSO is capable of capturing.

To understand this it is necessary to consider the type of sampling technique the DSO is using. A digital storage oscilloscope acquires signals by taking momentary values - or "samples" - of the input analog signal at regular time intervals. The sampled values are stored in memory, and the original waveform is then reconstructed by displaying the memory contents.

As shown below, generally, the higher the sampling rate - specified in samples/second - the higher the frequency, and greater the accuracy, of the signal that can be captured, displayed and analyzed.





This simple picture is complicated, however, by the fact that there are a variety of sampling approaches common in DSOs today.

Real Time Sampling

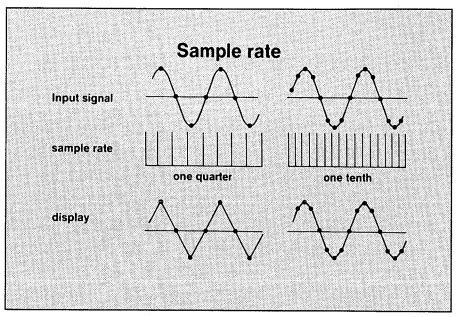
For one-time signals, or for events that repeat themselves at a very low frequency, all information must be quickly obtained in one pass, while the event/signal is actually happening. Fast real-time sampling accomplishes this, taking a series of rapid samples from a single signal period, and using them to reconstruct the original wave shape.

The rate at which these real-time samples are taken is directly related to the maximum speed of single-shot signals that can be captured and accurately displayed. For example, the accepted industry rule of thumb is that you need 10 samples per period of the input signal's highest frequency content to accurately reconstruct a waveform. A 250 MS/s real time sampling rate (as on the PM 3355 and PM 3375) would thus permit the capture of single-shot events with frequencies up to 25 MHz (250 MS/s divided by 10 samples/period).

For DSOs that have only real time sampling, this frequency is sometimes also called the digital bandwidth, although as described below, that term has another basis for scopes with additional sampling techniques.

In addition to considering this single-shot signal capturing performance in terms of frequency, it can also be thought of in terms of time, yielding the "horizontal resolution" of the scope. The above 250 MS/s sampling rate is equivalent to a resolution of 4 ns for the shortest single shot signal detail that can be captured.

One point to be remembered when comparing DSO sampling rate specs is the number of A/D converters used in the sampling process. Some DSOs have only one A/D shared between 2 or more input channels. When only 1 channel is in use, it can sample the input signal at full speed. When 2 channels are in use the effective sample rate for each channel is cut in half. The result is that its single-shot frequency performance is cut in half and a time skew between the samples on each channel exists.



Comparison of signal reproduction accuracy resulting from different sample rates.

Repetitive Sampling

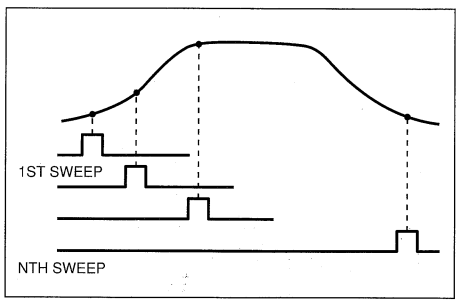
For repetitive signals, different sampling techniques can be used to capture much higher frequency signals than with real-time sampling. Repetitive (or time-equivalent) sampling takes samples from successive cycles in the repetitive signal, and stores them in memory.

During each acquisition cycle the time offset with respect to the trigger point is also stored. This enables a replica of the original signal to be built up with sub nanosecond resolution, without having to have a very fast - and expensive real-time sampling A/D converter.

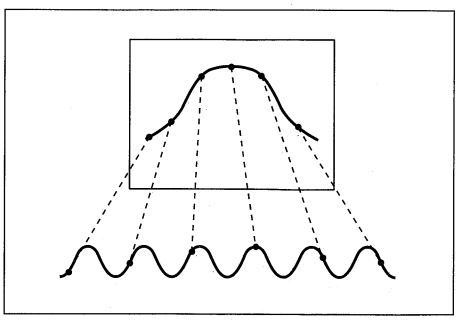
The high effective sampling rate is usually called the "time-equivalent sampling speed". This method only applies to signals that are repetitive. It does not apply to single-shot signals, and is also not suitable for signals with a low repetition rate.

There are two types of repetitive sampling:

SEQUENTIAL repetitive sampling takes a single sample of the incoming repetitive signal, with each sample occurring at progressively increasing time interval beyond the trigger point. In this way, the samples are "strobed" down the waveform in the sequence in which they actually occurred. Since the samples are "triggered" by the signal itself, no "sample rate" can be specified. Further, the maximum repetitive signal frequency that the scope can capture - or the digital bandwidth - is determined by the frequency characteristics of the scopes vertical bandwidth, not by the sampling rate!



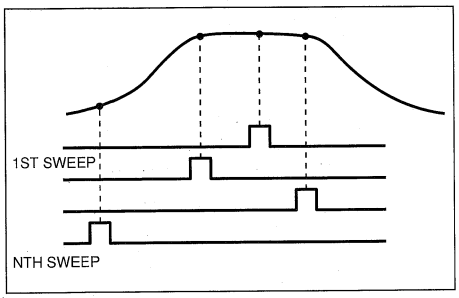
Sequential sampling - display buildup



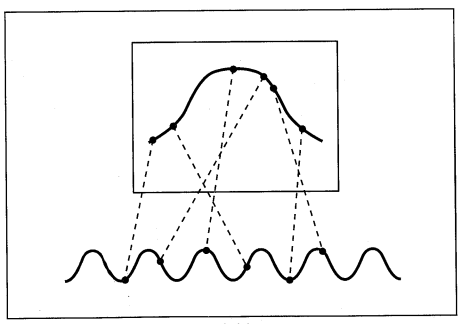
Sequential sampling - acquisition

RANDOM repetitive sampling uses the internal clock of the DSO to make a number of samples during each cycle of the repetitive signal. A timing device keeps track of the distance between the original signal trigger point and that moment at which each sample is taken, so that the scope can then reconstruct the signal with the samples in the correct sequence. Even though the samples are taken at intervals determined by the instrument's clock, the actual clock frequency is usually much lower than the signal to be

sampled and has no relationship with the maximum repetitive signal frequency (or digital bandwidth) that can be captured. (For example, with a 20 MS/s clock frequency, a random sampling system can still digitize frequencies of 100 MHz or more, by taking samples out of the repetitive waveform that are many periods apart.) Here again, the digital bandwidth is determined by the vertical amplifiers of the scope, not by the sampling rate.



Random sampling - display buildup



Random sampling - acquisition

These two Repetitive sampling methods make it possible to digitize signals up to the quoted analog bandwidth of the DSO. Each technique has its advantages. The Sequential method gives faster signal reconstruction on HF signals, while the Random method offers pretrigger information and gives a faster display on LF signals.

Vertical Resolution and Sensitivity

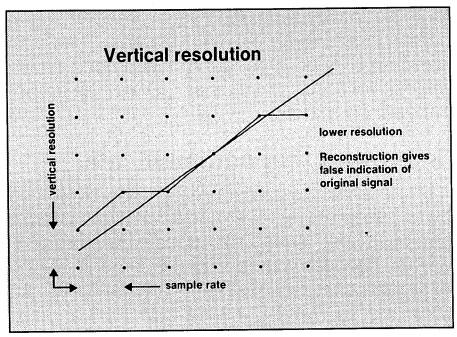
With an analog oscilloscope the vertical resolution is infinite and the sensitivity is simply specified in mV/div. When evaluating a DSO specification both vertical resolution and sensitivity need to be much more carefully examined.

The vertical resolution of a DSO determines the fidelity with which the signal will be acquired and displayed, and is directly related to the number of conversion levels used in the ADC. Philips employ a 10 bit ADC in the PM 3323 which results in a full scale of 1024 conversion levels. This results in single shots being displayed with a resolution comparable to that of an analog storage oscilloscope.

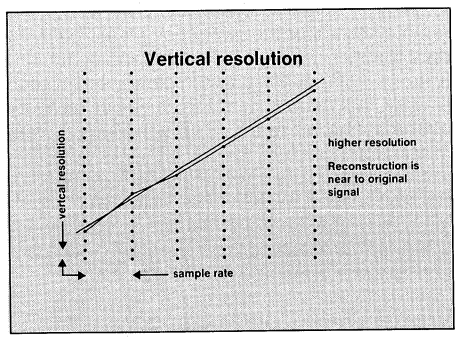
When evaluating DSOs it is of prime importance to check the single shot , or real time, sampling ADC resolution as it is this which determines the amount of detail which can be realized. Most DSO sensitivities are quoted in mV/div just like analog oscilloscopes, and this can often be very misleading to potential users.

For example a 2 mV/div specification appears much better than a 5 mV/div specification, but if the 2 mV has only 2 ADC levels and the 5 mV has 100 ADC levels (as on the PM 3323) then the absolute sensitivity is really 1 mV/ADC level against 50 µV/ADC level. It is therefore advisable to check the maximum sensitivity per ADC level in the single shot mode as it is this which determines the real sensitivity and not the mV/div specification.

When appraising DSO specifications of resolution or sensitivity the comparison should be made in the single shot (real time) mode. In repetitive sampling modes averaging of a number of acquisitions can be used to improve these specification points.



Significant signal distortion can result from signal digitizing with insufficient vertical resolution.



Significant distortion is greatly reduced by increased vertical resolution.

Offset Voltage

Inherent accuracy as offered by high resolution Digital Storage Oscilloscopes such as the Philips PM 3323, can be enhanced by input offset circuitry.

By using the built-in offset of up to 1000x the attenuator range used, no valuable vertical resolution is wasted on the conversion of DC. This way, all 1000 voltage levels resulting from the 10 bits of vertical resolution in the PM 3323 are utilized for digitizing the AC components of a signal with great accuracy. AUTO-OFFSET helps the user quickly find and use the appropriate offset voltage, which is then displayed in the CRT.

Digitizing Ultra High Frequencies

Many high frequency and high speed applications require very wide bandwidths. Often, such applications can benefit from all advantages that digitizing oscilloscopes have to offer :

Automatic measurements of signal parameters, manipulation and calculation of waveforms, mass storage, and automatic go / no-go decisions. One such instrument, the PM 3340, with a bandwidth of 2 GHz, is described in this catalog.

Utilizing a sequential time-equivalent sampling technique, the PM 3340 offers a very high sensitivity of 1 mV/div (with 100 ADC levels/div) at the rated 2 GHz bandwidth, and triggers to the full bandwidth as well. The PM 3340 offers full Digitizing Oscilloscope capabilities, including envelooping, save/stop on difference, histogram and FFT calculations, and EYE pattern and constellation diagrams for digital communication link testing.

Memory Considerations

Digital Storage Oscilloscopes can have multiple memories to allow reference waveforms to be stored. However, a primary selection criterion may be the length of each record that can be stored, especially in single shot applications. A long memory with many datapoints allows the study of signal details after the single event has occurred and been recorded.

The PM 3335 offers a record lengths of up to 8 k to facilitate this. There is usually a trade-off between the number of datapoints available in each record, and the speed and resolution of the A/D process. In some instruments, record lengths are a function of sweep speed used, and can also dependent on the selection made by the user.

Digital delay techniques help to avoid filling memory locations with useless information and optimally combine A/D speed and resolution.

Displaying the Signals

In most Digital Storage Oscilloscopes, a CRT is used to display waveforms and operational settings. And unlike analog oscilloscopes, high speed signals can always be displayed at maximum brightness, regardless of repetition rate used. This is the result of a DSO displaying the signals from memory, rather than "real time".

Philips DSOs excel in leaving the waveform display areas uncluttered. In some instruments, the CRT is strictly reserved for the display of the waveforms, with an additional LCD to show the instrument's settings. The Philips PM 3323 and PM 3340 oscilloscopes offer extra large screens, leaving the measuring area unobstructed.

Cursor Measurements and Signal Processing

In a Digital Storage Oscilloscope, cursors are not merely electronic graticule lines superim-

Introduction

posed on the oscillogram on the screen, as is the case in an analog scope. Instead they represent display highlights of actual datapoints present in memory. The numerical value of the delta-distance between cursors is therefore extremely accurate.

Since Digital Storage Oscilloscopes usually have an abundance of microprocessor power on board, many automatic calculations may be available, providing direct readouts of risetimes, mean values, RMS, frequencies, PP values etc. In the PM 3323 and PM 3340, for example, it is even possible to test newly collected waveform data against references and have the scope automatically take action when a newly acquired waveform violates predetermined waveform criteria.

These calculations and measurements can be executed and updated at very high speeds, even as the instrument is collecting new data. A major advantage of DSOs,such as the PM 3323 or PM 3340, is the ability to process captured signals. For example the multiplication math capability enables power measurements to be quickly realized with very high accuracy.

Modern DSOs now include a host of processing functions like integration, differentiation or even FFT to make the analysis of signals a simple and fast operation.

Operational considerations for all Philips Oscilloscopes

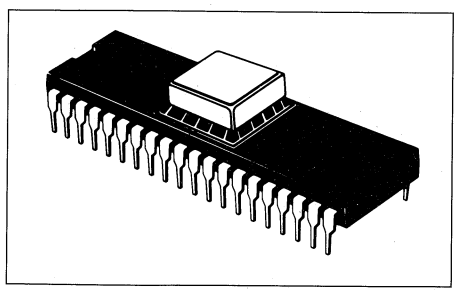
Ease of use is AUTOSET

All of the Philips oscilloscopes in this catalog are microprocessor operated. The intelligence of the microprocessor, along with the cold switching technology employed in all Philips scopes, combine to offer the industry's most complete and convenient AUTOSET feature.

AUTOSET is a one-button feature, which automatically selects the active channel(s), selects the proper trigger source and other trigger conditions, and sets attenuator and timebase ranges.

AUTOSET not only speeds up operation with known signals, it helps find unknown signals during trouble shooting, with great ease.

AUTOSET is available on all Philips analog scopes (except PM 3208/9) as well as on all Digital Storage models.



The AUTOSET feature on Philips models, as well as the clear and logical front panel layouts ensure ease of use throughout the product line. For many routine tasks in production and service, a number of Philips oscilloscopes are available with extensive menu operation, in which complete front panel setups can be stored in non-volatile memories, and recalled at random, or in sequences.

User Feedback even from Probes

All of the Philips oscilloscopes described in this catalog excel in providing the user with unambiguous and clear readout of all of the oscilloscope's settings. This is either presented on separate LCD and LED readouts, or by displaying the instrument settings in dedicated areas of their oversized screens.

All Philips oscilloscopes above 50 MHz automatically recognize the type of probe in use and their respective attenuation factor. These factors are always included in all readouts and cursor measurements. With oscilloscopes with selectable input impedance, the probes cause the oscilloscopes to automatically set the proper impedance match.

Interfaces that communicate

Some analog oscilloscopes can be controlled by an external controller and sometimes interrogated so that knob settings can be stored, or values between cursors can be found. Good examples of such instruments are the Philips 60 MHz and 100 MHz PM 3050, PM 3065 and PM 3070 series, as well as the 200 MHz and 400 MHz PM 3285A/86A and PM 3295A/96A series.

Digital Storage Oscilloscopes offer more interfacing capabilities, by not only permitting remote control of the instrument itself, but also data transfer between the scope and computer. In some instruments, this is implemented in such a away, that remote locations can be as far away as the phone will reach : Through Modem communication!

All Philips DSO's offer GPIB/IEEE 488 and/or RS 232 options. With this capability, all computing power of a controller becomes available for waveform processing, mass storage, comparison of waveforms and documentation.

World Wide Power Supply

All oscilloscopes above 50 MHz in this catalog operate from built-in power supplies that accept 90 VAC to 270 VAC in one range, with frequencies of 46 to 440 Hz. No switch settings are to be remembered, and no fuses to be changed.

Engineering Excellence and Durability

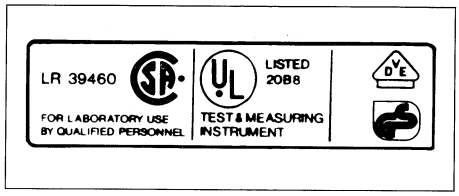
Controls on many Philips oscilloscopes are not what they used to be: Complex, failure prone electro mechanical devices such as attenuator and timebase switches have been replaced by microprocessor controlled, sealed switching arrangements in reed relays and solid state, so that switch failures and worn or dirty contacts are a thing of the past.

Reliable and stable operation is assured over long lifetimes. Power supplies in almost all Philips oscilloscopes are high efficiency, direct-conversion types that operate over wide ranges of supply voltages and frequencies. Their high efficiency ensures cool operation of the instrument, adding to the overall reliability. See product descriptions for details.

Quality, Reliability and Safety

All Philips oscilloscopes meet stringent published requirements regarding environmental characteristics. Many of these requirements are referenced to MIL T 28800 D. (See product description for details).

All Philips oscilloscopes meet the requirements on instrumentsafety per IEC 348. Most Philips oscilloscopes are UL listed (UL 1244) and CSA approved (CSA 556 B), and meet VDE 0411. See product descriptions for details.



Software and Hardware Support for Systems Applications

Digital Storage Oscilloscopes (DSO's) are often used in automatic test and measurement systems. Waveforms measured with a DSO are stored in its memory and can be processed/displayed on request, or transferred to a computer for more extensive processing, display, mass storage or documentation.

All of the Philips Digital Storage Oscilloscopes are programmable through the GPIB IEEE 488 bus, and through the serial RS 232 port as well.

Fluke and Philips offer a number of software packages to ease programming of GPIB systems applications. These PM 223x Instrument drivers and PM 2240 TestTeam allow GPIB instruments to be easily programmed and result in easy to understand and reliable test programs.

The PM 2260 Oscilloscope Signal Processing software is a package for the PC and compatibles that extends the DSO's capabilities with an extensive set of interactive waveform processing and display facilities.

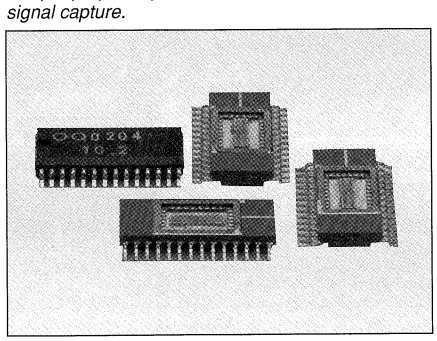
In most applications in automatic test and measurement systems, waveforms have to be sampled at several different points on the device under test. The PM 2295/09 Probe Switch Unit with a full 400 MHz bandwidth can be used for this purpose : under GPIB control it can switch 1 out of 4 signals to the input of the oscilloscope, still maintaining the high input impedance and low load at the tip of each of the four probes. For further information on this product see page 44 and onwards.

Fast Real Time Sampling

Most Philips digital storage oscilloscopes employ a fast analog shift register (Charge Coupled Device or CCD) for fast and accurate signal capture. Once a signal is captured, the contents of the CCD are digitized and stored in memory. This mechanism ensures high effective vertical resolution at high clock speeds, even when capturing fast slew rate signals. Philips was the first to introduce the CCD technology to digitizing oscilloscopes. Based on the CCD concept of Philips' Physics labs in Waalre, the Netherlands (first published in 1966) and on Philips' extensive and world leading linear IC technology, a CCD, (also nicknamed "bucket-brigade"), and in particular the Profiled Peristaltic Charge Coupled Device (P^2CCD) proves to be a powerful, fast and efficient technique in the process of waveform digitizing. Rather than attempting to digitize high frequency waveforms or signals with fast transients with parallel digital conversion techniques, the P^2CCD provides a fast sampling, analog shift register to sample signal waveforms with excellent time resolution. The Philips chips used in Philips DSO's always incorporate two fast track-and-hold circuits, along with sample-and-holds and the CCD's themselves, as well as the output circuitry. They offer real time resolutions of up to 2 ns between data points, simultaneously on both channels, for the capture of single events. Sampling is continuous and the samples are stored in analog format until the moment of triggering, at which point the input signal to the chip is disconnected, the clock frequency to the chip is slowed down and the samples are read out at the output of the chip in order to be digitized. An accurate sequential approximation ADC is used for this purpose.The overall result of such an arrangement is obtaining a high sampling speed while maintaining excellent vertical resolution, (even when digitizing fast slew rates), at low cost.

For example, nowhere, at this moment, can you find a Digital Storage Oscilloscope that offers 250 MS/s on both channels simultaneously, at 8 bits, for a lower price than that of the Philips PM 3355 !

Philips' proprietary P^2CCD's that allow high speed signal capture.



PM 3285A, PM 3286A, PM3295A & PM 3296A

GPIB
IEEE-488



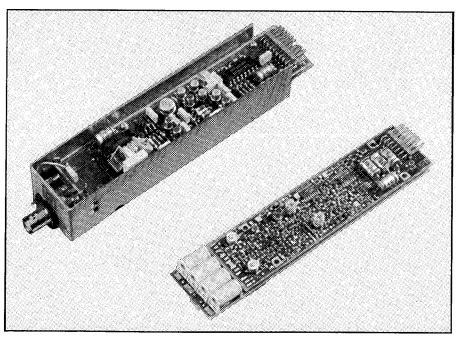
PM 3296A

PM 3285A/86A 200 MHz & PM 3295A/96A 400MHz Oscilloscopes

- Bandwidths of 400 MHz and 200 MHz
- Risetimes of 0.9 ns at the probe tip (1.75 ns for PM 3285A/86A)
- High visual writing speed CRT's
- AUTOSET
- Menu operation from 75 non-volatile memories
- Cursor measurements for volt, time and frequency
- Dual delayed sweep
- LCD and LED status information for positive feedback

Performance

The PM 3285A/86A and PM 3295A/96A VHF oscilloscopes redefine portable, monolithic oscilloscope capabilities. With more capabilities and more straight foward operation than you will find in other portables.


The PM 3295A/96A split-band, drift corrected preamplifier, using state-of-the-art SMD technology.

Up to 400 MHz bandwidth offers portable subnanosecond performance all the way to the probe tip. Excellent for a wide array of applications including communications, avionics, radar, data processing and video processing.

CRT's with 24 kV acceleration potentials for optimum viewing. Ultra-fast writing speeds of up to 4 div/ns reveal the most elusive details and the narrowest glitches — even at high sweep speeds and low signal repetition rates. Triggering performance is in excess of 400 MHz, stable, and easy to use.

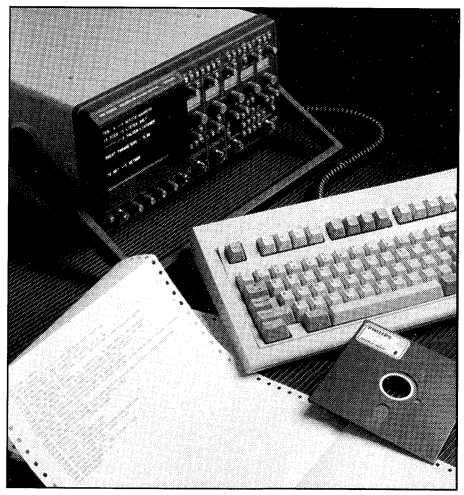
Probe factors are read out automatically. Philips probes automatically adjust the input for proper impedance setting and, where appropriate, sensitivity ranges. 50 Ohm input impedance can be selected. The 50 Ohm termination is protected by software, as well as a thermal sensor on the thin film circuit, causing the microprocessor to disconnect the 50 Ohm load, when overload conditions lead to overheating.

Autoset

Philips' AUTOSET is the first and the most comprehensive intelligent beamfinder available. It automatically selects the proper channel and trigger source for a properly triggered display, and sets amplitude and timebase speed to obtain optimum viewing of almost any input signal, even unknown, at the touch of just one button.

Built-in Programmability

For quick, correct measurements in routine tasks time after time, the PM 3286A and PM 3296A models offer programmability without a computer, by offering up to 75 front panel setups to be stored in non-volatile memory. These menus can be stored, modified and recalled at random or in sequences by using Philips IR remote control.



Cursor Measurements

On-screen cursors let you measure waveform parameters exactly as you see them, easily, with the screen providing numeric readouts of voltage, time and frequency. Absolute and relative measurements (referred to any reference as 100%) can be easily obtained.

Delayed Sweep and Delta-Time

Both timebases can be set to up to 1 ns/div, to match the risetime performance of the vertical channels (2ns/div for PM 3285A series). Delay values are visible in the screen and on the backlit LCD. The dual delayed delta time feature permits accurate differential time and frequency measurements.

Trigger Level Readout

Trigger levels can be set and adjusted using the level readout on the screen. Levels are displayed in divisions, or volts, for internal and external triggering respectively.

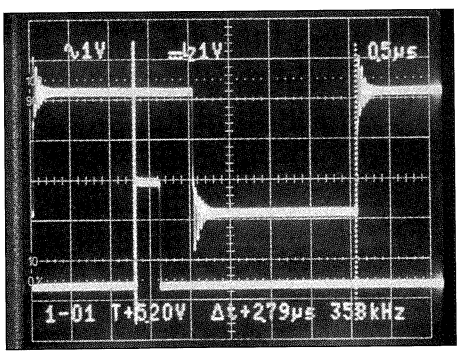
High Performance Engineering

Operation is based on microprocessor controlled cold-switching, in which all signal paths are switched in sealed environments, with no switches to wear out, or get dirty, ever. Not only does this arrangement enhance reliablity, it also permits the full implementation of before-mentioned AUTOSET, and programmability. Opto-encoders replace the front panel switches and provide control over the internal bus.

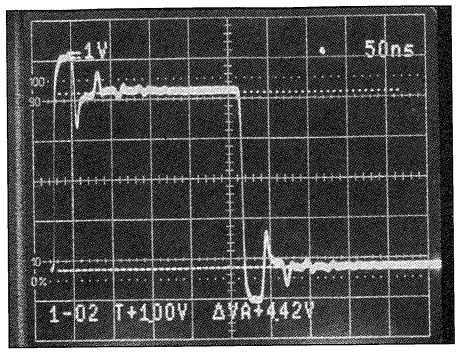
Programmability

GPIB/IEEE-488* is fully implemented in the PM 3286A and PM 3296A, at no extra charge. All front panel settings except intensity and focus are programmable. The controller can always interrogate the units' settings via the IEEE-488 bus. Programmability is further enhanced by the instrument's menu storage, allowing the scope to be controlled by simple, single commands via the bus.

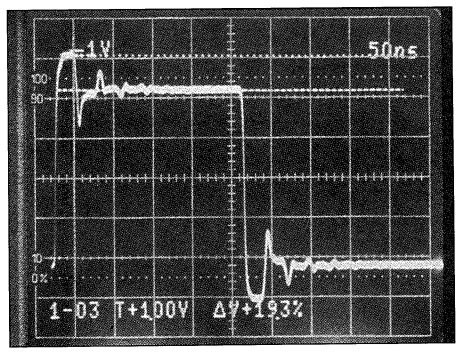
Versatility



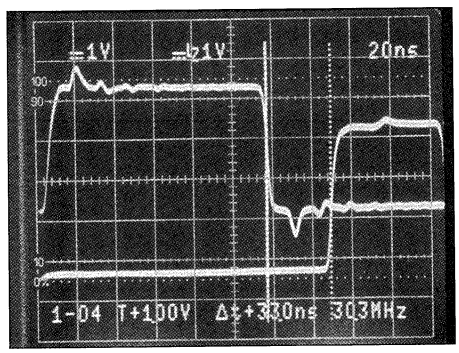
1. At the heart of these portables is Philips' proprietary 8 x 10 cm, 24 kV CRT, assuring bright, clear display of even the fastest signals. Graticule illumination is continuously variable. Intensity controls for traces and text are separate.
A complete information center, the screen exhibits input impedance, input coupling and scalefactor for each channel. Probefactors are automatically recalculated. Timebase speeds are displayed and corrected for magnifier use.
Delta time or cursor readouts appear in the lower righthand corner.
Trigger level is displayed in Volts (for Ext trigger) or Div (for Int trigger). Cursor time readouts are displayed in delta time and Hz.
Setting readouts are duplicated in LEDs and backlit LCDs on the front panel.
Input impedance is automatically set by the probe, so no mismatch can occur. Note the test sequence number in the lower left corner of this PM 3296A display.



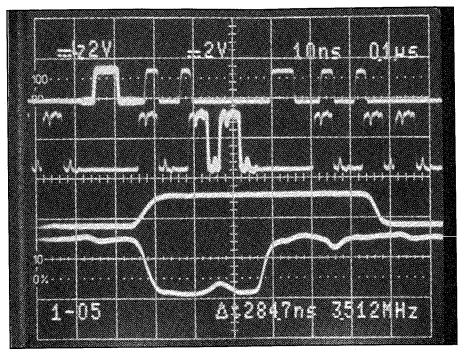
2. Channel is DC coupled at 1 V/div. Timebase is set at 50 ns/div. Cursor readout of pp amplitude is 4.42 Volts, and is referred to as 100% for the overshoot measurement in picture 3.



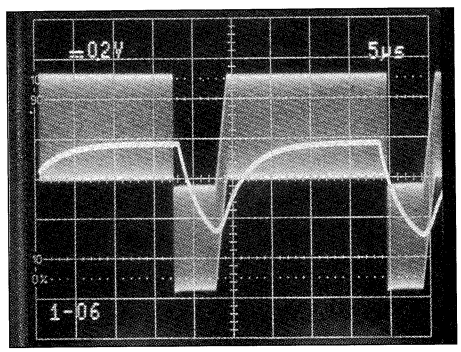
3. The PM 3296A's ability to set any amplitude as a reference lets you take quick readings of overshoot percentages — as in this picture — or measure modulation depth of an AM signal.
Note that the scope can perform relative measurements while channels remain calibrated.



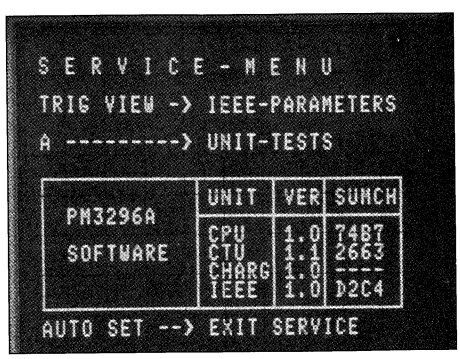
4. Cursors can be used to measure time between two events in the same signal, or between signals. Readout is in (fractions of) seconds, or in Hz.
Time measurements using cursors are simple to make and permit relative time readings on any time section using calibrated timebase settings.



5. When the waveform is too complex to properly set the cursors, better accuracy can be obtained by using delta-time delayed sweep.
Alternative timebase display mode allows you to view the total time-window and, at the same time, magnify signal detail for proper identification.



6. Triggerview can be used as an extra input channel, and also to verify proper trigger conditions.
Here, the trigger signal is obtained from channelA, and contains enough noise that it would make the display unstable and fuzzy.
Trigger selection is from channel A through HF reject. Lower trace shows signal after filtering through HF reject.
Note that the trigger level is midscreen for easy reference and setup.



7. The PM 3296A's extensive service menu facilitates performance check and calibration. Many adjustments can be performed by using internally generated signals to save calibration time.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3285A, PM 3286A, PM3295A & PM 3296A

Specifications

Technical Specifications

Autoset

Selects channel, amplitude, vertical position, timebase speed and triggering for surveyable display of input signal.

Display

CRT: Philips rectangular pda tube
Viewing Area: 8 x 10 cm
Acceleration Voltage: 24 kV (PM 3295/96A); 16.5 kV (PM 3285/86A)
Phosphor: Type GH (P31)
Readout: Alphanumerical display of relevant vertical and horizontal function selections, deflection coefficients and cursors.
Graticule: Internal with % indications for rise-time measurements. Illumination continuously variable.
Photographic Writing Speed:
4 cm/ns (PM 3295/96A);
2 cm/ns (PM 3285/86A),
with lens aperture F:1.2, object to image ratio: 1: 0.5 and filmspeed 20,000 ASA.
External Z-Modulation: Positive voltage decreases intensity

Vertical Deflection

Sources: ChB, ChB, Trig view, ChA and ChB added. ChB and ChB can be inverted
Modes: Single channel or any combination of sources. Alternate or chopped. Display time in chopped mode 350 ns/channel.
Input Impedance (High Z): 1 MΩ in parallel with 9 pF
Input Impedance (50Ω): V.S.W.R.
1.3:1 at 400 MHz (PM 3295/96A);
1.2:1 at 200 MHz (PM 3285/86A)
Max. Input Voltage (High Z): 300V (DC + AC peak)
Max. Input Voltage (50Ω): 5 Vrms overload protected
Deflection Coefficient: 1 mV/div...5V/div (continuous control between steps)
Error Limit: 2%
Cursor Voltage Error Limit: 2% overall

Frequency Response (pm 3295/96A):
DC...400 MHz (-3 dB) (15°C...35°C)
DC...350 MHz (-3 dB) (5°C...40°C)
In 1 mV/div and 2 mV/div settings: DC...70 MHz

Frequency Response (PM 3285/86A):
DC...200 MHz (-3 dB) (15°C...35°C)
DC...175 MHz (-3 dB) (5°C...40°C)
In 1 mV/div and 2 mV/div settings: DC...70 MHz

AC Coupled Lower -3 dB Point: 10 Hz

Rise Time*: 0.9 ns (PM 3295/96A);
1.75 ns (PM 3285/86A);
In 1 mV/div and 2 mV/div settings:
5 ns (PM 3295/96A);
5.4 ns (PM 3285/86A)

*Rise time calculated using $tr = \frac{0.35}{\text{bandwidth}}$

Dynamic Range: 24 div up to 100 MHz
CMRR: 100:1 up to 1 MHz; 20:1 up to 50 MHz
Visual Signal Delay: 20 ns
Bandwidth Limiter: Reduces bandwidth to 20 MHz (-3 dB)

Trigger View
Deflection Coefficient: Via EXT. input 100 mV/div or 1V/div; Via ChA or ChB 1 mV/div...5V/div
Frequency Response (PM 3295/96A):
Via EXT input: DC...370 MHz (-3 dB);
Via ChA or ChB: DC...350 MHz (-3 dB)
Frequency Response (PM 3285/86A):
Via EXT input: DC...200 MHz (-3 dB);
Via ChA or ChB: DC...150 MHz (-3 dB)
Delay Between EXT. Input and ChA or ChB: 2 ns

Horizontal Deflection

Display Sources: MTB, MTB intensified by single or dual DTB, DTB, MTB and DTB Alternate, EXT., Line. Trace separation between MTB and DTB in ALT mode continuously controllable over at least 4 divisions

Main Time Base
Modes: AUTO, Trig., Single
Deflection Coefficient:
1s/div...10 ns/div (PM 3295/96A);
1s/div...20 ns/div (PM 3285/86A)
(continuous control between steps)
Error Limit: 0.5% of full scale + 1% of reading
Cursor Δt: Error limit 0.5% of full scale + 1% of reading
Frequency Readout: 1/Δt
Time Base Magnifier: x 10 fastest sweep...
...1 ns/div (PM 3295/96A)
...2 ns/div (PM 3285/86A)
Error Limit: 1% of full scale + 1.5% of reading
Variable Hold Off: Up to 6 x min. value

Delayed Time Base
Modes: Starts immediately after delay time or upon first trigger after delay time
Deflection Coefficient:
0.5s/div...10 ns/div (PM 3295/96A);
0.5s/div...20 ns/div (PM 3285/86A)
(continuous control between steps)
Error Limit: 0.5% of full scale + 1% of reading
Time Base Magnifier: x 10 fastest sweep...
...1 ns/div (PM 3295/96A)
...2 ns/div (PM 3285/86A)
Error Limit: 1% of full scale + 1.5% of reading
Delay Time: 20 ns...10s
Error Limit: 1.2% of full scale + 1% of reading + 12 ns
Time Interval (Δt):
10 ns...10s (PM 3295/96A)
20 ns...10s (PM 3285/86A)
Error Limit: 0.1% of full scale + 0.5% of reading + 2 ns
Frequency Readout: Δt/t
Resolution of Delay Time or Δt Control:
1: 65,000
Jitter: 1: 20,000

Triggering MTB Sources: ChA, ChB, Composite, EXT, EXT ÷ 10, Line
Coupling: DC, AC, LF REJ, HF REJ
Slope: + or -

Level Range:
Internal: +8...-8 div.
EXT: +0.8...-0.8V
EXT ÷ 10: +8V...-8V
Trigger level is read out on screen if instrument is equipped with GPIB IEEE interface.
Standard on PM 3286A/PM 3296A

Triggering Sensitivity

	PM 3295/96A	
	up to 100 MHz	up to 400 MHz
INT	0.5 div.	2 div.
EXT	50 mV	300 mV
EXT ÷ 10	500 mV	3V

	PM 3285/86A		
	up to 100 MHz	up to 200 MHz	up to 250 MHz
INT	0.5 div.	1 div.	—
EXT	50 mV	—	300 mV
EXT ÷ 10	500 mV	—	3V

Triggering DTB: See MTB triggering except for Line triggering

External

Sources: ChA, ChB, EXT
Input Impedance Via EXT: 1 MΩ in parallel with 9 pF
Deflection Coefficient Via EXT: 100 mV/div or 1V/div
Frequency Response: DC...2 MHz (3 dB)
Phase Difference Between Y and EXT: <3° up to 100 kHz
Line: 7 div for frequencies of 50 Hz...60 Hz

Signal Outputs

Calibration Voltage: Square wave, positive going
Amplitude: 0.8V ±1%
Frequency: 5 kHz ±0.1%
Impedance: 50Ω ±1%
Y Signal: Selectable via DTB trigger source
Amplitude: 20 mV/div into 1 MΩ; 10 mV/div into 50Ω
Range: 160 MV_{p-p} into 1 MΩ; 80 mV_{p-p} into 50Ω
Frequency: DC...300 MHz (-3 dB) (PM 3295/96A);
DC...200 MHz (-3 dB) (PM 3285/86A)
MTB Gate: TTL compatible
DTB Gate: TTL compatible

Cursors

Voltage Cursors
Cursor Range: Center 7 divisions
Ratio Range: 0.1%...999%; 100% reference at any amplitude

Timer Cursors
Cursor Range: Center 9 divisions
Ratio Range: 0.1%...999%; 100% reference at any time difference

GPIB IEEE-488 Interface

All functions (except CRT controls) can be controlled or read by a controller via GPIB IEEE-488 interface bus. GPIB IEEE address and talker/listener functions can be set by front panel switches in service menu mode. In remote mode front panel is locked (remote LED on) or unlocked (remote LED blinking) by program. In unlocked mode SRQ function is available via AUTOSET.

Power

Voltage Range: 90...264 VAC, one range
Frequency Range: 45...440 Hz
Consumption: 136W
Battery Back-Up: Holds front panel setting when instrument is switched off
Retention Time: 2 years

Environmental Capabilities

The instrument meets the requirements of MIL-T-28800C, type III, class 5, style D.

Temperature
Operating: 0...50°C
Storage: -40...+75°C
Humidity: 95% R.H.

Altitude
Operating: 4.5 km (15,000 ft)
Storage: 12 km (50,000 ft)

Vibration: Frequency Range 5 Hz...55 Hz, 15 minutes along with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found.
Shock: Operating and non-operating: Max. Acceleration 30g. $^1/_2$ sine, 11 ms duration, 6 shocks each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD 810, method 516, procedure V
EMI: MIL-STD 461 class B, VDE 0871, VDE 875 Grenzwert Klasse B
Safety: The instrument meets the requirements of IEC 348 class I, VDE 411, UL 1244, CSA 556B

Mechanical

Height: Without feet and accessory pouch; 170 mm H (6.7 in)
Incl. feet and accessory pouch: 240 mm (9.4 in)
Width: Incl. feet and accessory pouch:
340 mm (13.4 in)
Depth (excl. handle):
PM 3295/96A: 523 mm (20.6 in)
PM 3285/86A: 473 mm (18.6 in)
Depth (incl. handle);
PM 3295/96A: 625 mm (24.6 in)
PM 3285/86A: 575 mm (22.6 in)

Weight:
PM 3295/96A: 13.9 kg (30.7 lbs)
PM 3285/86A: 13.6 kg (30 lb)

Setting Memory (PM 3296A and PM 3286A)
Memory Capacity: up to 75 front panel settings

Infrared Remote Control
Functions: RECALL, NEXT, PREVIOUS...for recall of programmed settings.
Special functions for protection of programmed settings and identification of instruments.
AUTO...for automatic setting-up of front panel for surveyable display of any input signal.
Transmission Type: Infrared
Batteries: 4 x AAA lifetime typically 2 years
Transmission Distance: Typically 10 ft. (3.5m)
Dimensions: 71 mm W x 16 mm H x 173 mm L (2.6 in W x 0.6 in H x 6.8 in L)
Weight: 135g (0.3 lbs)

Environmental Characteristics
Operating Temp. Range: +5...45°C
Storage Temp. Range: -25...+70°C
(without batteries)
Unit is splash-proof; no functional failure after drying period of 24 hrs.

Included with the Instrument:
2 x 10:1 passive probes 1m (3 ft) (PM 3295/96A), 2x10:1 passive probes 1.5m(5ft)(PM 3285/86A), Collapsible viewing hood, Blue contrast filter, Front cover, Operating Manual

Ordering Information

Models

PM 3285A/00n* 200 MHz Oscilloscope
PM 3286A/40n* 200 MHz Oscilloscope, with 75 setting memory, IR remote control and IEEE-488 interface
PM 3295A/00n* 400 MHz Oscilloscope
PM 3296A/40n* 400 MHz Oscilloscope, with 75 setting memory, IR remote control and IEEE-488 interface

**Subject to export regulations.*

Optional Configurations

When ordering, select one of the standard model numbers listed above and add configuration number listed below as suffix:
PM ..../00n Standard model, bench/portable configuration (PM 3285A, PM 3295A)
PM ..../30n 19-inch Rackmount version (PM 3285A, PM 3295A)
PM ..../40n Standard model, bench/portable configuration with IEEE-488 (GPIB) interface
PM ..../80n 19-inch Rackmount version with IEEE-488 (GPIB) interface

Accessories

Passive Probes
PM 8911/091 500Ω, 10:1 Probe with readout, cable length 1m (3 ft)
PM 8912/091 5 kΩ, 100:1 Probe with readout, cable length 1m (3 ft)
PM 8924/001 1:1 Probe, cable length 1.5m (5 ft)
PM 8929/091 10:1 Probe with readout, cable length 1.5m (5 ft)
PM 8929/191 10:1 Probe with readout, cable length 1m (3 ft)
PM 8929/291 10:1 Probe with readout, cable length 2.5m (8 ft)
PM 8931/091 20 MΩ, 100:1 Probe with readout
PM 9599/091 Set of VHF Attenuators

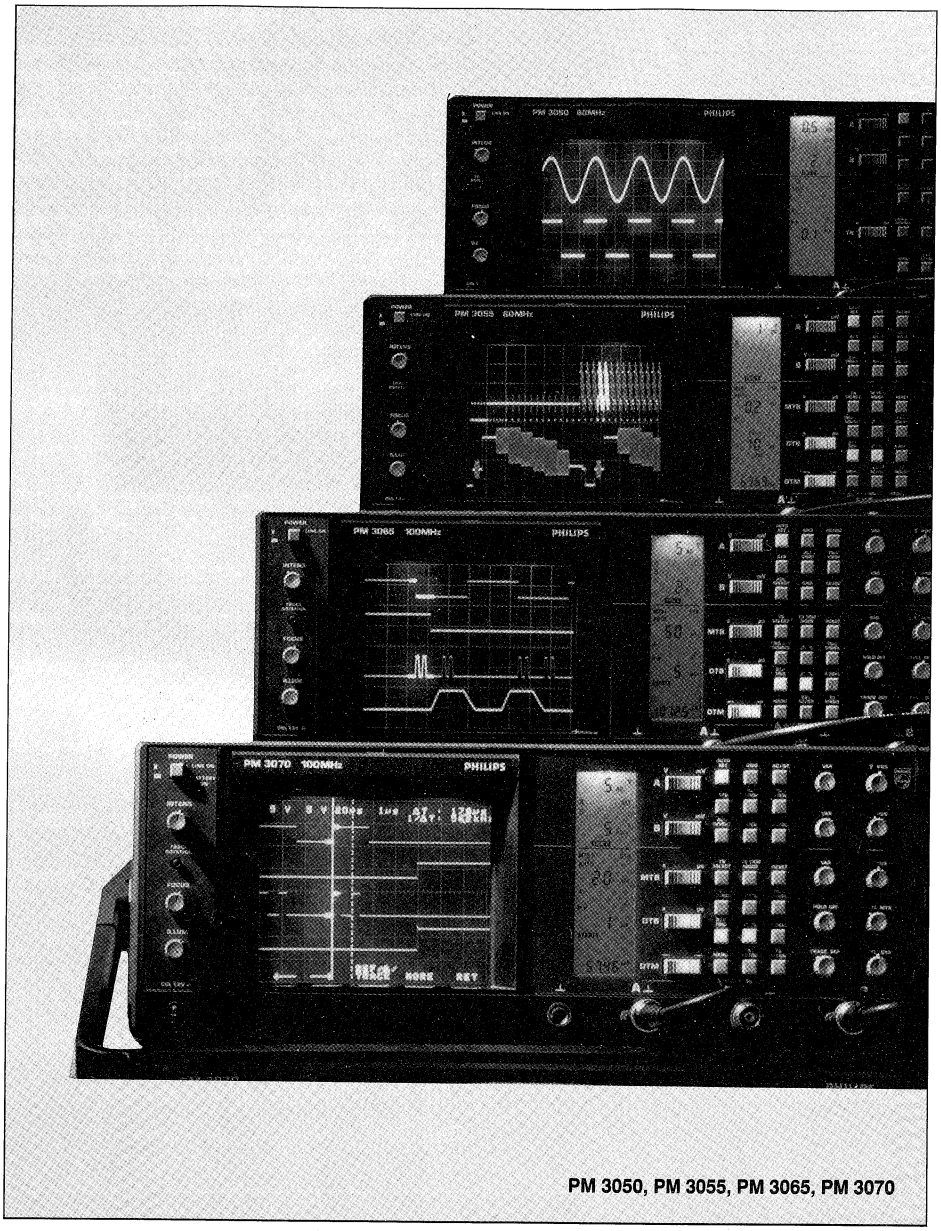
Active Probes
PM 8940/09n High Voltage Isolation Amplifier with readout
PM 8943/00n 650 MHz FET Probe
PM 9355/09n AC Current Probe with readout

Other Accessories
PM 9051/001 BNC to 4 mm Banana Adapter
PM 9310/001 Collapsible Viewing Hood
PM 9311/001 Long Viewing Hood
PM 9381/001 Oscilloscope Camera
PM 9877/001 Camera Adapter for stationary use
PM 8991/041 Oscilloscope Cart
PM 8992/801 Accessory Pouch
PM 8950/951 Retrofittable IEEE-488 (GPIB) Interface
PM 8917/003 Video Sync Separator and Line Selector
PM 2195/09 Probe Switch 400 MHz

PM 3050, PM 3055, PM 3065 & PM 3070

T&M EXPRESS LINE

GPIB IEEE-488



PM 3050, PM 3055, PM 3065, PM 3070

PM 3050/55 60 MHz & PM 3065/70 100 MHz Smart Oscilloscopes

- AUTOSET for automatic amplitude,time,and trigger setting
- LCD panel displays status and settings
- 16 kV crt acceleration voltage
- Fast action up/down controls and cold switching
- GPIB/IEEE-488 interface option
- Single timebase, dual timebase and cursor versions

The 60/100 MHz Standards

The PM 3050 to PM 3070 series of oscilloscopes set new standards in the 60 to 100 MHz oscilloscope range. A new standard in convenience and ease of use together with a new price/performance standard for instruments of this class.

The series consists of four models which are all optionally available in rackmount versions for systems use. These are;

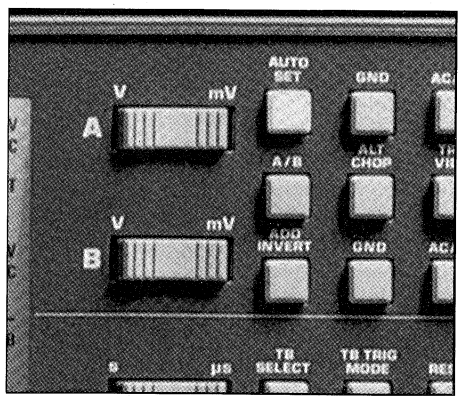
- PM 3050 60 MHz 2 channel, single time base
- PM 3055 60 MHz 2+1 channel, dual time base
- PM 3065 100 MHz 2+1 channel, dual time base
- PM 3070 100 MHz 2+1 channel, dual time base with clever cursors

Each unit represents a significant step forwards in 'scope technology through their use of microcomputer control to both speed up and simplify the task of signal measurements.

Standard features in all models include AUTOSET for single push button set up; a large backlit LCD showing all operating parameters; fast up/down rocker keys and cold switching for high reliability.

Measurements In Seconds

Just press the green AUTOSET button and automatic setting of channel amplitude, time base sweep speed and triggering takes place, for any signal. If only one channel is connected only one channel is displayed but if both channels are being used then both are automatically scaled and displayed. Triggering takes place on the lower frequency channel to give a clear jitter free display. AUTOSET eliminates time consuming manual range finding and adjustment to give fast accurate results at the touch of one button.



Just press the green AUTOSET button and automatic setting of channel amplitude, time base, sweep speed and triggering takes place, for any signal.

Clean and Simple Operation.

With up/down rocker keys for amplitude and time base speed selection and pushbuttons for display mode and trigger source selection the operation of this series of oscilloscopes is kept clean and simple. Upon each user action the backlit LCD display is immediately updated making at a glance review of the 'scopes current parameter settings possible rather than having to search the complete front panel to determine the operating conditions.

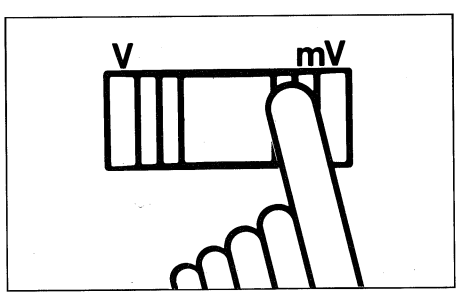
The internal microcomputer prevents illegal setups like incorrect main and delayed timebase settings and clearly identifies on the display non-calibrated amplitude settings or grounded inputs. This avoids incorrect measurements and wasted time.

To speed accurate measurements when using the delayed time base, the LCD gives a digital readout of the delay time so making the calculation of MTB sweep speed x delay time vernier redundant. For infrequent 'scope users the MENU key functions as a 'help' key showing the facilities offered by each key on the 'scope and quickly aquainting the user with its operation.

High Reliability and Easy Service

Behind the push button operation all input signals are switched by hermatically sealed long life relays. These keep out damp and dirt from the active signal paths and ensure long life and long term measurement stability.

The advanced modular construction of these 'scopes allows complete functional testing of each subassembly before they are built together to form a complete instrument. An extended burn in period lasting 48 hours then follows before another series of extensive tests takes place. This ensures that zero hour defects are almost completely eliminated and results in long term trouble free operation. In the unlikely event that a failure should occur the modular construction enables easy access to the suspect board without major disassembly.

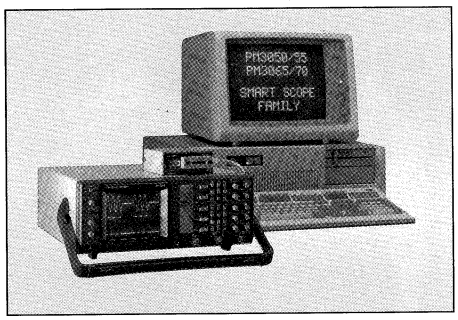


Advanced CRT

With 16 kV acceleration and advanced electron optics the CRT display has exceptional brilliance combined with a small spot size making it ideal for measurements on high speed or low repetition rate signals. The effective screen area is a full 8 x 10 cm. An internally etched graticule is provided for accurate and parallax-free measurements. Graticule illumination is standard on all models.

Fast Computer Hook Up

For systems use this Smart Scope series can be simply controlled by the GPIB/IEEE-488* bus using the PM 8953A interface. This ingenious interface enables the 'scopes to be automatically set up for production testing or QA applications.



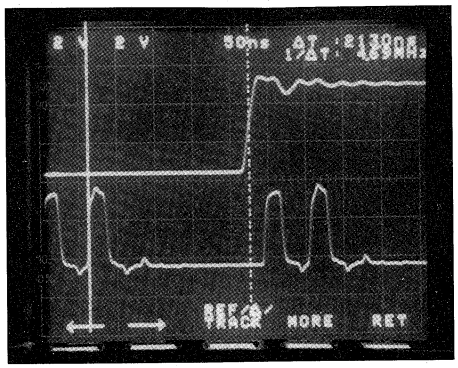
As the PM 8953A IEEE-488 interface is a separate unit which simply plugs onto the rear of the 'scope it is extremely interesting for fleet owners as it permits automatic IEEE based recalibration of the complete fleet with only one interface needing to be purchased, so saving time in recalibration, and money as well.

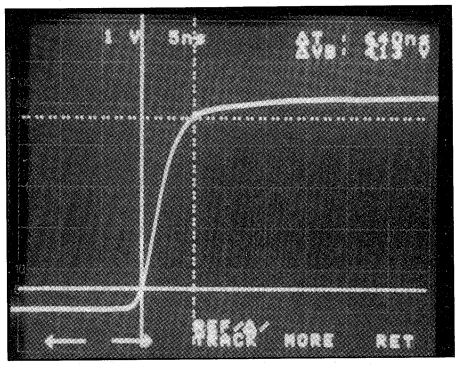
Clever Cursors

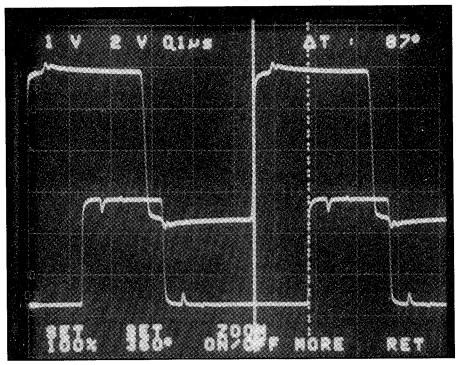
The PM 3070 offers full cursor measurement capabilities in both time and amplitude axes. Control of all cursor functions is by five keys in the bezel of the CRT which also are used to independently control the intensity of the alpha-numerics and the cursor intensity. Accurate measurements of peak-peak values, voltage ratios, rise times, phase relationships and time ratios are possible with direct numerical display on the CRT.

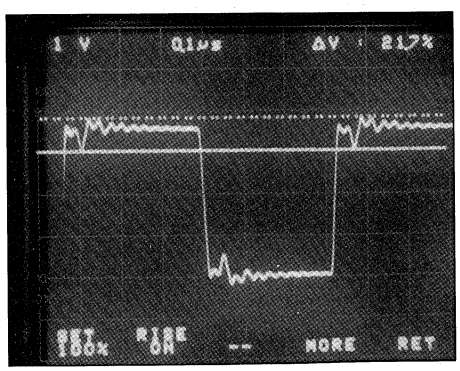
A special facility called the ZOOM function enables the signal between the cursors to be expanded to fill the full width of the screen by automatically adjusting the delay time and delay time base speed. This makes it easy to zoom in on a particular point of interest without having to consider how to set up the delay time section. In addition to the measured data both channel and time base status is displayed on screen and user text or messages can also be specified.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*



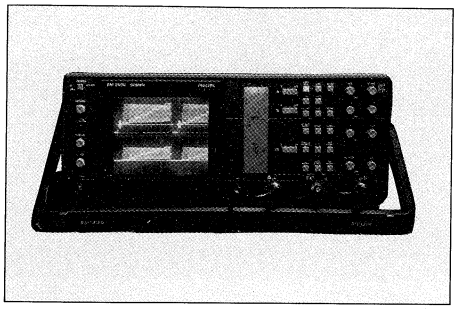






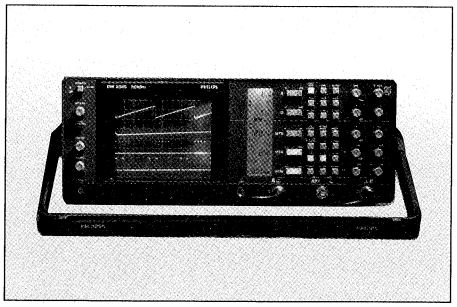
PM 3050, PM 3055, PM 3065 & PM 3070

PM 3050 60 MHz 2 Channels, SingleTime Base



With all the standard facilities of the Smart Scope series this basic instrument provides comprehensive trigger facilities like TV line, TV frame, Peak-Peak Auto and DC coupling in addition to trigger hold off. Time base speeds to 5 nsec per division are standard as well as x 1 and x 10 probe identification. X deflection via either channel is possible.

PM 3055 60 MHz 2+1 Channels, Dual Time Base

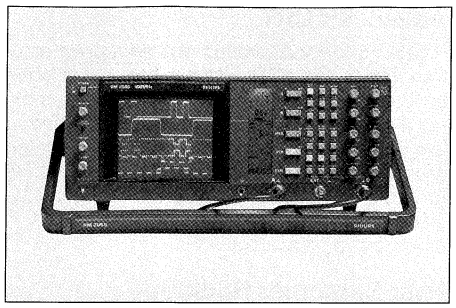


PM 3055 60 MHz oscilloscope with delayed time base and third channel trigger view.

The external trigger input of this 'scope doubles as a third input channel with a fixed attenuation. The Delayed Time Base facility can be directly triggered from the main time base or from either input channel. Display of MTB intensified and DTB is possible at the same time or independently.

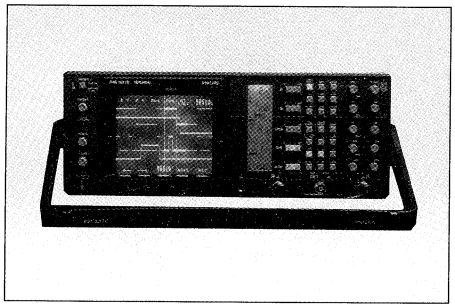
PM 3065 100 MHz 2+1 Channels, Dual Time Base

Triggering to 150 MHz plus the high intensity CRT makes this unit the ideal general purpose workhorse.The fast 3.5 nsec rise time and good pulse response characteristics make the PM 3065 the ultimate 100 MHz oscilloscope.



PM 3065 100 MHz oscilloscope with delayed time base and third channel trigger view.

PM 3070 100 MHz 2+1 Channels, Dual Time Base, Clever Cursors



PM 3070 100 MHz delayed sweep oscilloscope with clever cursors.

The Clever Cursors provide both amplitude and time measurement capabilities. In the amplitude mode peak-peak, ratio and 10% and 90% levels (for rise times) can be read directly from the display.

In the time mode rise times, ratio and phase measurements can be made and read from the display. In addition the ZOOM facility enables fast pinpointing and expansion of a specific section of the measured signal.

Specifications

Technical Specifications

Display: CRT 8 x 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate LCD for display of menus, settings, status indications etc. LCD is constantly illuminated by backlighting.

AUTOSET

Autoset selects proper channel, sets vertical deflection, timebase speed and triggering for easy-to-read display of input signals.

Vertical Deflection
Display Modes: ChA, ChB, - ChB, ChA + ChB, ChA - ChB, ChB
Trigger View: In any combination, chopped or alternate (not PM 3050).

Frequency Response
PM 3065/70: DC...>100 MHz -3 dB (20 mV/div ...10V/div)
DC...>75 MHz -3 dB (20 mV/div ...10 mV/div)
PM 3050/55: DC...>60 MHz -3 dB (0...35°C) (20 mV/div...10 V/div)
DC...>35 MHz -3 dB (2 mV/div...10 mV/div)
In AC Mode: Lower -3 dB point is <10 Hz

Rise Time
PM 3065/70: <3.5 ns (20 mV/div ...10V/div)
<4.9 ns(20 mV/div ...10V/div)
PM 3050/55: <6 ns (20 mV/div...10 V/div)
<10 ns (2 mV/div...10 mV/div)
Deflection Coefficient: 2 mV/div...10 V/div in steps of 1, 2, 5 sequence
Error Limit: 3%
Continuous control between steps with > flashing in LCD as warning symbol for uncal. amplitude.
Input Impedance: 1 MΩ± 2%//20 pF ± 2 pF
Max. Rated Input Voltage: 400V (DC + AC peak)
Dynamic Range: >24 div. at 10 MHz > 8 div. at 100 MHz (PM 3065/70); 8 div. at 60 MHz (PM 3050/55)
CMRR: 100:1 at 1 MHz

Trigger View

Frequency Response:
PM 3065/70: DC...>100 MHz -3 dB (via ext)
DC...>75 MHz -3 dB (via ChA or ChB)
PM 3050/55: DC...> 60 MHz -3 dB (via ext)
DC...>50 MHz -3 dB (via ChA or ChB)
Deflection Coefficient: 100 mV/div. via Ext. Input 2 mV/div...10 V/div. via ChA or ChB

Horizontal Display Modes
PM 3055/65/70: MTB, MTBI, Alt TB, DTB, X-defl.
PM 3050: TB, X-defl.

Main Timebase (MTB) or Timebase (TB)

Time Coefficients: 0.5 s/div...50 ns/div. in steps of 1, 2, 5 sequence
Magnifier: x 10
Fastest Sweep Speed: 5 ns/div
Error Limit: 3%
Error Limit Magn. Sweep: 4%
Continuous control between steps with > flashing in LCD as warning symbol for uncal. sweep.
Hold-off: Continuously adjustable up to 10 x min. value

Delayed Timebase (DTB)
(not on PM 3050)
Time Coefficient: 1 ms/div...50 ns/div. in steps of 1, 2, 5 sequence
Magnifier: x 10
Fastest Sweep Speed: 5 ns/div
Error Limit: 3%
Error Limit Magn. Sweep: 4%
Trace Separation: >±4 div. DTB shift only

Delay Timebase Multiplier (DTM)

(not on PM 3050)
Resolution: 1 : 10.000
Error Limit Total: 4%
Delay Time Jitter: 1 in >20.000

Triggering (MTB or TB)

Trigger Modes: Auto (free run), Non Auto Triggered, Single
Trigger Sources: ChA, ChB Composite (ChA, ChB), Ext. (DC or AC), Line
LCD indicates Not triggered, Triggered or Armed status
Trigger Coupling: Peak-to-peak (P-P), DC, TVL, TVF

Triggering (DTB) (not PM 3050)

Starts, ChA, ChB, Composite (ChA, ChB), Ext. TVL (only if MTB TV selected)

Trigger Sensitivity

PM 3050/55	Int.	Ext.
10 MHz	0.5 div	50 mV
60 MHz	1 div	150 mV
100 MHz	3 div	500 mV
TVF/TVL	0.7 div sync.	70 mV sync.
Level range	±8 div	±800 mV

PM 3065/70	Int.	Ext.
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2 div	500 mV
TVL/TVF	0.7 div sync.	70 mV sync.
Level range	±8 div	±800 mV

Slope pos. (_/‾), or neg. (‾_), TVF or TVL pos. (+) or neg. (–)

X-Deflection

Deflection Coefficient: Via ChA or ChB 2 mV/div...10 V/div.
via Ext. input 100 mV/div
Frequency Response: DC...2 MHz
Error Limit: 5%
Phase Shift: <3° (at 100 kHz)
Ext. Input: 1 MΩ ±2%//20 pF ±2 pF
Max. Input Voltage: 400V (DC + AC peak)
PM 3070 Cursor Modes
Measurements: V, t, 1/t
Ratio
Phase
Rise Time (4 way cursors)
Zoom
Settings: User text
Settings read-out
Intensity control independent of trace

Output Options

Y Signal out from ChA
Deflection Coefficient: 100 mV/div.; load 10 kΩ 40 M/div.; load 50Ω
Frequency Response
PM 3050/55: >50 MHz -3 dB
PM 3065/70: >75 MHz -3 dB
MTB Sweep Out: Output voltage 0.5 V/div; load 1 MΩ
MTB Gate Out: High when running MTB sweep; otherwise low; voltage output high > 2.4V; low <0.4V
DTB Gate Out: High when running MTB sweep; otherwise low; voltage output high >2.4V; low <0.4V

Check the comprehensive range of system oriented accessories for the PM 3065/PM 3070 to specify exactly the configuration you need. These options add extra functions, convenience and transportability to everyday work with your oscilloscope.

General Specifications

Power Supply

Safety requirements meet following specifications: IEC 348 Class I, UL 1244, CSA 556B, VDE 0411
Line Voltage: 100...240V ±10% in one range
Line Frequency: 50...400 Hz ±10%
DC Nominal Voltage: 145...335V

Power Consumption (AC source)
PM 3050/55: 50W
PM 3065/70: 60W

Miscellaneous
Cal. Output: 1.2V ±1%
Frequency: 2 KHz
Z-modulation Input: TTL-compatible
>2.0V blanks display
<0.8V gives max. intensity. Analog control possible between 2.0V and 0.8V

Mechanical Data

Width
Incl. Handle: 387 mm (15.2 in)
Excl. Handle: 350 mm (13.8 in)

Length
Incl. Handle, Excl. Knobs: 518 mm (20.4 in)
Excl. Handle and Knobs: 433.5 mm (17.1 in)
Incl. Handle and Knobs: 530.5 mm (20.9 in)
Excl. Handle, Incl. Knobs: 455.7 mm (17.9 in)

Height
Incl. Feet: 146.5 mm (5.8 in)
Excl. Feet: 134.5 mm (5.3 in)
Excl. Lower Cabinet: 132.5 mm (5.2 in)
Weight: Approx. 7.5 kg (16.5 lb) excl. access.

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Limited Range of Operation: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 15.000 ft (4,500 m)
Transport: 40,000 ft (12,000 m)
Humidity: 95% RH
EMI: Meets requirements of MIL-STD-461 Class B, VDE 0871 and VDE 0875 Grenzwert- klasse B

Shock
Operating and Non-operating: 30g, 1/2 sine, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks
Vibration: 5...55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Bench Handling: MIL-STD-810, method 516, procedure V
The PM 3050/55/65/70 are designed to meet the requirements of MIL-T-28800 D, Type III, Class 5, Style D.

Included with instrument: 1 set 100 MHz, 10:1 probes with 5 ft. (1.5m) cable and scale factor readout (unless noted); Blue CRT contrast filter; Operating Manual

Ordering Information

Models

PM 3050/00n 60 MHz Oscilloscope
PM 3052/00n 60 MHz Oscilloscope, rackmounted
PM 3055/00n 60 MHz Oscilloscope with delayed sweep
PM 3057/00n 60 MHz Oscilloscope with delayed sweep, rackmounted
PM 3065/00n 100 MHz Oscilloscope with delayed sweep
PM 3067/00n 100 MHz Oscilloscope with delayed sweep, rackmounted
PM 3070/00n 100 MHz Oscilloscope with cursors and delayed sweep
PM 3072/00n 100 MHz Oscilloscope with cursors and delayed sweep, rackmounted
Note: n defines the power cord option

Optional Configurations

When ordering, select one of the standard model numbers listed above, and add the configuration option suffix as listed below
PM 30..../11n CRT with P7 long persistence phosphor
PM 30..../70n Y-Signal Output
PM 30..../74n MTB Sweep + MTB gate + DTB gate outputs
PM 30..../75n MTB Sweep + MTB gate + DTB gate outputs, P7 phosphor
PM 30..../76n Y-Signal + MTB gate + DTB gate outputs
PM 30..../77n Y-Signal Output + MTB gate + DTB gate outputs + P7 phosphor
PM 30..../79n Y-Signal Output + P7 phosphor

PM 3050, PM 3055, PM 3065 & PM 3070

Ordering example
To order the 60 MHz dual timebase oscilloscope with MTB sweep + MTB gate + DTB gate outputs and a 110V US line cord:

Oscilloscope	PM 3055/ . .n
Option suffix	PM 30 . ./74n
Line cord suffix	PM . . . . /. . 3
Complete model number	PM 3055/743

Accessories

Passive Probes
PM 8922/501 1:1 or 10:1 Probe, cable length 1.5m (5 ft)
PM 8924/001 1:1 Probe, cable length 1.5m (5 ft)
PM 8924/201 1:1 Probe, cable length 2.5m (8 ft)
PM 8926/591 10:1 Probe with readout, cable length, 1.5m (5 ft)
PM 8926/291 10:1 Probe with readout, cable length 2.5m (8 ft)
PM 8931/091 20 MΩ, 100:1 Probe with readout

Active Probes
PM 8940/09n High Voltage Isolation Amplifier with readout
PM 8943/00n 650 MHz FET Probe
PM 9355/09n AC Current Probe with readout

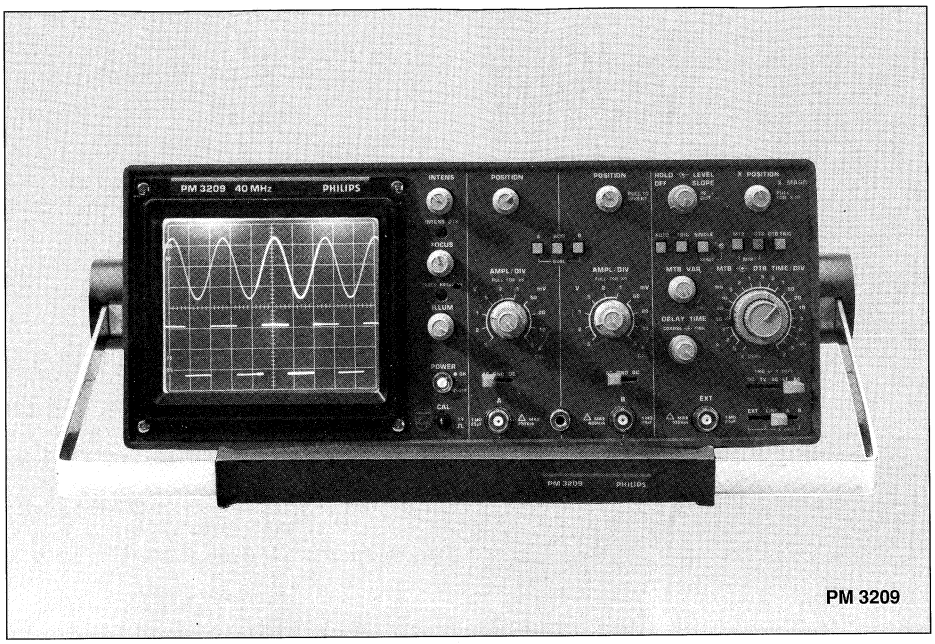
Other Accessories
PM 8902/001 12V dc power converter
PM 8917/00n Video Line Selector
PM 8953A/001 Retrofittable IEEE-488 (GPIB) Interface
PM 8988/001 Protective Front Panel Cover
PM 8991/041 Oscilloscope Trolley
PM 8992/801 Accessory Pouch
PM 8999/001 Traveller Bag
PM 9381/001 Oscilloscope Camera
PM 2195/09 Probe Switch 400 MHz
PM 2122 50Ω Coaxial Switch

For full details of all accessoiries see the end of this section.

PM 3208 & PM 3209

T&M EXPRESS LINE

NEW



PM 3209

PM 3208/09 20/40 MHz Analog Oscilloscopes

- Dual channel operation at 20MHz (PM3208) or 40 MHz (PM3209)
- Delayed time base on PM 3209
- 1 mV/div. sensitivity for low level measurements
- XY mode for time independent phenomena
- TV line and frame triggering
- Full 8 x 10 cm screen with illumination
- Supplied complete with probes

The Philips PM 3208 and PM 3209 give full performance ,ease of use ,and reliability at a price much lower than you would expect from such a professional instrument. Their comprehensive specification and guaranteed performance are fully supported by the Fluke Philips Alliance to ensure you of many years of faithful and trouble free service.

Easy-to-use versatility

High performance starts with clear, easy operation. A logical front-panel layout puts every function at your fingertips. So you can get to work fast, and get the results you need every time.

These scopes give you dual-channel operation, with bandwidth of 20 MHz (PM 3208) or 40 MHz (PM 3209).

Powerful Delayed Time Base facility (PM 3209 only)

The DTB is easy to use, and lets you select any waveform section for close examination. You can effectively 'zoom in' up to 1000 times by using a different, faster timebase speed for that section. An important extra capability at no additional cost, which gives you much more than a simple magnification function!

Precise measurement results

The high input sensitivity of both instruments goes right down to 1 mV/div. in the 5x setting. So you can view low-level signals clearly - for example from magnetic pick-up heads and other transducers. Risetime is fast 8.8 ns for the PM 3209 (PM 3208: 17.5 ns) for accurate representation of high-speed signal peaks or square-waves.

If your work involves electronic service, you'll appreciate the TV triggering facility that these scopes give you. Triggering may be on line or frame, so you can isolate and view exactly the signal you want. While for video sinals or complex digital pulse trains, there's an adjustable trigger hold-off to give you a clear, stable display every time.

More professional facilities

Another valuable facility of these professional instruments is the XY mode: the capability to display a signal not as a function of time, but as a function of another, separate signal. You'll find this mode gives you easy solutions for checking circuit and filter frequency characteristics, making input vs. output measurements, or mechanical observations like pressure vs. displacement.

There's also a rear-panel Z-modulation input, at which you can apply a signal to blank parts of the display at controlled time intervals. This function gives you valuable extra display versatility in the XY mode, when neither of the signals shown is also provided to connect an external counter, for example.

The PM 3209 adds a variable delayed sweep; an addition facility that allows viewing of both the original signal and a delayed sweep signal

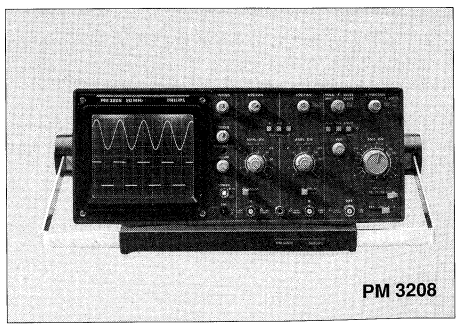
Bright, clear display

For superior waveform display, these instruments have a large, high-performance flat 8 x 10 cm screen with an integral graticule scale for parallax-free read-out. Acceleration voltage is a high 12.5 kV on the PM 3209, to ensure a bright trace at this model's high writing speeds. While adjustable focusing and scale illumination allow optimum viewing of every signal.

Value that's unmatched anywhere

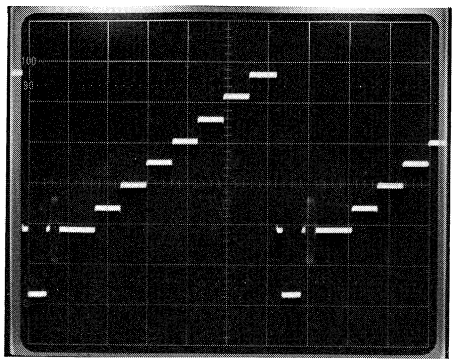
With performance like this, the PM 3208 and PM 3209 take the high ground in low-cost oscilloscopes. By giving you just what you need to handle a wide range of everyday oscilloscope applications in education & training, service, quality assurance and much more. All at a price that represents unbeatable value for money.

These benefits are backed-up by a firm commitment to service and support from a major forece in the test & measurement market - the Fluke and Philips global alliance. A combination that adds up to solid oscilloscope value that's unmatched anywhere.

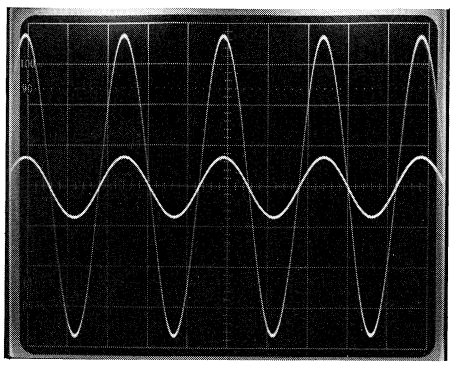


PM 3208

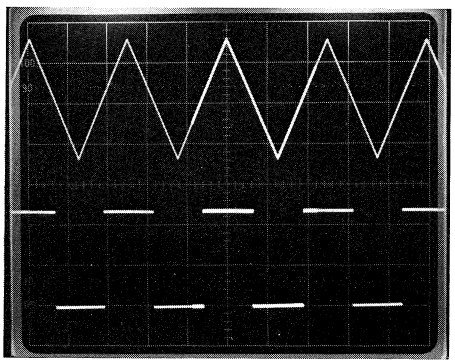
PM 3208 & PM 3209

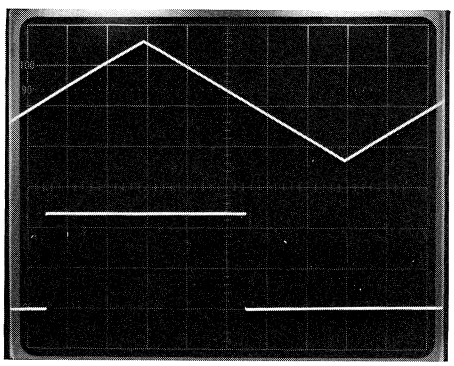


TV and video signals can be viewed clearly with TV line and frame triggering

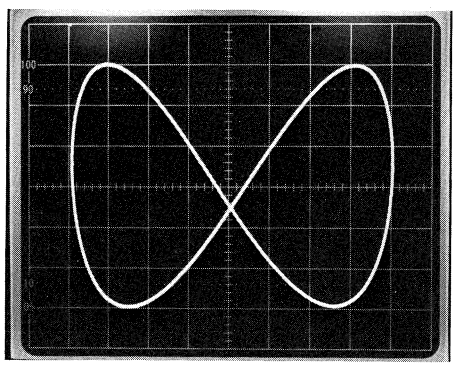


Vertical magnification of 5 times gives a high sensitivity of up to 1 mV/div. for viewing low-level signals

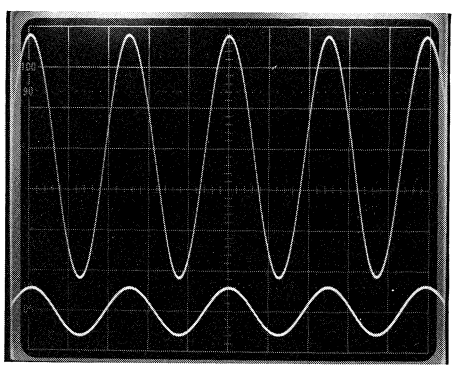




The Delayed Time Base (DTB) allows close examination of selected signal details with 'zoom-in' of up to 1000 times (PM 3209 only)



The XY mode for displaying the relationship between two separate signals; e.g. to show circuit or filter characteristics



The rear-panel Z-modulation input allows connection of an external signal for controlled blanking of the display

Specifications

Technical Specifications

CRT display

8 x 10 cm rectangular, domed mesh and post accelerator type with illuminated, parallax-free, internal graticule
2 kV accelerating potential (PM 3208);
12.5 kV (PM 3209)
8 x 10 division graticule (1 div. = 10 mm)

Vertical Amplifier (ChA and ChB identical)

Operating modes: ChA, ChB, -ChB, ChA and ChB, ChA + ChB, ChA - ChB, ALT, CHOP
Sensitivity: 5 mV - 5V/div., ±5% in 1-2-5 steps, 1 mV - 1V/div in x5 MAGN
Bandwidth DC: PM 3208 DC to 20 MHz (-3 dB)
PM 3209 DC to 40 MHz (-3 dB)
Bandwidth AC: PM 3208 10 Hz to 20 MHz (-3 dB)
PM 3209 10 Hz to 40 MHz (-3 dB)
Input impedance: 1 MΩ, 30 pF
Rise-time: less than 17.5 ns (PM 3208)
less than 8.8 ns (PM 3209)
Chopping frequency: 250 kHz approx
Input voltage max.: 400V (DC + AC peak)
Input coupling: AC, GND, DC

Horizonral Amplifier

Operating modes: X-Y operation (ChA-X, ChB-Y)
Sensitivity: 5 mV - 5V/div., ±10% in 1-2-5 steps
Bandwidth DC: DC to 1 MHz (-3 dB)
10 Hz to 1 MHz (-3 dB)
X-Y Phase shift: 3° or less (at 50 kHz)

Time-base

Sweep mode: AUTO, NORMAL, SINGLE
Sweep time: 0.2 µs to 0.5 s/div., ±3% in 1-2-5 steps
Delayed sweep: 0.2 µs to 0.5 ms/div. in 1-2-5 steps (PM 3209)
Error limit: ±3%
Sweep magnifier: 10 times
Error limit - magnified sweep: ±5%
Fastest sweep speed: 20 ns/div.
Hold-off: contiuously adjustable
Delay method: contiuous delay and adjustment (PM 3209) delay time: 20 ns to 5s
Maximum delay time jitter: 1 : 10000

Triggering

Trigger sources: ChA, ChB, LINE, EXT
Trigger coupling: AC, DC, AC-LF, TVL, TVF
Trigger sensitivity:

	PM 3208	PM 3209
Internal	DC-1 MHz, 1div	DC-1 MHz, 1div
	DC-20 MHz, 2div	DC-40 MHz, 2div
external	DC-1 MHz,150 mV,	DC-1 MHz, 150 mV
	DC-20 MHz,300 mV	DC-40 MHz, 300 mV

Trigger level preset function

Vertical Amplifier Signal Output

Output voltage: 50 mV/div. into 50Ω
100 mV/div. into 1 MΩ
Bandwidth: PM 3208 DC...20 MHz (-3 dB)
PM 3209 DC...40 MHz (-3 dB)

Intensity Modulation (Z-axis)

Input voltage max.: 42V (DC+AC peak), 1 kHz max.
Sensitivity: 3V p-p

Probe Calibrator Output Voltage

Square-wave (approx.): 1 kHz, 1V

Power Required

Voltage: AC, 100V/120V/220V/240V, ±10%. 50 to 400Hz
Power (max): 40W (PM 3208)
40W (PM 3209)

Dimensions and Weight

356 x 147 x 435 mm (14 x 6 x 17.5 in)
8 kg/17.6 lbs. (PM 3208)
9 kg/19.8 lbs. (PM 3209)

Environmental Capabilities

Meets requirements of MIL-T-28800DF, type III, class 5, style E.
Ambient Temperature
Rated Range of Use: +5°C ... +35°C
Storage and Transit: -20°C ... +71°C
Altitude
Operating: 4500m/14700 ft.
Non-operating: 12000m/39000 ft.
Humidity: 80% (rel.)
Shock: 30g halve sinewave of 11 ms duration, 18 shocks
Vibration: in three directions
0.7g, 7 min., 5 to 15 Hz
1.3g, 3 min., 15 to 25 Hz
2.0g, 5 min., 25 to 35 Hz

Safety

Meets requirements of IEC 348 Class I
Included with instruments:
Two switchable 10:1 ,1:1 probes, operating and service manual, power cord, and spare fuse.

Ordering Information

Models

PM 3208/00n 20 MHz Analog Oscilloscope
PM 3209/00n 40 MHz Analog Oscilloscope
Note:n defines power cord option

Accessories

PM 8919/001 1:1 or 10:1 probe, cable length 1.5 m (5 ft)
PM 8922/501 1:1 or 10:1 probe, cable length 1.2 m (4 ft)
PM 8924/001 1:1 probe, cable length 1.5 m (5 ft)
PM 8924/201 1:1 probe, cable length 2.5 m (8 ft)
PM 8926/501 10:1 probe, cable length 1.2 m (4 ft)
PM 8926/291 10:1 probe with readout, cable length 2.5 m (5 ft)
PM 8931/001 20 MΩ100:1 probe, cable length 1.5 m (5 ft)
PM 8940/09n High voltage isolation amplifier with readout
PM 9355/09n AC current probe with readout
PM 8991/041 Oscilloscope trolley

For full details of all accessories, see end of this chapter

PM 3340

GPIB
IEEE-488



PM 3340 2 GHz Digitizing Oscilloscope

- DC to 2 GHz bandwidth
- 175 ps risetime
- Trigger response up to 2 GHz
- 4 memories of 4 kbytes x 10-bit words
- 1 mV/div vertical sensitivity
- Automatic cursor positioning and measurements of amplitude, time, frequency and phase
- Signal processing including basic algebraic functions, FFT and histogram
- Eye pattern mode for PCM inspection
- Standard GPIB/IEEE-488 and RS 232C interfaces
- Probes operate over full bandwidth
- Autoset function gives instant front panel set-up for any input signal

Introduction

The digitizing oscilloscope PM 3340 provides measurement, storage and analysis of input signals from DC to 2 GHz. The applied sequential sampling system not only provides you with a large display bandwidth, but also offers an unmatched 2 GHz triggering. Signal analysis is facilitated by a fast timebase including post- and pre-trigger modes, and a vertical dynamic range which permits the max. allowable input signal to be observed at an amplitude scale of 1 mV/div.

Measurement cursors provide a variety of automatic measurements, so that input signal parameters can be verified quickly and reliably. Signal processing modes such as FFT, digital filtering and save on difference are included as standard. A special eye pattern mode allows the display of random pulse patterns, such as in PCM or QAM, as well as the display of constellation diagrams.

The instrument is fully GPIB/IEEE-488* and RS-232C compatible. This includes computer controlled operation, data transfer between instrument and controller plus hard copies on standard plotters and printers.

In addition to its many powerful features, the PM 3340 is very easy to operate thanks to the Autoset facility, its menu-driven analyzing functions and a setting memory for more than 250 preprogrammed front panel settings.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Reliable Measurements of High Speed Signals

Advanced technologies like ECL or GaAs need oscilloscopes that can display risetimes and propagation delays in the sub-nanosecond domain. PM 3340's risetime of 175 ps and 2 GHz bandwidth make the PM 3340 ideal for these applications. Moreover the pulse response, thanks to its 50Ω input and a sampling system actually at the input, is more reliable than in any analog or digital oscilloscope with conventional input attenuators and amplifiers. Inputs are via high-speed N-connectors combining ruggedness and a superior VSWR.

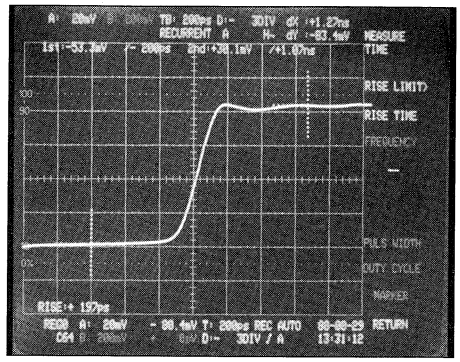


Fig. 1: Reliable pulse measurements are obtained from a carefully designed 50Ω input system.

Wide Dynamic Range

A floating input sampling bridge enables an input signal range of 1 mV/div up to 200 mV/div. This allows for any signal up to 1.6V to be magnified up to 1 mV/div with no distortion. Offset controls allow you to position any signal detail in the viewing window of 8 by 10 cm. Signal probes increase the range of 200 mV/div up to 2V/div or 20V/div if larger amplitudes have to be measured.

Noise Suppression

To enable accurate measurements on noisy signals, which is often the case with high bandwidth low level signals, the averiging mode is indispensable. The averaging mode reduces the noise drastically, enabling a clean display to be achieved even at the highest sensitivities.

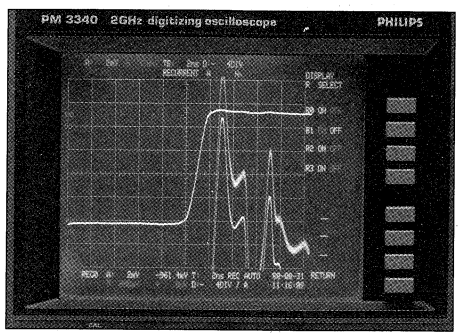


Fig. 2: A fast pulse is 100 x expanded and the resulting noise is subsequently suppressed by averaging the input signal..

Triggering up to Full Bandwidth

Many HF applications, for example in radar, satellite links or fiber optics, need GHz triggering. A new approach in the PM 3340 — a fast prescaler — extends trigger capabilities up to 2 GHz. This unique trigger circuit enables triggering from either channel or from the external trigger input up to the full bandwidth.

To ensure trigger stability there are optimized trigger modes for low amplitudes (SYNC mode) and for high frequencies (COUNTDOWN mode). Activating the AUTOSELECT function results in the optimum trigger mode being automatically selected by the PM 3340, and clearly indicated by the front panel LEDs.

Waveform details both before and after the trigger point can be displayed. The selected negative (pre-trigger) or positive (post-trigger) delay is adjustable over a wide range dependent on the selected time scale. For example a signal in a 100 ps/div timebase can be shifted over 90 divisions pre-trigger and 70 divisions post-trigger.

Clear Unambiguous Display

The PM 3340 has a 10 x 12 cm CRT. The center area of 8 x 10 cm is used for waveforms; setting parameters and measuring results are displayed in the remaining screen part. Four signal memories enable comparison of waveforms or display of processing results. The contents of the non-volatile memory can be displayed simultaneously or individually and memory back-up ensures you always have a back-up of data.

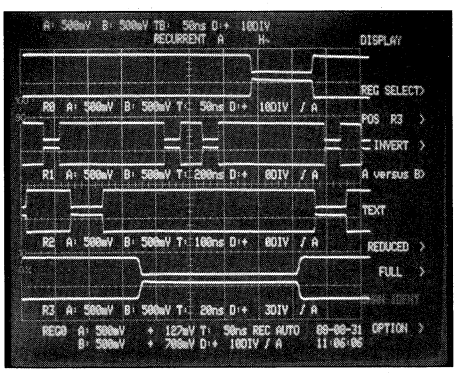


Fig. 3: Up to 8 waveforms can be displayed simultaneously (2 channels by 4 registers).

Automatic Cursor Positioning and Measurement

The PM 3340 offers a host of waveform measurements for both engineering and production environments. Once set, the instrument automatically measures time intervals, rise times, frequencies, amplitudes etc. without the need for resetting the scope for a new waveform. Time intervals between any waveforms in any register may be measured, allowing for example, automatic tests on semiconductor switching times.

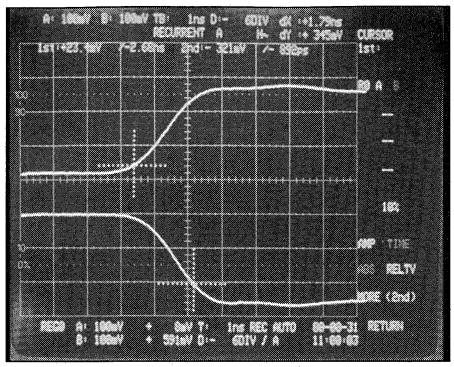


Fig. 4: Time interval measurements as required for semiconductor switching time.

To enhance and quicken specific application measurements the PM 3340 also offers full automatic cursor positioning. In this mode the cursors are automatically positioned with respect to user defined reference levels. The choice of reference levels are:

MIN PEAK the most negative signal value measured

MAX PEAK the most positive signal value measured

ABS VOLT an absolute voltage level set by the user

PROB LOW the voltage level that corresponds with the lower flat part of a pulse

PROB HIGH the voltage level that corresponds with the upper flat part of a pulse

The two PROB reference levels are derived from the amplitude histogram of the signal being measured. This eliminates the influence of overshoot, preshoot, and ringing on time measurements derived from these amplitude levels. These reference levels define the 0% and 100% values for cursor positioning. The cursors can then be automatically placed at any value between -50% and +150% relative to these reference levels.

Signal Comparison and Processing

Input signals can be checked for max. and min. deviations, for example for noise or jitter measurements, and signals passing a predetermined threshold can be saved automatically by the Stop on Difference mode. An FFT function allows frequency rather than time do main display and digital filtering removes spurious noise often found on high frequency signals.

In many telecommunication systems using digital radio links or cable transmissions, datastreams are measured in the form of eye patterns. The PM 3340 offers a dedicated eye pattern mode in which signals are displayed with a unmatched sample density of 4000, or even 12000 in the multiple eye mode. This approach ensures that no information is lost, even in case of very noisy signals.

In case of Quadrature Amplitude Modulations (QAM) two signals, the In-phase (I) and Quadrature (Q), can be combined into a constellation diagram via the A versus B mode.

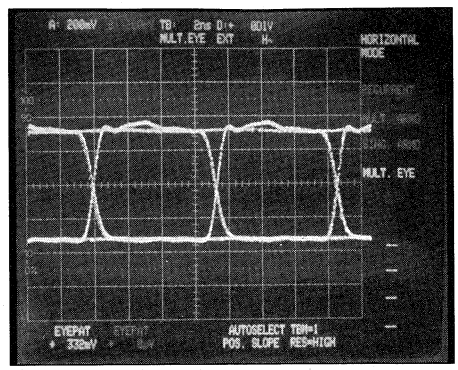


Fig. 5: Eye pattern formed by PCM signal.

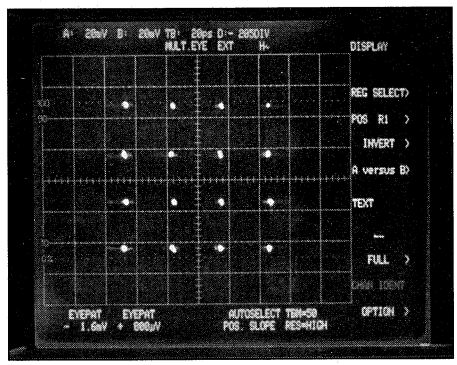


Fig. 6: 6 QAM signals presented on a constellation diagram.

Interfacing and Hardcopy

IEEE-488 and RS 232C interfaces are built-in as standard, allowing all controls to be set or interrogated and data transferred to and from any of the four memories. Digital printers/plotters can be used to obtain hard copies of waveforms with relevant alphanumeric data. An analog output for X-Y recorder is also available.

User Friendly Operation

Operation of the PM 3340 has been optimized for user-friendliness. All main functions are directly accessible and self-explanatory softkeyed menus provide the various signal processing functions. The CRT presents all waveform information on new input signals as well as the contents of any memory.

Initial set-up is by a single Autoset button, automatically providing an immediate on-screen display of both input signals. Repetitive measurement set-ups can be programmed and recalled via the setting memory keyboard, without the need for a computer.

Signal Probing

Many engineering applications ask for reliable signal pick-ups, with minimum loading of the signal source. Two 1 pF//500Ω passive probes with full 2 GHz bandwidth are included in the package. If higher DC impedance is required,

5 kΩ passive probes and a FET probe (1 MΩ//1.5 pF) are also available.

Digitizing Scopes and High Speed Measurements

Any digitizing or digital storage oscilloscope uses the principle of sampling at regular time intervals. Sampled values are digitized and stored in a memory; then the original waveform is reconstructed by scanning the memory and displaying its content on a CRT.

Non-recurring input signals require the maximum possible number of samples to be taken while the signal is present: this is called real-time sampling. The sample rate determines the maximum signal speed of single events which can be captured by the oscilloscope.

Repetitive signals can be handled differently. Collecting the required samples can be spread over several periods of the input signal. This principle is called **repetitive sampling.** There are two ways in which repetitive sampling is performed:

- Random sampling, where the moment at which sampling occurs is determined by an internal clock and is not related to the input signal.
- Sequential sampling, in which the input (trigger) signal determines the moment at which sampling occurs.

The PM 3340 is optimized for high frequency applications and therefore employs sequential sampling; samples are taken at increasing time intervals after the trigger moment. At least 512 signal periods are necessary to collect all samples for a complete reconstruction of the input signal.

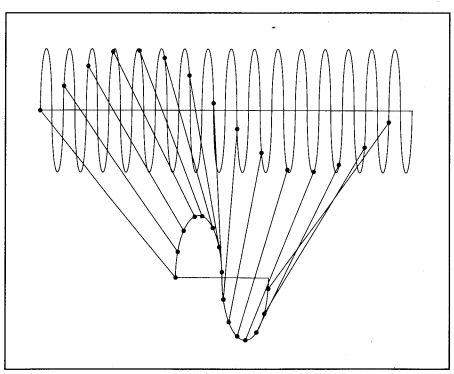


Fig. 7: Several periods of the input signal are sampled for reconstruction of the waveform.

Wide Dynamic Input Range

The input circuit has a high speed sampling gate which converts the input signals into an LF signal. The sampling gate is rebiased by a feedback circuit after each sampling action to the level of the last signal sample, so only differences between successive samples are measured, resulting in an excellent linearity over a wide dynamic range.

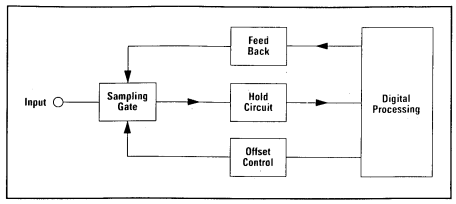


Fig. 8: Input circuit of sequential sampling scope.

The offset control allows the operator to scan the input signal to select any detail for precise observation.

High Bandwidth

The bandwidth of a sequential sampling system is determined by the sampling gate. A sample pulsewidth of less than 175 ps results in a bandwidth of at least 2 GHz. Trigger pick-off and delay line are part of the 50Ω impedance circuit, which contributes to the excellent pulse response of the instrument.

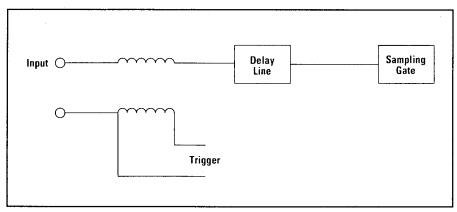


Fig. 9: VHF part of input.

Image Construction Speed

Different sampling systems give different speeds of display build up. Rather than random sampling, sequential mode only samples that part of the signal which will be displayed on screen. Moreover, as sequential sampling is related to the input signal, sample density is equal for all signal parts and no parts are missing.

Although for relatively low frequencies sequential sampling requires more time, at higher speeds this approach builds up the display much faster than other sampling systems, especially if parts of a waveform, such as risetime are measured

Specifications

Technical Specifications

Signal Acquisition

Autoset: Sets display, text, vertical settings, horizontal settings and triggering for instant overall-view display of input signal
Sampling: Sequential
Sources: ChA, ChB
Modes: Single-channel, dual-channel, added
Polarity: Each channel can be inverted
Processing: Normal, eye pattern (single- or dual-channel modes only), average, multiple sampling, absolute min/max
Range:
Vertical: 10 div
Horizontal: 10.2 x time/div
Resolution:
Vertical: 1:1024 (10-bit)
Horizontal: 1:512, 1:256, 1:128, 1:64 (in fast display mode 1:64)
Minimum Acquisition Time: <25 ms for max. horizontal resolution

Y Channels

Input Impedance: 50Ω ±1%
VSWR: 1:1.3 up to 1 GHz; 1:1.4 up to 2 GHz
Input Coupling: DC
Max. Input Voltage: 5 V_{peak}, pos and neg
Deflection Coefficient: 1 mV/div...200 mV/div. (in 1, 2, 5 sequence)
Error Limit: 1.5%
Deflection Coefficient in Eye Pattern Mode: 5 mV/div...200 mV/div
Error Limit: 10%
Continuous Control Between Steps:
Range: 3:1
Resolution: 1:4096 (12-bit)
Error Limit: 3%
Frequency Response: DC...2 GHz (-3 dB)
Risetime: 175 ps (calculated value using t_r = 0.35/bandwidth
Visible Signal Delay: 9 ns
Dynamic Range: -0.8V...+0.8V
DC Offset:
Range: -1.6V...+1.6V
Resolution: 0.01 div
Common Mode Rejection: 40:1 up to 100 MHz
Channel Isolation: 1000:1
Noise: <0.5 mV (RMS)
Averaging: x2...x64 in powers of 2
Multiple Sampling: x2...x32 in powers of 2

Timebase

Acquisition Mode: Recurrent, single scan, multiple scan, multiple eye, save/stop on difference
Deflection Coefficient:
Timebase: 1 ns/div...20 µs/div (error limit 3%)
Magnifier: x2 ... x50 (error limit - add 2%)
Fastest Sweep: 20 ps/div
Delay: Controllable in steps of div or screens
Maximum Negative Delay: 9 ns
Maximum Positive Delay: 10 div at timebase setting of 20 µs/div and magnifier x1
Hold-off Time: 30 µs...75 µs at max. horizontal resolution

Triggering

Sources: ChA, ChB, EXTernal
Input Impedance: 50Ω ±1%
Coupling: AC (RC time: 1 µs)

Max. Input Voltage: ±5 V_{peak}, pos and neg
Modes: Trigger, synchronize, countdown with AUTO or manual selection

Sensitivity:
Trigger Mode: 10 mV (up to 100 MHz)
Sync. Mode: 2 mV (up to 100 MHz)
Countdown Mode: 50 mV (up to 2 GHz)

Level Range:
High Sensitivity: +4 mV...-4 mV
Low Sensitivity: +40 mV...-40 mV
Level Resolution: 1:16384 (14-bit)
Slope Selection: + and -
Jitter: 7 ps (RMS, timebase at 1 ns/div.)

Memory

Memory: 4 memories of 4 k x 10-bit words
Functions: Clear, save, write, lock

Display

Modes: Dot join, dots only, invert, ChA versus ChB
Registers: Register R0, R1, R2 and R3 can be displayed in any combination

Expansion:
Horizontal: 1...64 in powers of 2 (Y vs t), 1...8 in powers of 2 (A vs. B), continuous control between steps
Vertical: x0.2, x1, x5
Position: All registers can be positioned independently
Horizontal: +5 div...-5 div (expansion x1)
Vertical: +5 div...-5 div (expansion x1)

Cursors

Vertical Resolution: 1:1024 (10-bit)
Vertical Error Limit: 1.5%
Horizontal Resolution: 1:4096 (12-bit)
Horizontal Error Limit: 3%

Setting Memory

Memory Size: 251 front panel settings
Functions: SAVE, INSERT, DELETE for storage or erasure of settings: RECALL, NEXT, PREVIOUS for recall of settings

Calibration Output

Squarewave Voltage:
Amplitude: 1V ±1% into 50Ω
Frequency: 100 kHz ±0.1%
Impedance: 50Ω ±1%
Risetime: 1.5 ns

Plot Output

Analog Outputs: Screen dump or register dump
Output Voltage Vertical: 1V
Output Voltage Horizontal: 1V
Error Limit: 3%
Pen Lift: TTL-compatible
Plot Time: Adjustable between 20 ms and 2s per dot
Digital Plot Output: HPGL and Philips language compatible: up to 4 screens on standard A4 size
Printer Plot Output: Compatible with Epson (FX80) and HP Thinkjet

CRT

Type: Philips 18cm rectangular PDA tube
Useful Screen Area: 10 cm x 12 cm
Graticule: Internal, with variable illumination
Acceleration Voltage: 16 kV

Power Supply:
Voltage: 90V...264 VAC
Frequency: 45 Hz...440 Hz
Power Consumption: 136W
Memory Back-Up: 2 rechargeable batteries type NCR6 (Size AA)
Retention Time: 8 weeks (recharged when instrument is powered)

Interface

Interface board: contains IEEE-488 interface, RS 232C interface and real-time clock
IEEE-488 (IEC-625) Interface
Bus Driver: E2 (three-state)

Interface Functions:

Source Handshake	SH1	Fully capable
Acceptor Handshake	AH1	Fully capable
Talker	T5	Basic talker, serial poll, talk only and unaddress if MLA
Listener	L3	Basic listener, listen only and unaddress if MTA
Service Request	SR1	Fully capable
Remote/Local	RL1	Local lock-out
Parallel Poll	PPO	No parallel poll
Device Clear	DC1	Fully capable
Device Trigger	DT1	Fully capable
Controller	CO	No controller
Address	0...30	
Default Address	8	

RS 232C Interface:
Connector: RFI/EMI

Bus Drivers:
Data Circuits:
Spacing "0" >+3V (TxD)
Marking "1" <-3V (RxD lines)
Control Circuits:
ON >+3V (RTS, CTS, DSR)
OFF <-3V (DTR lines)
Current Output: <10 mA
Output Impedance: 300Ω
Input Impedance: 3 kΩ...7 kΩ
Output Voltage: -7V...+7V
Input Voltage: -25V...+25V

Interface Function Repertoire:
Baud Rate: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 (input and output separately selectable)
Stop Bits: 1 or 2
Parity: Odd, even or none
Length: 7 or 8
Transmission: Asynchronous, full duplex

Handshake:
Software XON/XOFF
Hardware DSR/DTR and CTS/DTR

Serial Poll	ESC 7
GoTo Remote	ESC 2
GoTo Local	ESC 1
Device Clear	ESC 4
Device Trigger	ESC 8
Local Lock Out	ESC 5

Measurement and Mathematical Functions

Voltage Measurements: RMS (including or excluding offset voltage); Mean (including or excluding offset voltage); Peak-to-peak; Overshoot and Preshoot

Time Measurements: Risetime (Falltime) over 10%...90% or 20%...80% of waveform, or within variable boundaries; Pulse width; Duty cycle (expressed as a percentage of period); Frequency; Phase

Cursor Measurements
Readout on screen: V1, V2, dV, T1, T2, dT 1/dT
Positioning: Time, voltage, relative voltage
References for Relative Voltage cursors: MIN PEAK, MAX PEAK, PROB HIGH, PROB LOW, GND, ABSolute VOLTage

Mathematics

Result of calculation displayed in selected register and scalable for optimum display
Basic Arithmetic Operations: Add, Subtract, Multiply, Divide, Differentiate, Integrate
Amplitude Histogram: Amplitude density vs. absolute amplitude of an input signal
FFT: Frequency domain presentation of input signal
Window: Rectangular, Hamming, Hanning
Vertical Scale: lin. or log
Dynamic Range: 49.8 dB
Horizontal Scale: lin.
Filter: Digital filter of order 3, 5, 9, 17, 33, 65, 129
Delay Channel: Allows compensation of delay between channels or signal probes

Vertical Processing Modes

Eye Pattern: Displays pseudo-random pulse pattern, showing eye height and width
Absolute Min/Max: Measures and stores max/min values of an input signals in a selected register (envelope mode) over time

Horizontal Processing Modes

Multiple Eye: Displays eye pattern in 12k memory size for optimum signal representation
Save/Stop on Difference: Input signals outside the limits of a reference signal are saved in a selectable register or stop the acquisition.

PM 3340

General Specifications

Mechanical Data

Height: 176 mm (6.9 in.): 250 mm (9.8 in.) with feet and pouch, 5E in 19-in. rackmount version
Width: 419 mm (16.5 in.): 465 mm (18.3 in.) with handle
Depth: 570 mm (22.5 in.): 670 mm (26.4 in.) with handle
Weight: 18.7 kg (41.2 lb.) excl. accessories

Environmental Characteristics

Meets environmental requirements of MIL-T-28800C Type III, Class 5, Style D

Temperature:
Rated Range of Use: +15°C...+35°C
Limits of Operation: 0°C...+50°C
Storage: -40°C...+70°C

Altitude:
Operating: 4500 m (15000 ft)
Storage and Transport: 12000 m (40000 ft)
Maximum Humidity: 95% RH
Vibration: Frequency 5 Hz...55 Hz, 15 minutes along each of the 3 axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Shock: Operating and non operating: Max acceleration 30g, $^1/_2$ sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD-810 method 516, procedure V
EMI: MIL-STD 461 Class B, VDE 0871 and VDE 0875
Safety: Meets the requirements of IEC 348 Class 1, VDE 0411 Class 1 UL 1244, CSA 556 B

Included with the Instrument: 2 passive 10:1 probes PM 8911/08 with scale read-out (input impedance 500Ω//1 pF, cable length 1.5m), blue contrast filter, 2 BNC-N adapters, probe-BNC adapter, operating manual, programming manual, quick operating guide, cable for analog plot output

Ordering Information

Models

PM 3340/40n 2 GHz Digitizing Oscilloscope
PM 3340/80n 19-inch Rackmount Version
Note: n specifies power cord required

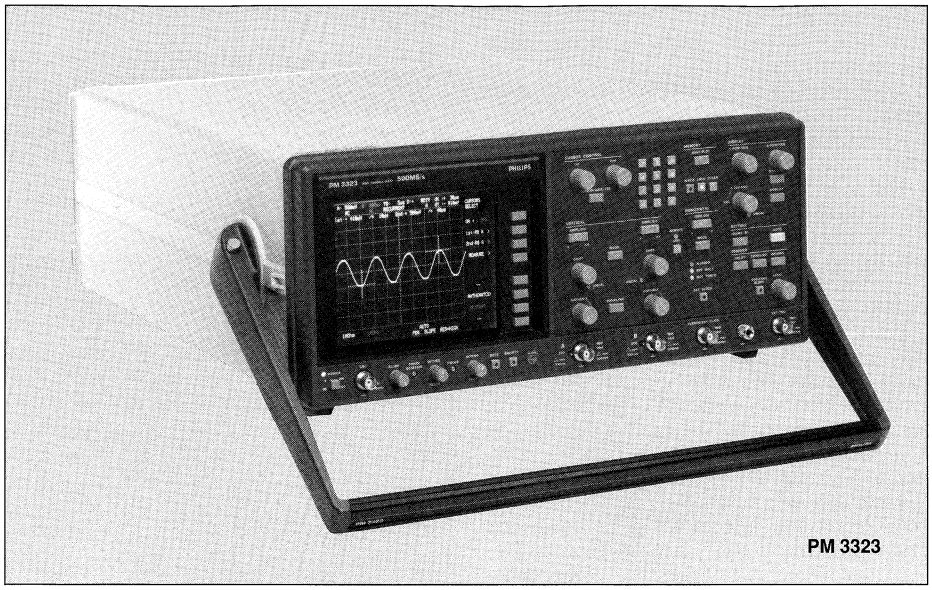
Accessories

PM 8911/081 Passive 10:1 Probe
PM 8912/081 Passive 100:1 Probe
PM 8943/00n FET Probe
PM 2295/051 IEEE-488 cable length 0.5 m
PM 2295/101 IEEE-488 cable length 1 m
PM 2295/201 IEEE-488 cable length 2 m
PM 8991/041 Oscilloscope Trolley
PM 8992/801 Accessory Pouch
PM 2195/09 Probe Switch 400 MHz
PM 2122 50Ω Coaxial Switch
PM 223x Instrument Drivers Software
PM 2240 TestTeam Software
PM 2260 Oscilloscope Signal Processing Software
Service Manual

PM 3320A & PM 3323

GPIB IEEE-488

RS-232



PM 3323 300 MHz, 500 MS/s Digital Storage Oscilloscope
PM 3320A 200 MHz, 250 MS/s Digital Storage Oscilloscope

- Up to 300 MHz Bandwidth
- 250 MS/s or 500 MS/s sampling rate on each channel
- 2 ns or 4 ns single shot resolution on each channel
- 10 bit vertical resolution
- Four 4k deep memories
- Horizontal expansion of up to 64 times
- Automatic cursor positioning and measurements of amplitude, time, frequency and phase
- Signal processing including algebraic functions, FFT and histogram

Extensive Acquisition and Display Functions

The PM 3323 and PM 3320A have extensive acquisition, calculation and display functions to capture exactly the signals of interest and quickly extract the information and measurements required. Both models offer an absolute min/max mode ('envelope' mode) that creates a cumulative record of signal amplitudes over the measuring period. Also available are stop on difference and save on difference modes. These allow signals outside a predetermined band to be captured, after which acquisition either stops (stop on difference) or continues after saving the waveform in a register (save on difference). In both cases the signals are time and date stamped to help relate intermittent faults to possible external causes. In combination with the other acquisition modes such as pre- and post-triggering, offset and restart, the PM 3323 and PM 3320A offer exceptional versatility in capturing and analyzing exactly the signal of interest. A complete measurement center in one unit.

Inputs and Signal Acquisition

The PM 3323 and PM 3320A have the power and versatility to cover a wide range of applications. Two signal inputs are provided, each with a choice of 1 MΩ or 50Ω input impedance. The built-in 50Ω terminations are protected against damage through overloads by a combination of software and thermal protection.

Calibrated voltage offset of up to 1000 x each input sensitivity permits the full utilization of the instrument's 10 bit vertical resolution even when examining small signals present on large DC offsets. Even if the magnitude of this DC offset is unknown the PM 3323 or PM 3320A can make the compensation automatically using their AUTO-OFFSET facility. To enable accurate measurements on noisy signals, which is often the case with high bandwidth low level signals, the averaging mode is indispensable. The averaging mode reduces the noise drastically, enabling a clean display to be achieved even at the highest sensitivities. Further, the PM 3323's fast 500 MS/s sampling rate (250 MS/s on PM 3320A) applies to both channels, simultaneously, and synchronously. It offers a full 2 ns resolution for each channel, for repetitive signals and single events! And random sampling permits the use of higher time base speeds for repetitive signals, so that the full 300 MHz of the instrument can be used and stored. Each channel is also provided with a dual, fast peak-detector which permits the capture of events down to 3 ns, even when slow time base speeds are used. This is not only useful to catch short glitch-type signals over longer time windows, it also allows the instrument to accurately digitize and display high frequency signals which are modulated in amplitude by a lower frequency, without aliasing. For the slowest of signals, a roll mode is provided. The roll mode can be triggered, if desired, to stop at any significant signal detail.

Triggering and Delay Capabilities

The PM 3323 or PM 3320A can be triggered from a choice of internal and external signal sources.Pre-trigger of up to one full screen is possible, not only in the direct acquisition modes, but also at the higher time base speeds, thanks to the instrument's random sampling technique. Extensive post-trigger recording with delays of up to 1000 screen lengths permits analysis of small signal details out of long and complex signals. In addition, the RESTART function, which enables the user to quickly 'zoom in' on a point of interest, make analysis fast and simple and provide a better alternative to the traditional Delayed Sweep arrangement. Trigger level can be checked in the CRT display for fast setup, for all selected trigger sources, whether internal, or external.In addition to normal trigger delay, the delay can also be used to give an internal time delay after an external event. Both models also offer excellent TV trigger capabilities. (See also PM 8917.)

Storage

Signals from each channel can be stored in each of four 4k memories. This allows for easy comparison of waveforms, or the display of references. A unique, multiple-single-shot mode allows for quick and automatic storage of up to four dual-channel acquisitions which occur rapid succession. All waveforms are kept with all relevant acquisition parameters, such as sensitivity, time base, and delay settings at the moment of recording. A real-time clock provides automatic 'time stamps'. Full compatibility with GPIB/IEEE-488* and RS-232C enables almost unlimited recording of waveform data on external devices.

Display and Soft Keys

The PM 3323 and PM 3320A have a large 10 x 12 cm CRT screen. The center 8 x 10 cm area is exclusively used for waveforms. The edges of the screen the show acquisition parameters of live signals, or of previously recorded wave-

forms. This clear separation of signal traces and parameters eases interpretation of results. All softkey displays are to the right of the display and adjacent to the softkeys. A separate numeric keypad allows direct input of pertinent data such as offset and delay.

Operation and User Friendliness

All main functions are directly accessible to the user, without the need to learn soft-key menus. This also eliminates the time consuming need to back up through various levels of menus to change instrument settings.And Philips 'Green-button' Autoset provides for even faster set-ups by automatically determining the optimum acquisition parameters for any input signal. This is a great help in finding and viewing unknown signals.Once captured, waveforms are immediately displayed, and without interference from text or menus. All texts are displayed along the screen edges, with only channel identification (A or B) displayed with the relevant trace. The PM 3323 and PM 3320A even show a warning when aliasing due to undersampling is detected! The logical front panel layout follows the traditional concepts of clearly grouping input channels, time base functions and trigger functions. This logical approach makes the use of this advanced DSO possible right from the start.

SetUp Memories

Both models have user-programmable setup feature allows even greater ease of use, providing automation without a computer. This ensures repeatability of tests and their results.Up to fully 250 user-defined instrument setups can be stored for measurements of user-specific interest. These instrument setups can also be linked together to form sequences of test steps, or can be recalled at random.

Versatile Measurement Functions

Once a signal has been acquired, a full range of measurement and calculation functions to extract exactly the information needed from the signal are available. Measurements of voltage and time differences between the cursors positioned on a single waveform are possible. In addition comparative measurements to be made between two waveforms recorded on channel A and channel B, or between separate waveforms stored in any of the instrument's four memory registers.Not only absolute and relative time and voltage measurements are possible,but also phase measurements. In each case, all that's necessary is to position the cursors on the desired part of the signal or signals concerned, make a simple menu selection of the required measurement, and the numeric result is immediately displayed on-screen. To enhance and quicken specific application measurements the PM 3323 and PM 3320A also offer full automatic cursor positioning. In this mode the cursors are automatically positioned with respect to user defined reference levels. The choice of reference levels are:

MIN PEAK the most negative signal value measured

MAX PEAK the most positive signal value measured

ABS VOLT an absolute voltage level set by the user

PROB LOW the voltage level that corresponds with the lower flat part of a pulse

PROB HIGH the voltage level that corresponds with the upper flat part of a pulse

The two PROB reference levels are derived from the amplitude histogram of the signal being measured. This eliminates the influence of overshoot, preshoot, and ringing on time measurements derived from these amplitude levels.These reference levels define the 0 % and 100 % values for cursor positioning. The cursors can then be automatically placed at any value between -50 % and +150 % relative to these reference levels. Cursors can also be used as 'Smart-Start cursors'. When the cursors are placed over any signal detail of interest, the activation of 'Restart', automatically reestablishes proper delay and sampling speed to acquire that detail with maximum resolution.

Advanced Signal Processing Modes

The PM 3323 and PM 3320A offer more than signal measurements alone. A wide range of signal-processing modes allow you to explore more deeply into your acquired signals, and perform calculations that reveal hidden data and relationships.The basic arithmetic functions of add, subtract, multiply and divide are supplemented by signal differentiation and integration, as well as amplitude histograms, the application of digital filters and an optional FFT facility for signal representation and analysis in the frequency domain.

System Use

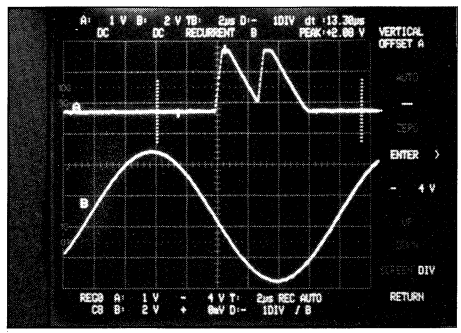
The interface option on both models offers full GPIB/IEEE-488 and RS 232C capabilities. All controls can be set or read. Waveform data can be taken from any of the four memories, or be sent back to the scope ,for example when loading a template for the 'stop on difference ' mode. All 250 user defined setup memories can be set by the controller, as well as called by the controller. This drastically reduces bus traffic and significantly speeds automatic testing applications.

Hard Copy

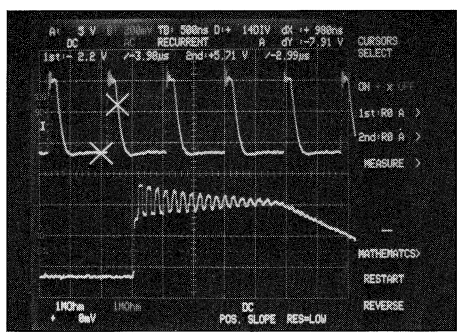
Each model is equipped with an analog output to drive an analog XY recorder. The operator can select any waveform in any memory to be drawn by the recorder. Instruments equipped with the interface option provide direct output to digital plotters or printers. A digital plot or print-out of any waveform is possible, along with alphanumeric data pertinent to that waveform.

Construction

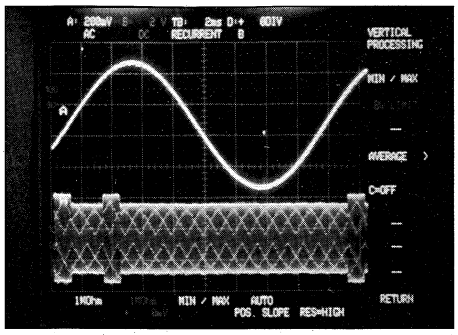
The sturdy construction provides for a variety of operating configurations. At just under 18 kg, it can easily be carried from one location to another, and the carrying handle doubles as an adjustable stand. Scopecart PM 8991/04 offers further mobility. In addition, a rackmountable version for use in standard 19 inch racks is also available.



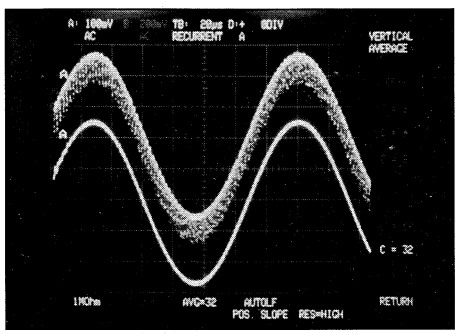
1. The PM 3323 and PM 3320A screen is a complete information center. Because of the 10 x 12 cm. screen size and full 8 x 10 cm dedicated trace area , no text is interfering with the displayed waveforms.



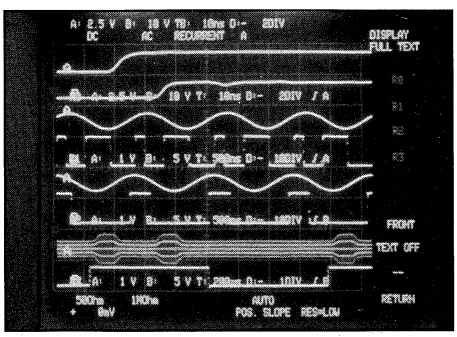
2. Restart allows fast zoom-in on signal detail. All that's necessary is to locate the cursors around the area of interest and press the Restart key. A new acquisition is made at a higher sampling rate so that the area of interest fills the full screen.



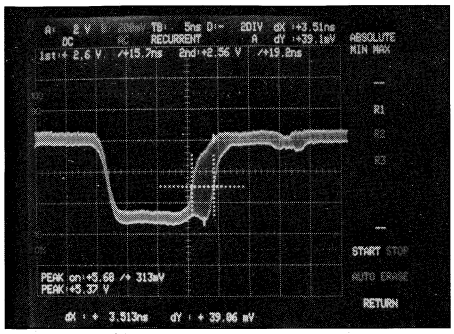
3. Vertical signal processing includes averaging, Bandwidth limit and MIN/MAX incorporating a fast Track and Hold circuit in each channel to reveal spikes or glitches down to 3 ns, even at low timebase speeds. This facility also enables accurate display of HF signals which are LF amplitude modulated without aliasing.



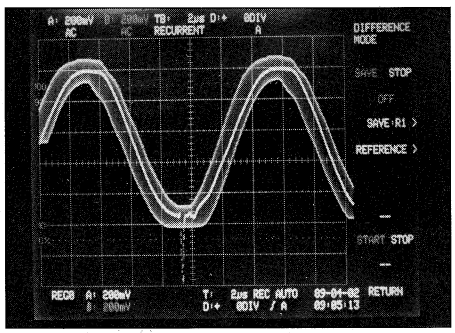
4. The 'running average' not only reduces random noise but allows the user to get the most out of the 10-bit resolution even at the full bandwidth.



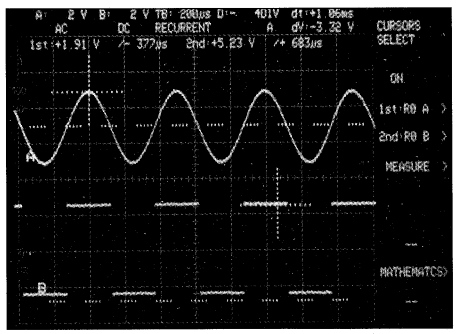
5. Signals from each channel can be stored in each of the four 4k deep memories, along with all the relevant setting parameters.



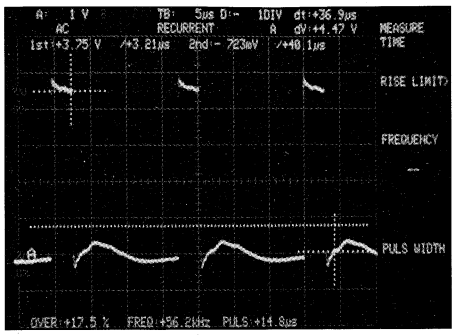
6. The envelope mode makes it easy to track signal variations over time, for example changes caused by temperature drift, interference, stability problems etc.



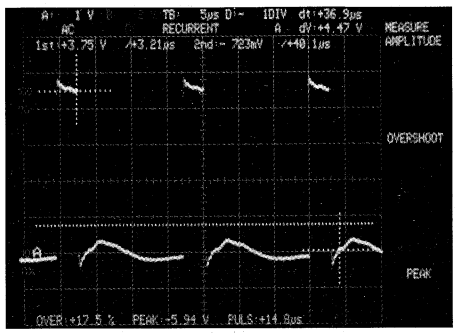
7. Built in 'envelope' functions provide a powerful capability for the testing of components or assemblies. With 'Stop on Difference' items not conforming to specification are easily identified.



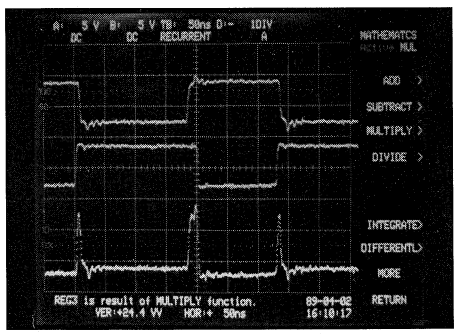
8. As should be expected of any high performance DSO, a wide range of measuring facilities are offered. Absolute ground referenced results are achieved on up to two traces selectable from any of the 8 displayable waveforms.



9. Together with the cursor measurements on a single trace, selection can be made from a wide variety of automatic and calculated results. Amplitude measurements of RMS, mean, peak-peak, pulse overshoot and preshoot can be readily selected.

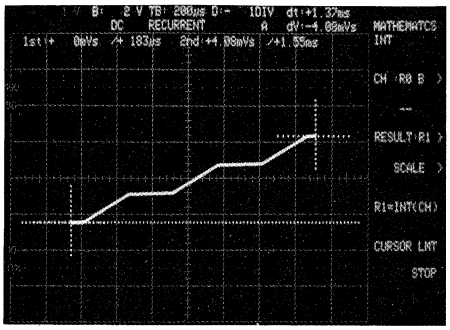


10. Further time measurements of frequency, period, pulse width, duty cycle and rise time are available to give timer/counter results. Even phase can be measured between channels and/or waveforms.



11. The basic arithmetic operation add, subtract, multiply and divide can be performed on captured waveforms allowing quick, convenient calculations.

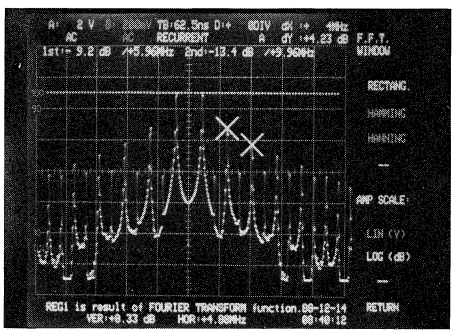
PM 3320A & PM 3323



12. A further example of the math facility -integrate - seen here as the integral of the signal between the cursors. A convenient display for use in 'energy' measurements for example.



13. Further processing gives a new dimension to single shots buried in noise. These signals, unlike repetitive waveforms that can be 'averaged' if noise exists, are once off, and average cannot be used. With the PM 3323's or PM 3320A post acquisition filtering, the true signal can be revealed.



14. The optional FFT function with selectable windowing (rectangular, Hamming or Hanning) and linear or logarithmic scaling gives fast calculation and display of the power spectra in the frequency domain.

Specifications

Technical Specifications

Unless stated all specifications refer to both PM 3323 and PM 3320A.

CRT

Philips 180 mm rectangular tube with 16 kV acceleration potential and P31 phosphor (GH). 100 mm x 120 mm useful screen area. 80 mm x 100 mm for traces.
Readout: Three separate areas reserved for front panel setting information, register parameters on softkey menus
Graticule: Internal with % indications. Illumination continuously variable

Autoset

Sets display, text, vertical mode, horizontal mode and trigger coupling in a predefined position. Other parameters depending on signal so that available signals are correctly recorded and displayed.

Signal Acquisition

Sampling Type:
Real time: PM 3323 100 ns/div...360s/div.
PM 3320A 200 ns/div...360s/div.
Equivalent time: PM 3323 5 ns/div...50 ns/div.
PM 3320A 5 ns/div...100 ns/div.
Maximum Sample Rate:
Real time: PM 3323 500 MS/s.
PM 3320A 250 MS/s.
Equivalent time: 10 GS/s.
External clock: 50 kS/s.
Vertical Resolution:
10 bits or 0.1% of full scale
Voltage resolution: 50 µV
Maximum Horizontal Resolution
Single channel (single shot)
PM 3323 100 ns/div...500 µs/div: 512 samples/acquisition; 1 ms/div...360s/div: 4096 samples/acquisition
PM 3320A 200 ns/div...500 µs/div: 512 samples/acquisition; 1 ms/div...360s/div: 4096 samples/acquisition
Single channel (repetitive or single scan)
PM 3323 5 ns/div...50 ns/div: 512 samples/acquisition; 100 ns/div...360s/div: 4096 samples/acquisition
PM 3320A 5 ns/div...100 ns/div: 512 samples/acquisition; 200 ns/div...360s/div: 4096 samples/acquisition
Dual channel (single shot)
PM 3323 100 ns/div...500 µs/div: 512 samples/acquisition; 1 ms/div...360s/div: 2048 samples/acquisition
PM 3320A 200 ns/div...500 µs/div: 512 samples/acquisition; 1 ms/div...360s/div: 2048 samples/acquisition
Dual channel (repetitive or single scan)
PM 3323 5 ns/div...50 ns/div: 512 samples/acquisition; 100 ns/div...360s/div: 2048 samples/acquisition
PM 3320A 5 ns/div...100 ns/div: 512 samples/acquisition; 200 ns/div...360s/div: 2048 samples/acquisition
Acquisition Time: Real time 10.24 x time/division (exclusive delay time). Equivalent time 2s for 5 ns/div. (input signal dependent): 10 ms for 100 ns/div. (99% probability of all samples being updated).
Sources: ChA, -ChA, ChB, -ChB
Modes: ChA, ChB, ChA and ChB, ChA + ChB, ChA - ChB, ChB - ChA, -ChA -ChB. Average and MIN/MAX possible in all modes.
Sample Difference Between ChA and ChB: Both channels are sampled simultaneously ±200 ps.
Acquisition Processing:
Absolute min./max. (envelope)
Averaging
Save on difference
Stop on difference

Channels A and B

Input Impedance (High Z): 1 MΩ in parallel with 14 pF
Input Impedance (50Ω): V.S.W.R. 1.2:1 at 200 MHz
Maximum Input Voltage (High Z): 300V (DC + AC peak) at 1 MHz
Maximum Input Voltage (50Ω): 5V DC and r.m.s.; 50 V AC peak. Protected against selection with unsafe voltage on input: connector.
Deflection Coefficients: 5 mV/div...5V/div. in 1-2-5 sequence. (Continuous control between steps)
Error Limit (Variable Calibrated): Overall 2%. Add 2% in min./max. mode and in 100 ns/div range
Dynamic Range: 10 divisions
DC Offset

	Range	Resolution
5 mV/div...20 mV/div.	±5V	5 mV
50 mV/div...200 mV/div.	±50V	50 mV
500 mV/div...5V/div.	±300V	500 mV

Shift Range: ±5 divisions
Frequency Response:
PM 3323 DC...300 MHz (-3 dB)
PM 3320A DC...200 MHz (-3 dB)
AC coupled lower -3 dB point with 50Ω input 10 Hz; AC coupled lower -3 dB point with high Z input 1 Hz. Bandwidth limiter reduces bandwidth to 20 MHz.
Risetime (0.35/Bandwidth): PM 3323 1.16 ns
PM 3320A 1.75 ns
CMRR: 100:1 at 1 MHz; 20:1 at 50 MHz
MIN/MAX Function: Accuracy for pulse longer than 3 ns is 50%. Reset time 20 ns
Average: Continuous average where:

$$\text{New Value} = \text{Old Value} + \frac{\text{New Sample - Old Value}}{\text{Constant}}$$

And constant is: 32 x in roll mode; 2...64 x in other modes.

Time Base

Modes and Time Coefficients:
Recurrent: 5 ns/div...5s/div
Single shot: PM 3323 100 ns/div...5s/div
PM 3320A 200 ns/div...5s/div
Single scan: 5 ns/div...5s/div
Multiple shot: PM 3323 100 ns/div...5s/div
PM 3320A 200 ns/div...5s/div
Multiple scan: 5 ns/div...5s/div
Roll: 50 ms/div...360s/div.
Absolute min./max.: 5 ns/div...5s/div.
Stop/save on difference: 5 ns/div...5s/div.
Error Limit:
In equivalent time mode ± 1.0%
In real time mode ± 0.01%
Save/Stop on Difference: Time between end of last comparison and ready for next: 100-150 ms dependent on memory resolution
Absolute Min./Max: Auto resets after 100 acquisitions or after 10s whichever occurs last (can be switched off)

Triggering

Sources: ChA, ChB, External, Line and External events
Ext. Input Impedance: 1 MΩ in parallel with 14 pF
Ext. Maximum Input Voltage: 300V (AC + DC peak) at 1 MHz
Coupling: Signal triggering; AC, DC, LF rej., HF rej., Auto level or TVF. Events triggering; TTL, ECL or adjustable voltage
Triggering Sensitivity

	Internal	External
30 MHz	0.5 div.	50 mV
100 MHz	1.5 div.	100 mV
300 MHz	4.0 div	300 mV

Slope: Positive, negative or dual slope
Level Range:
Channel A and B: ±8 div.
External: ±0.8V
External/10: ±8V
Any source in AUTO: related to p-p value
Frequency Range:
Trigger coupling in DC: DC...300 MHz
Trigger coupling in AC: 10 Hz...300 MHz
Trigger coupling in LF rej.: 50 kHz...300 MHz
Trigger coupling in HF rej.: DC...50 kHz
Trigger Delay:
Range:
PM 3323 -10...9999 divisions (100 ns/div...360s/div.); -10...500 divisions (5 ns/div... 50 ns/div.)
PM 3320A -10...9999 divisions (200 ns/div...360s/div.); -10...500 divisions (5 ns/div... 100 ns/div.)
1...9999 events (max. frequency 5 MHz), Internal delay after event count

Memory

4 memories of 4k x 10 bit-words each

Display

Sources: Register R0, R1, R2 or R3 in any combination
Expansion
Horizontal: In steps 1x...64x (8x in A vs B). Continuously between 1x and 2x
Vertical: 0.2x, 1x and 5x
Display Handling:
Smoothed
Dots only
Dot join
All registers can be inverted
Position: ±5 div. horizontally and vertically from screen center for each register and/or individual trace.

Setting Memory

Memory Size: 251 front panel settings maximum
Functions: SAVE, INSERT or DELETE for storage or erasure of settings. RECALL, NEXT or PREVIOUS for recall of programmed settings.
Configuration: Front panel settings can be grouped as main and sub settings in order to reach up to 10 closed sequences each with an own number of steps.

Calculation Functions

All waveform calculations can be performed with results stored in different registers from source register. Original waveform need never be affected.
Add
Subtract
Multiply
Divide
Differentiate
Integrate
Delay channel
Amplitude histogram
Digital filter
FFT (optional)
Digital Filter: Breakpoint related to filter order and TB by (0.72/N+1)*f sample, where N=filter order and f sample=sample rate (dependent on [TB*10]/memory depth).
FFT (option): Range of amplitude display 49.8 dB. Positive spectrum display resolution 2000 points single channel, 1000 points dual channel. Frequency resolution related by TB/10.24. DC point is mid-memory.
FFT Windowing: Rectangular, Hanning or Hamming with linear or logarithmic vertical scaling.
FFT Calculation Time: No windowing; linear display 6 secs; windowing and logarithmic display, 15 secs.

Cursors

Max. Horizontal Resolution: Single channel mode 1:4096; Dual channel mode 1:2048
Vertical Resolution: 1:1024
Read Out Resolution: 3 digits
Error Limit: < 2% of voltage; < 0.2% of time
Range: Visible part of signal
Readout on screen: V1, V2, dV, T1, T2, dT, 1/dT
Positioning : Time, voltage, relative voltage
References for Relative Voltage cursors: MIN PEAK, MAX PEAK, PROB HIGH, PROB LOW, GND, ABSolute VOLTage

Measurement Capabilities

dV	dt
RMS	1/dt
Max	Rise/fall
Min	Rise/fall-ECL
Overshoot	Rise/fall-VAR
Preshoot	Frequency
Mean	Period
Absolute volts	Pulse width
Volts Ch-Ch	Duty cycle
Volts Reg-Reg	Phase
Relative time	Time Ch-Ch
Relative volts	Time Reg-Reg

Calibration Output

Output voltage: 1 Vp square wave
Frequency: 2 kHz
Internal impedance: 50Ω
Output current: 20 mA

Interface (optional)

Interface board contains IEEE-488 interface, RS 232C interface and a real time clock.
IEEE-488: Bus driver. E2 (Three-state).
Interface Functions

Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker	T5	Basic talker, Serial poll, Talk only and Unaddress if MLA.
Listener	L3	Basic listener, Listen only and Unaddress if MTA.
Service request	SR1	Complete capability
Remote/local	RL2	No local lock out
Parallel poll	PP0	No parallel poll
Device clear	DC1	Complete capability
Device trigger	C0	No controller
Default address	8	

RS 232C

Connector: RFI/EMI shielded 25 pole
Bus drivers: Data circuits Spacing '0' +3V;Marking '1' -3V (TxD and RxD lines)
Control circuits: ON +3V; OFF -3V (RTS, CTS, DSR and DTR lines)
Current Output: 10 mA
Impedance: Output 300Ω ; Input 3 k...7 k
Voltage: Output -7V...+7V; Input -25V...+25V
Interface Functions
Baud-rate: 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200 (input and output separately selectable)
Stop-bits: 1 or 2
Parity: odd, even or none
Length: 7 or 8 bits
Transmission mode: Asynchronous, full duplex
Handshake: Software, XON/XOFF; Hardware DSR/DTR and CTS/RTS
Serial Poll: ESC 7

PM 3320A & PM 3323

Go to Remote: ESC 2
Go to Local: ESC 1
Device Clear: ESC 4
Device Trigger: ESC 8
Digital Plot (option /40n and /80n)
Language: Selectable HPGL or Philips GL dependent on plotter type
Plotter select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155,
HP 7450, HP 7475A
Pen select: Pen 1 for ChA
Pen 2 for ChB
Pen 3 for Register ChA
Pen 4 for Register ChB
Pen 5 for graticule and alphanumerics
Plot area: Softkey selectable
Dot Matrix Printer
Screen Dump: Compatible with Epson FX 80 and HP Thinkjet®
Drawing Area: 10 cm x 10 cm
Analog Plot Output
Screen dump or register dump possible.
Output voltage: 1 V horizontal and vertical (±3%). Pen lift: TTL compatible.
Plot time: adjustable between 20 ms...2 sec per dot.

General Specifications

Power Supply

Nominal AC Voltage Range: 100...240 V
Nominal Frequency: 50 Hz...400 Hz
Power Consumption: With options 170 W nominal
Memory Backup for Settings and Traces: Two rechargeable batteries are supplied with the instrument
Retention Time: 8 weeks (recharged when instrument is powered)

Mechanical Data

Height: 176 mm (6.9 in); 250 mm (9.8 in) with feet and pouch; 4E (7 inch) in 19-inch rackmount version
Width: 419 mm (16.5 in); 465 mm (18.3 in) with handle
Depth: 570 mm (22.5 in); 670 mm (26.4 in) with handle extended
Weight: 18 kg (39.6 lb) excl. accessories

Environmental Characteristics

Meets environmental requirements of MIL-T-28800C Type III Class 5, Style D.
Temperature: Operating 0°C...+50°C; Storage -40°C...+70°C
Maximum Humidity: 95% relative humidity
Maximum Altitude: Operating 4.5 km (15 000 ft); Non-operating 12 km (40 000 ft)
Vibration: Frequency 5...55 Hz, 15 minutes along each of the 3 axes, with a maximum acceleration of 3 g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Shock: Operating and non operating: Max acceleration 30 g, 1/2 sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD-810 method 516, procedure V
EMI: MIL-STD-461 Class B. VDE 0871 and VDE 0875.
Safety: The instrument meets the requirements of IEC 345 class 1, VDE 0411 class 1, UL 1244 and CSA 556B.
Included With instrument: 2, 10:1 passive probes, Blue contrast filter, Operating Manual,2 rechargeable penlight batteries, reply card for free Service Manual.

Ordering Information

Model

PM 3323/00n 300 MHz 500 MS/s Digital Storage Oscilloscope
PM 3320A/00n 200 MHz 250 MS/s Digital Storage Oscilloscope
Note :n defines the power cord option

Optional Configurations

When ordering, select basic 'PM' model, and substitute the configuration option number listed below as a suffix.
PM 332./.1n Adds FFT Option to any configuration
PM 332./3.n Adds 19 inch Rackmount only
PM 332./4.n Adds IEEE 488/RS 232C Interface Option only
PM 332./8.n Adds Rackmount and IEEE 488/RS232C Interface option
Example, Ordering Configuration
To order a 300 MHz, 500 MS/s Digital Storage Oscilloscope with rackmount and FFT, select:

Basic model	PM 3323/00n
Rackmount only	PM 3323/3. n
FFT option	PM 3323/ .1n
110 V Power cord option	PM 3323/ . .3
Complete model number	PM 3323/313

Accessories

Passive Probes

PM 8911/091 500Ω,10:1 Probe with readout, cable length 1.5 m (5 ft)
PM 8912/091 5 kΩ, 100:1 Probe with readout, cable length 1.5 m (5 ft)
PM 8924/001 1:1 Probe, cable length 1.5 m (5 ft)
PM 8924/201 1:1 Probe, cable length 2.5 m (8 ft)
PM 8929/191 10:1 Probe with readout, cable length 1 m (3 ft)
PM 8929/291 10:1 Probe with readout, cable length 2.5 m (8 ft)
PM 8929/391 10:1 Probe with readout, cable length 1.5 m (5 ft)
PM 8931/091 20 MΩ, 100:1 Probe with readout, cable length 1.5 m (5 ft)
PM 9599/091 Set of VHF Attenutators Active Probes
PM 8940/09n High Voltage Isolation Amplifier with readout
PM 8943/00n 650 MHz FET Probe
PM 9355/09n AC Current Probe with readout

Other Accessories

PM 8917/00n Video Line Selector
PM 8956A/001 Retrofittable IEEE-488 (GPIB) and RS 232C interface
PM 8992/801 Accessory Pouch
PM 8991/041 Oscilloscope Cart
PM 9051/001 BNC to 4 mm Banana Adapter
PM 2122/01 50Ω Coaxial Switch
PM 2195/09 Probe Switch 400 MHz
PM 2230/001 Series Instrument Drivers Software
PM 2240/001 TestTeam Software
PM 2260/001 Oscilloscope Signal Processing Software

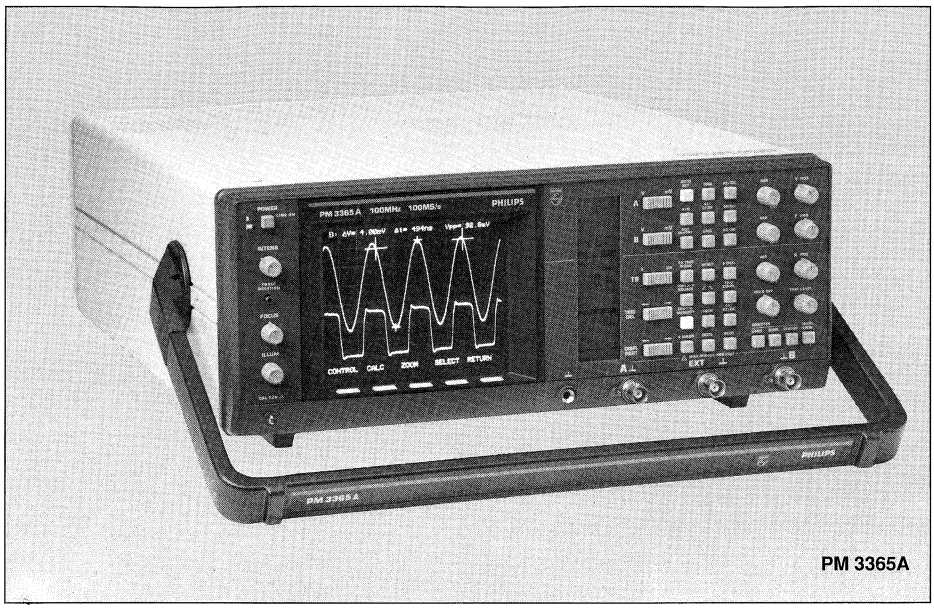
For full details of all accessories, see page 44

PM 3365A & PM 3375

GPIB IEEE-488

RS-232

NEW



PM 3365A

PM 3365A& PM 3375 Digital Storage Oscilloscopes

- Two high performance oscilloscopes (analog and digital storage) in one
- Simultaneous sampling on both channels up to a high 250 MS/s
- Analog and digital repetitive bandwidth to a full 100 MHz with 150 MHz Triggering
- Multifunction AUTOSET gives instant display of any input signal
- 64 Front Setting Memories
- Advanced cursors for automatic measurements
- Dual timebase referencing
- 12k reference memory stores up to 6 traces
- Interface options for extensive remote control or screen plot/print
- Average and Envelope display modes

The PM 3365A and PM 3375 bring additional real time and DSO capabilities to the PM 3350A range of oscilloscopes. They offer all the potential found in the PM 3350A and PM 3355 but with increased bandwidth in both real time and DSO modes. In both the PM 3365A and PM 3375 sequential sampling makes the full 100 MHz bandwidth available in the digital storage mode.

Double Performance

The new PM 3365A and PM 3375 sets a new performance standard for the popular 'combiscope', a term which describes a full capability Digital Storage Oscilloscope and conventional analog real time scope in one unit. A high performance 100 MHz bandwidth for both analog and digital operation is complemented by a fast 100 MS/s or 250 MS/s sampling rate, simultaneously on both channels for single shot capture. These combination give exceptional capture and analysis capabilities to crack tough measurement problems.With their advanced features, the PM 3365A and PM 3375 are powerful systems instruments, offering all the advantages of digitizing such as long term storage of waveforms for future reference; transfer of waveform data; and automatic waveform parameter extraction, either internally through their in-built measurement calculations or externally via a remote systems controller.

Simultaneous Sampling

Unlike many DSOs in the PM 3365A and PM 3375's class, the maximum sample rate is maintained even when both channels are in use. It's essential that sample rate is not reduced in two channel acquisition, because sample rate determines the effective single shot bandwidth, and this is one of the critical specifications for a DSO. The PM 3375 offers full 250 MS/s on both channels simultaneously, which also means no time errors are caused by sample multiplexing in capture from channel to channel. Furthermore, the resolution is maintained at a very high 4 ns.

Extending single shot applications further, the PM 3365A and PM 3375 incorporate a multishot capability where the reference memory effectively doubles single shot memory depth. First a single shot is captured in the acquisition memory (which itself can be as long as 4 k words). Then it is dumped into one of the reference memories (again a deep 4k). The scope re-arms and takes the next once-off signal, so capturing 2 events. These signals may be close in time (within 50 ms) or may be many hours apart. Combined with the high sample rate, this flexibility is a great help in tracking down elusive intermittent faults.

Repetitive Sampling

While the sample rate determines the single shot capabilities of a DSO, repetitive sampling is needed to make use of the full analog bandwidth. Here the digitized signal is built up over successive sweeps of the incoming signal; on each sweep a sample is taken until the memory is completely filled and the cycle begins again. The PM 3365A and PM 3375 use the sequential sampling technique to provide a 100 MHz capture bandwidth, mirroring the analog capabilities. All the benefits of digitized signals can then be harnessed to give measurement and analysis capabilities to 100 MHz and beyond, including constant light output over all timebase ranges even at 20 ns/div. With an equivalent time sample rate of 2.5 Gs/s expansions up to 32 times enable small signal details to be accurately examined.

Sensitive to Your Needs

The input sensitivity of PM 3365A and PM 3375, at 2 mV/div over almost the full bandwidth, covers practically every application. This gives µV resolution in results, pinpointing those small signal variations. Couple this with a 1.2 division trigger sensitivity at 100 MHz and you have stable wideband low level signal capture. If you want even more speed, the trigger capabilities are specified all the way up to 150 MHz.

Average and Envelope Modes

Often on low level signals spurious noise can mask the real signal of interest. To reveal the true signal of interest both the PM 3365A and PM 3375 are equipped with and averaging capability by which the average signal of upto 256 acquisitions is displayed. This capability effectively reduces the noise level by a factor 16 compared with a single acquisition measurement.For the measurement of jitter or the investigation of minor instability the Envelope mode is available in both models. This mode displays the accumulated signal over a period of time so that the boundaries of the input signal can be easily measured. In the PM 3365A and PM 3375 both these facilities work in the sequential sampling mode so the full 100 MHz bandwidth is available for signal analysis.

PM 3365A & PM 3375

Advanced Cursors

Analysis of captured signals couldn't be easier than with the PM 3365A and PM 3375. Independent control allows positioning of the two cursors to perform measurements on exactly the part of the waveform of interest. With signal tracing cross-hair cursors, parallax errors and the inconvenience of manual measurements are eliminated. No calculations are needed; signal voltages and time differences are read directly from the crisp, clear display and all important pulse characteristics including signal frequency, period, pulse width and rise and fall times are automatically calculated. Amplitude can be measured as peak-peak, RMS, mean and absolute voltage referenced to signal ground.

This advanced performance is easily accessed, through intuitive softkey menus, and simply executed in most cases with a single push of a button. Remote control allows access to distributed computing power; the scope will itself analyze trace data for a frequency measurement and return the result.

Delayed Timebase Referencing

When examining fine detail within a signal cycle it is necessary to expand the section of interest while maintaining a complete cycle display. Analog scopes do this by delayed sweep, where the main timebase (MTB) is slow and the delayed timebase (DTB) is at a much faster speed, to give greater time resolution on a specific part of the signal. To see any part of the wave in detail and not just a portion from the trigger point on, the second timebase sweep is delayed by a user-specified time interval relative to the MTB. At the same time reference of the detailed part to its position in the cycle is displayed on the MTB waveform by an intensified zone.

In the PM 3365A and PM 3375, a similar function is available with the AUTOZOOM feature. A waveform is stored in the reference memory and displayed on screen, and acquisition takes place over a portion of the waveform, defined by cursors positioned by the user on the reference. If the cursors are moved towards each other, the acquisition timebase is automatically increased or 'zoomed' and so resolution and sample rate are higher only in the area between the cursors. For examination of any point, both cursors can be tracked together left and right across the screen over the reference trace, delaying acquisition to that point. This delayed timebase referencing makes signal capture and analysis fast, efficient and simple over the full 100 MHz bandwidth.

Complete Ease of Use

All the PM 3365A and PM 3375 functions are easy to use in all applications. The AUTOSET push button gives instant, optimal display of any input signal. The separate, clear LCD gives all relevant set-up information, so there is no searching of a crowded front panel.

Ease of use also comes through clear menu structures and softkey positioning on screen. You can keep your attention focused on the trace even when performing tasks such as cursor measurements.

Settings and Reference Memories

Up to 64 front panel settings can be stored in the PM 3365A and PM 3375. These can be set or recalled at the touch of a button enabling specific setups for production or service applications to be accurately duplicated each and every time. In system control environments it is also possible to set and recall each setting remotely.

The large 12k memory is divided into three sections each containing up to 2 traces. Each of these trace memories can be displayed with the main acquisition memory for comparison of old and new trace information.

IEEE-488 or RS 232 C Interface

Both the PM 3365A and PM 3375 are available with IEEE 488 or RS 232C interfaces. With either of these interfaces full control of all push button functions and trigger level is possible as well as the sending of operator screen messages. The simple programming language used to facilitate remote control enables rapid program development or interactive control of these products. This is further enhanced by the capability of these instruments to dump their current settings to a controller in a packed binary format. Each setting made like this can be reloaded at a later date and stored as a front panel setup. By calling front panel setups with a single control command the complete instrument is reconfigured to the required setting. In ATE or remote service applications this drastically reduces interface traffic and appreciably speeds system throughput.

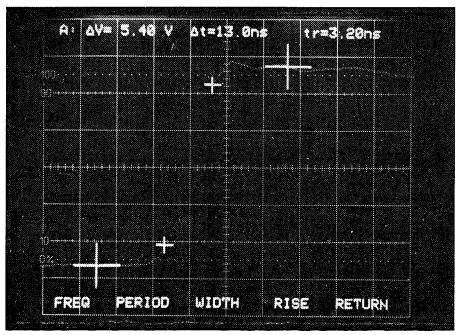
In addition software support in the form of the PM2230 Instrument Driver Software or the PM 2240 Test Team Software packages fully support these products to further lower the burden of their integration into system or interactive control environments.

Documentation and Hard Copies

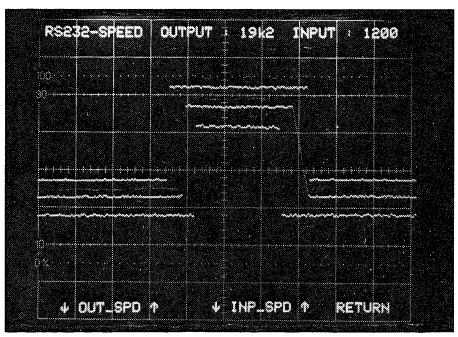
The PM 3365A and PM 3375 have several options for making hard copies of waveforms. An analog output to drive an X-Y recorder with pen lift control provided as standard. Digital plotters or printers can be driven directly via the optional IEEE-488 or RS 232 ports. Philips GL and HPGL compatible plotters are supported as well as dot-matrix printers, such as the Epson FX 80 and compatibles, and HP Thinkjet®.

Automatic testing

The modular construction of the PM 3365A and PM 3375 brings a major benefit as thorough testing, at module level is effected before building into a complete instrument. Each module passes through a computerized test station where it is given a complete functional test and adjustments are made. There is thus no chance of a complete instrument containing a faulty module. As a check, complete instruments have to pass a test routine, an extended burn-in period and then, a final series of tests. Thus, through such a rigorous test procedure, last minute defects are eliminated ensuring a long, trouble-free service life for the instrument.No matter what your application, PM 3365A and PM 3375 not only offers very powerful, advanced functions but is easy-to use. These characteristics make it the ideal instrument for use in development and production environments.



1. Once the signal is digitized, full advantage can be taken of the PM 3365A's or PM 3375's extensive calculation facilities. Here, for example, measuring fast rise time of just a few nanoseconds.



2. Full IEEE 488 or RS 232C interfacing makes the PM 3365A or PM 3375 ideal for automated tests. Structured programming codes allow fast development of programs, and on board measurement facilities allow transmission of results rather than kilobytes of raw data.

Specifications

Technical Specifications

Analog Mode

Vertical
Display Modes: ChA, ChB, -ChB, ChA + ChB, ChA - ChB (ALTernate or CHOPped)
Frequency Response:
DC...>100 MHz, -3 dB (20 mV/div...10 V/div)
DC...>75 MHz, -3 dB (2 mV/div...10 mV/div)
AC, lower -3 dB point is <10 Hz
Risetime: <3.5 ns (20 mV/div...10 V/div)
<4.5 ns (2 mV/div...10 mV/div)
Deflection Coefficient: 2 mV/div...10 V/div in 1, 2, 5 sequence
Error Limit: ±3% continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting
Input Impedance: 1 MΩ ±2%//20 pF ±2 pF
Max. Input Voltage: 400 V (DC + AC peak)
Dynamic Range: >24 div at 10 MHz, >8 div at 100 MHz
CMRR: 100:1 at 1 MHz

Horizontal

Display Modes: Timebase, or XY displays using ChA and/or ChB (vertical) and ChA, ChB or Ext. (horizontal)
Timebase: 0.5 s/div...50 ns/div in steps of 1, 2, 5 sequence
Expansion: x10, fastest sweep speed 5 ns/div Error Limit: ±3%, in x10; ±4%. Continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep
Trigger Sources: ChA, ChB, composite (ChA, ChB), Ext. (DC or AC), Line. LCD indicates not-triggered, triggered or armed status
Trigger Coupling: Auto peak-to-peak (P-P), DC, TVF, TVL. PM 3375 also has LF reject and HF reject (filter point at 50 kHz)
Trigger Sensitivity:

	Int.	Ext.
10 MHz	0.5 div	50 mV
100 MHz	1.2 div	150 mV
150 MHz	2.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope: Positive or negative, TVF or TVL positive or negative video

X-Deflection

Deflection coefficient:
Via ChA or ChB: 2 mV/div...10 V/div
Via Ext input: 100 mV/div
Frequency response: DC to 2 MHz
Error Limit: ±5%
Phase Shift: <3° (at 100 kHz)
Ext. Input Impedance: 1 MΩ ±2%//20 pF ±2 pF
Max. Input Voltage: 400 V (DC + AC peak)

Digital Mode

All specifications as analog part unless otherwise stated

Vertical
Resolution: 8-bit
Display Modes: ChA, ChB, -ChB. Average and Envelope possible in all three modes.
Frequency Response:
DC...>100 MHz, -3 dB (20 mV/div...10 V/div);
DC...>75 MHz, -3 dB (2 mv/div...10mV/div);
repetitive sampling to full bandwidth

Horizontal
Acquisition modes: Recurrent, single shot, multiple shot (up to 2), autozoom

Timebase
Recurrent: PM 3365A 0.2 µs/div...20 ns/div (repetitive sampling)
PM 3375 0.1 µs/div...20 ns/div (repetative sampling)
Single Shot, Multiple Shot:
PM 3365A 0.5 s/div...0.5 µs/div
PM 3375 0.5 s/div...0.2 µs/div
Roll: 50 s/div...1 s/div
Timing Accuracy: ±0.1%
Display Expansion: x1...x32

Horizontal Resolution

Single Channel:
50 s/div...5 ms/div; 4096 samples/acquisition
2 ms/div...20 ns/div; 512 samples/acquisition
Dual Channel:
50 s/div...5 ms/div; 2048 samples/acquisition
2 ms/div...20 ns/div; 512 samples/acquisition

Signal Acquisition

Maximum Sample Rate:
PM 3365A 100 MS/s, synchronously for both channels
PM 3375 250 MS/s, synchronously for both channels
Equivalent Time Sample Rate: 2.5 GS/s
Trigger Delay:
PM 3365A 10 div. pre-trigger to 2500 div. post trigger
PM 3375 10 div. pre-trigger to 5000 div. post trigger
Display Expansion: x1...x32 horizontal

Memory

Number of Storage Memories: 4
No of Traces Stored in Each Memory: up to 2
Depth of Acquisition Memory: 4096 words
Depth of Reference Memory: 4096 words in each of 3 memories
Vertical Memory Resolution: 8-bit
Display Modes: ChA, ChB (from acquisition memory), Reg A, Reg B (from one of the three reference memories), in any combination

Acquisition Processing

Average: Continuous when activated. Selectable at 2, 4, 8, 16, 32, 64, 128, 256 times. Each shot contains the number of acquisition equal to the average factor selected.
Envelope: Continuous when activated. Works on an incremental basis.

Cursors

Horizontal Resolution:
Single channel; 1:4096 over 10 divisions
Dual channel; 1:2048
2 ms/div...20 ns/div; 1:512 (1:1024 in dot join)
Vertical Resolution: 1:256 over 10 divisions
Read Out Resolution: 3 digits amplitude and time
Calculation Functions: dV, Vpk-pk, Vrms, Vmean, Vabs, dt, Freq, Period, Width, Rise/Fall time

Analog Output for XY recorders

Output level: 1V/full memory ± 3%
Penlift: TTL level selectable 0 or 1
Plot Time/Sample: 20 ms ... 2000 ms selectable
Connector: 9 pin D type, male/female
Function: Memory dump, acquisition or reference memory selectable

Interface Options

IEEE-488 (Option /40n)
Bus Driver: E2 (three state)
Function Available: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C (Option /50n)
Handshake: Software XON/XOFF, hardware DSR/DTR and CTS/RTS
Baudrate: Transmit 75...19200, Receive 75...1200
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Digital Plot Output (with option /40n or /50n)
Language: HPGL or Philips GL dependent on plotter type selected
Plotter Select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155 HP7450, HP7475A
Pen Select: Pen 1 for ChA
Pen 2 for ChB
Pen 3 for Register A
Pen 4 for Register B
Pen 5 for graticule and alpha-numerics
Plot Area: Softkey selectable

Dot Matrix Printer Output (with option /40n or /50n)
Screen Dump: Compatible with Epson FX80 and HP Thinkjet ® graphics protocol or compatibles
Drawing Area: 10 cm x 10 cm

PM 3365A & PM 3375

General Specifications

Miscellaneous

Display
Screen: CRT with 8 x 10 cm viewing area; P31 phosphor, 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
Graticule: Parallax-free with continuously variable illumination.
LCD Display: Separate constantly backlit LCD for display of status information, settings etc.
Autoset: Selects correct channels, vertical deflection, timebase speed and triggering for easy to read display of input signals

Power Supply

Line Voltage Range: 100 V...240 V AC ±10%
Line Frequencies: 50 Hz...400 Hz ±10%
Power Consumption: PM 3365A 75 W, PM 3375 85 W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle, 350 mm (13.8 in) excl. handle
Length:531 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle, excl. knobs
456 mm (17.9 in) excl. handle, incl. knobs
434 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet, 134.5 mm (5.3 in) excl. feet
Weight: Approx 9.5 kg (20.9 lbs) excl. accessories

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Operating Range: 0°C...+40°C
Storage: -40°C...+75°C
Altitude
Operating: 4500 m (15000 ft)
Transport: 12000 m (40000 ft)
Vibration: Frequency 5...55 Hz, 15 minutes along each of the 3 axes, with a maximum acceleration of 3 g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Shock: Operating and non operating: Max acceleration 30 g, 1/2 sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD-810 method 516,procedure V
Safety: Meets requirements of IEC 348 class 1, VDE 0411, UL 1244, CSA556 B
Included with the instrument: Operating manual, blue contrast CRT, 2 x 10:1 passive probes with scale readout factor

Ordering Information

Models

PM 3365A/00n 100 MS/s, 100 MHz DSO
PM 3367A/00n 100 MS/s, 100 MHz DSO, rackmounted
PM 3375/00n 250 MS/s, 100 MHz DSO
PM 3377/00n 250 MS/s, 100 MHz DSO, rackmounted
Note:n specifies power cord required

Options

When ordering, select on of the standard model numbers listed above and add configuration number listed below as suffix:

PM 33../40n IEEE-488 (GPIB) interface
PM 33../50n RS 232 interface

Accessories

Passive Probes

PM 8922/501 1:1 or 10:1 probe, cable length 1.5 m (5 ft)
PM 8924/001 1:1 probe, cable length 1.5 m (5 ft)
PM 8924/201 1:1 probe, cable length 2.5 m (8 ft)
PM 8926/591 10:1 probe with readout, cable length 1.5 m (5 ft)
PM 8926/291 10:1 probe with readout, cable length 2.5 m (5 ft)
PM 8931/091 20 MΩ 100:1 probe with readout

Active Probes

PM 8917/00n Video line selector
PM 8940/09n High voltage isolation amplifier with readout
PM 8943/00n 650 MHz FET probe
PM 9355/09n AC current probe with readout

Other Accessories

PM 9051/001 BNC to 4 mm banana adapter
PM 9381/001 Oscilloscope camera
PM 8902/001 12 V dc power convertor
PM 8991/041 Oscilloscope trolley
PM 8999/001 Oscilloscope stand
PM 8992/651 Accessory pouch
PM 8957A/001 Retrofittable IEEE-488 (GPIB) interface
PM 8958A/001 Retrofittable RS 232 C interface
PM 8988/001 Protective front panel cover
PM 9076/011 Analog plot cable to Amphenol connector
PM 9076/021 Analog plot cable to banana plug
PM 2195/09 Probe Switch 400 MHz
PM 2122 50Ω coaxial switch
PM 223x Instrument Drivers Software
PM 2240 TestTeam Software
PM 2260 Oscilloscope Signal Processing Software

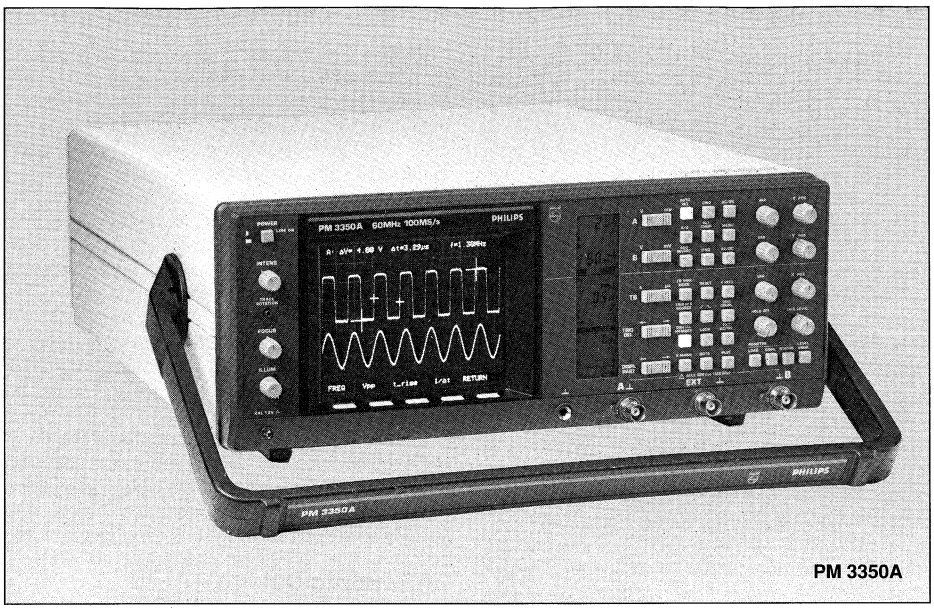
For full details of all accessories, see page 44

PM 3350A & PM 3355

GPIB IEEE-488

RS-232

NEW



PM 3350A

PM 3350A & PM 3355 Digital Storage Oscilloscopes

- Sample rates of 100 MS/s or 250 MS/s on each channel
- Synchronous sampling on both channels
- 60 MHz analog bandwidth with 100 MHz triggering on both models
- Operate as an analog oscilloscope or as fast digital storage oscilloscope
- 64 Front Setting Memories
- 12k Reference memory stores up to 6 reference traces
- AUTOSET for instant on-screen trace display in both operating modes
- Advanced cursors for automatic measurements of voltage and time parameters
- Average and Envelope display modes
- Dual Timebase Referencing with Autozoom

Analog and Digital

The PM 3350A and PM 3355 are the answer to many DSO measurement requirements, offering a combination of the best of real-time and digital storage oscilloscope technology. Both models contain high power digital storage scope capabilities for capture and analysis of single events and repetitive signals. For those applications where real-time oscilloscopes are needed or convenient full 60 MHz analog oscilloscope facilities are available.

These products are not simply analog scopes with "add-on" digital features but have fully implemented DSOs with real-time capabilities. The PM 3355 storage sampling rate "benchmark" is a very high maximum 250 Msamples/s for each channel simultaneously. This very high sampling frequency allows storage of fast signals with excellent resolution. Maximum single event resolution is just 4 ns.

Analog Shift Register

Both the PM 3350A and PM 3355 use a P^2CCD (or Profiled Peristaltic Charge Coupled Device), a solid state combination of a fast track-and-hold input circuit and an analog shift register. Momentary values of input signals in analog samples are captured with intervals as short as 4 ns (250 Msamples/s clock). After triggering these samples are presented to an accurate, successive approximation ADC at a much slower 100 ksamples/s. Digitizing is thus internally a low frequency operation, giving high resolution, yet not sacrificing the very high data capture rate of upto 250 Msamples/s. This ensures single shot events are captured and displayed to a bandwidth of over 25 MHz, with 10 sample points per period. Indeed, the fast sampling rate of PM 3350A and PM 3355 bring an unparalleled breakthrough in DSO performance in this price range.

Deep Memory

At lower timebase, signals measured at speeds up to 5 ms/div are stored in a 4 kbytes x 8-bit memory. Data from the memory can be transferred to one of the three reference memories which are each 4 kbytes x 8-bit memory. This allows storage and display of reference waveforms while at the same time, capturing and displaying live signals from the device under test. In addition to the 2 input channel traces another 6 reference traces may be stored and up to 4 traces may be displayed at any one time.

Simultaneous Sampling

Unlike many DSOs in the PM 3350A's or PM3355's class, the maximum sample rate is maintained even when both channels are in use. It's essential that sample rate is not reduced in two channel acquisition, because sample rate determines the effective single shot bandwidth, and this is one of the critical specifications for a DSO. The PM 3355 offers full 250 MS/s on both channels simultaneously, which also means no time errors are caused by sample multiplexing in capture from channel to channel. Furthermore, the resolution is maintained at a very high 4 ns.

Extending single shot applications further, the PM 3350A and PM 3355 incorporate a multishot capability. The second reference memory effectively doubles single shot memory depth, by first capturing a single shot in the acquisition memory (which itself can be as long as 4 k words). Then it is dumped into one of the reference memory (again a deep 4 k). The scope re-arms and takes the next once-off signal, so capturing 2 events. These signals may be close in time (within 50 ms) or may be many hours apart. Combined with the high sample rate, this flexibility is a great help in tracking down elusive intermittent faults.

Low Frequency Signal Registration

As well as fast signal capture both models have a 50s/div facility giving a visual display lasting 8 minutes, allowing low frequency phenomena to be studied. The signal can be frozen at any time by pressing a single button. This is useful for study of chemical or biological reactions and responses, or for slow mechanical "wear and tear" cycling. In fact the roll facility, as it is known, is used in a similar way to a paper and pen recorder.

Triggering Functions

The PM 3350A and PM 3355 have a wide selection of powerful trigger capabilities, including Automatic, Manual and Single shot settings. In addition, microcomputer control supplies a built-in intelligence that completely eliminates operator adjustment in auto-triggering mode, making operation simpler and more accurate. TV line and frame for positive and negative video, alternate, auto P-P or DC, ext. and line trigger as well as LF and HF reject filters on the PM 3355 are all

included in the triggering facilities. With a trigger bandwidth of 100 MHz stable triggering is assured on even the fastest signals.

Pretrigger and Posttrigger Delay Capabilities

A major advantage of a digital storage scope is its ability to define precisely the portion of the waveform to be captured before or after the trigger. Both models have a pre-trigger capability of up to 10 divisions, allowing events leading up to the trigger moment to be captured and viewed. For example in transient waveforms, the whole of the leading edge may be recorded rather than just from the trigger moment on. Furthermore, the PM 3355 has a capability of posttrigger (i.e. the time delay after the trigger point) for up to 5000 divisions (2500 for the PM3350A) so that records of over 500 screen widths of information can be captured and displayed. This effectively stretches the memory depth of these instruments as any occurence within this large delay range can be accurately examined.

Autoset plus User Settings

Accessed by a single button, the Autoset function allows instant setting of all scope parameters for any input signal, eliminating time-consuming manual range finding and fine adjustment. AUTOSET operates in the Digital Storage mode, as well as when operating in the Real Time analog mode.

For production and service applications, where the same setting needs to be accurately duplicated from time to time, both the PM 3350A and PM 3355 have 64 front panel settings. Each setting can be loaded or called from the front panel or from the IEEE 488 or RS 232C interface.

Advanced Cursors

Analysis of captured signals couldn't be easier than with the PM 3350A or PM 3355. Independent control allows positioning of the two cursors to perform measurements on exactly the part of the waveform of interest. With signal tracing cross-hair cursors, parallax errors and the inconvenience of manual measurements are eliminated. No calculations are needed; signal voltages and time differences are read directly from the crisp, clear display and all important pulse characteristics including signal frequency, period, pulse width and rise and fall times are automatically calculated. Amplitude can be measured as peak-peak, RMS, mean and absolute voltage referenced to signal ground.

This advanced performance is easily accessed, through intuitive softkey menus, and simply executed in most cases with a single push of a button. Remote control allows access to distributed computing power; the scope will itself analyze trace data for a frequency measurement and return the result.

Average and Envelope Modes

Often on low level signals spurious noise can mask the real signal of interest. To reveal the true signal of interest both the PM 3350A and PM 3355 are equipped with and averaging capability by which the average signal of upto 256 acquisitions is displayed. This capability effectively reduces the noise level by a factor 16 compared with a single acquisition measurement. For the measurement of jitter or the investigation of unstable signals the Envelope mode is available in both models. This mode displays the accumulated signal over a period of time so that the boundaries of the input signal can be easily measured.

Zooming in on Problems

When examining fine detail within a signal cycle it is necessary to expand the section of interest while maintaining a complete cycle display. Analog scopes do this by delayed sweep, where the main timebase (MTB) is slow and the delayed timebase (DTB) is at a much faster speed, to give greater time resolution on a specific part of the signal. To see any part of the wave in detail and not just a portion from the trigger point on, the second timebase sweep is delayed by a user-specified time interval relative to the MTB. At the same time reference of the detailed part to its position in the cycle is displayed on the MTB waveform by an intensified zone.

In the PM 3350A or PM 3355, a similar function is available with the AUTOZOOM feature. A waveform is stored in the reference memory and displayed on screen, and acquisition takes place over a portion of the waveform, defined by cursors positioned by the user on the reference. If the cursors are moved towards each other, the acquisition timebase is automatically increased or 'zoomed' and so resolution and sample rate are higher only in the area between the cursors. For examination of any point, both cursors can be tracked together left and right across the screen over the reference trace, delaying acquisition to that point. This delayed timebase referencing makes signal capture and analysis fast, efficient and simple.

Low Level Signals

In mechanical applications where very low level signals are normal, the 2 mV/div facility allows direct input to the memory from, for example, a transducer.

X-Y displays

The analog mode enables the display of X-Y diagrams. Filter curves, lissajous figures and other similar phenomena which are not time-related, but have other reference voltages, can then be displayed for further analysis.

Hard Copy and Full Interfacing

Making hard copies is easy with the RS 232 and IEEE-488 interface options. These are produced at the press of a single button. Hard copy to digital plotters using the HPGL and Philips GL protocols, and on printers such as the Epson FX80 and compatibles as well as HP Thinkjet® are supported.

The interfaces also allow simple application in systems environments. Complete system control of all main scope functions is possible by the use of simple programming commands.

In addition both the PM 3350A and PM 3355 can dump their current settings to a controller in a packed binary format. Each setting made like this can be reloaded at a later date and stored as a front panel setting. By calling a front panel setting with a single control command the complete instrument is reconfigured to the required setting. In ATE or remote service applications this drastically reduces interface traffic and appreciably speeds system throughput.

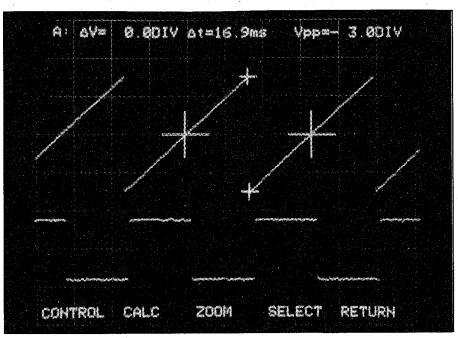
Ergonomic Design

Much attention has been paid to the operator interface on these products. All the innovations on the Philips 60 MHz and 100 MHz oscilloscopes are utilized, resulting in a front panel layout that is much clearer, simpler and easier to use than on conventional scopes. Significant and new features are:

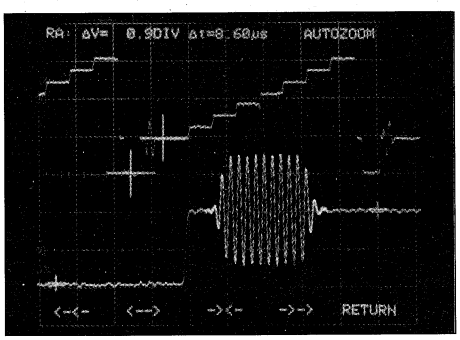
- LCD panel for direct read-out. The LCD panel is directly alongside the screen and gives a clear, at-a-glance alphanumeric read-out of settings, eliminating the need to look at control positions set on a crowded front panel.
- Fast-action up/down controls. Ranges and settings are entered by fast, fingertip-action controls.
- Menu-driven softkeys. Functions such as timebase and trigger settings are softkeyed, with a step-through function sequence. Selected functions are clearly indicated at all times on the LCD panelo
- Logical panel layout. Variable settings like Y-pos. and X-pos., trigger levels and hold-off are grouped together on the right of the front panel; display settings are grouped on the left of the CRT. The result is a clear panel layout that simplifies and speeds operation.

Modular design, easy service

The modular design and construction of the PM 3350 and PM 3355 DSOs provides exceptional component accessibility, making service fast, simple and low-cost. Swing-up PCBs allow easy access and removal is straightforward, due to the plug-in flat ribbon cable connections. Repairs in the field are quickly performed by simply replacing damaged modules. A complete, built-in software-driven test routine assures correct operation within minutes via on-screen test displays with instruction text.



Automatic Pk-Pk measurement between main cursors. The secondary cursors indicate where the positive and negative peak measurement is made.



Delay Time Referencing enables a burst within a video signal to be examined while still displaying the complete signal. This is directly equivalent to the delayed timebase function on an analog oscilloscope

Specifications

Technical Specifications

Unless stated all specifications refer to both PM 3350A and PM 3355.

Analog Mode

Vertical
Display Modes: ChA, ChB, -ChB, ChA+ChB, ChA-ChB (ALTernate or CHOPped)
Frequency Response:
DC...>60 MHz, -3 dB (20 mV/div...10 V/div)
DC...>35 MHz, -3 dB (2 mV/div...10 mV/div)
AC, lower -3 dB point is <10 Hz
Risetime:
<5.8 ns (20 mV/div...10 V/div)
<10 ns (2 mV/div...10 mV/div)
Deflection coefficient: 2 mV/div...10 V/div in 1, 2, 5 sequence
Error Limit: ±3% continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting
Input Impedance: 1 MΩ ±2% //20 pF ±2 pF
Max. Input Voltage: 400 V (DC + AC peak)
Dynamic Range: >24 div at 10 MHz, >8 div at 60 MHz
CMRR: 100:1 at 1 MHz

Horizontal

Display Modes: Timebase, or XY displays using ChA and/or ChB (vertical) and ChA, ChB or Ext. (horizontal)
Timebase: 0.5 s/div...50 ns/div in steps of 1, 2, 5 sequence
Expansion: x10, fastest sweep speed 5 ns/div
Error Limit: ±3%, in x10; ±4%. Continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Triggering

Trigger Modes: Auto (free run), non-auto triggered, single sweep
Trigger Sources: ChA, ChB, composite (ChA, ChB), Ext. (DC or AC), Line. LCD indicates not-triggered, triggered or armed status
Trigger Coupling: Auto peak-to-peak (P-P), DC, TVF, TVL. PM 3355 also has LF reject and HF reject (filter point at 50 kHz)

Trigger Sensitivity:

	Int.	Ext.
10 MHz	0.5 div	50 mV
50 MHz	1.0 div	150 mV
100 MHz	3.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope: Positive or negative, TVF or TVL positive or negative video

X-Deflection

Deflection coefficient:
Via ChA or ChB: 2μmV/div...10μV/div
Via Ext input: 100 mV/div
Frequency Response: DC to 2 MHz
Error Limit: ±5%
Phase Shift: <3± (at 100 kHz)
Ext. Input Impedance: 1 MΩ ±2%//20 pF ±2 pF
Max. Input Voltage: 400 V (DC + AC peak)

Digital Mode

All specifications as analog part unless otherwise stated

Vertical
Resolution: 8-bit
Display Modes: ChA, ChB, -ChB. Average and envelope possible in all three modes.
Frequency Response:
PM 3350A DC...>20 MHz, -3 dB (2 mV/div... 10 V/div)
PM 3355 DC...>20 MHz, -3 dB (2 mV/div... 10 mV/div)
DC...>35 MHz, -3 dB (20 mV/div... 10 V/div)

Horizontal
Acquisition modes: Recurrent, single shot, multiple shot (up to 2), autozoom
Timebase
Single Shot, Multiple Shot:
PM 3350A 0.5 s/div... 0.5 μs/div
PM 3355 0.5 s/div...0.2 μs/div
Roll: 50 s/div...1 s/div
Timing Accuracy: ±0.1%
Display Expansion: x1...x32

Horizontal Resolution

Single Channel:
PM 3350A/55: 50 s/div...5 ms/div; 4096 samples/acquisition
PM 3350A: 2 ms/div...0.5 μs/div; 512 samples/acquisition
PM 3355: 2 ms/div...0.2 μs/div; 512 samples/acquisition
Dual Channel:
PM 3350A/55: 50 s/div...5 ms/div; 2048 samples/acquisition
PM 3350A: 2 ms/div...0.5 μs/div; 512 samples/acquisition
PM 3355: 2 ms/div...0.2 μs/div; 512 samples/acquisition

Signal Acquisition

Maximum Sample Rate:
PM 3350A: 100 MS/s, synchronously for both channels
PM 3355: 250 MS/s, synchronously for both channels
Trigger Delay:
PM 3350A 10 div. pretrigger to 2500 div. posttrigger
PM 3355 10 div. pretrigger to 5000 div. posttrigger
Display Expansion: x1...x32 horizontal

Memory

Number of Storage Memories: 4
No of Traces Stored in Each Memory: up to 2
Depth of Acquisition Memory: 4096 words
Depth of Reference Memory: 4096 words in each of 3 memories
Vertical Memory Resolution: 8-bit
Display Modes: Ch A, Ch B (from acquisition memory), Reg A, Reg B (from one of the three reference memories), in any combination

Acquisition Processing

Average: Continuous when activated. Selectable at 2, 4, 8, 16, 32, 64, 128, 256 times. Each shot contains the number of acquisitions equal to the average factor selected.
Envelope: Continuous when activated. Works on an incremental basis.

Cursors

Horizontal Resolution
Single channel; 1:4096 over 10 divisions
Dual channel; 1:2048
2 ms/div...0.2 μs/div; 1:512 (1:1024 in dot join)
Vertical Resolution: 1:256 over 10 divisions
Read Out Resolution: 3 digits amplitude and time

PM 3350A & PM 3355

Calculation Functions: dV, Vpk-pk, Vrms, Vmean, Vabs, dt, Freq, Period, Pulse Width, Rise/Fall time

Analog Output for XY recorders

Output level: 1V/full memory ± 3%
Penlift: TTL level selectable 0 or 1
Plot Time/Sample: 20 ms ... 2000 ms selectable
Connector: 9 pin D type, male/female
Function: Memory dump, acquisition or reference memory selectable

Interface Options

IEEE-488 (Option /40n)
Bus Driver: E2 (three state)
Function Available: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C (Option /50n)
Handshake: Software XON/XOFF, hardware DSR/DTR and CTS/RTS
Baudrate: Transmit 75...19200, Receive 75...1200
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Digital Plot Output (with option /40n or /50n)
Language: HPGL or Philips GL dependent on plotter type selected
Plotter Select: Philips PM 8153/1, PM 8153/6, PM 8154, PM 8155 HP7450, HP7475A
Pen Select: Pen 1 for ChA
Pen 2 for ChB
Pen 3 for Register A
Pen 4 for Register B
Pen 5 for graticule and alphanumerics
Plot Area: Softkey selectable

Dot Matrix Printer Output (with option /40n or /50n)
Screen Dump: Compatible with Epson FX80 and HP Thinkjet® graphics protocol or compatibles
Drawing Area: 10 cm x 10 cm

General Specifications

Miscellaneous

Display

Screen: CRT with 8 x 10 cm viewing area; P31 phosphor, 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
Graticule: Parallax-free with continuously variable illumination.
LCD Display: Separate constantly backlit LCD for display of status information, settings etc.
Autoset: Selects correct channels, vertical deflection, timebase speed and triggering for easy to read display of input signals

Power Supply

Line Voltage Range: 100 V...240 V AC ±10%
Line Frequencies: 50 Hz...400 Hz ±10%
Power Consumption: PM 3350A 70 W, PM 3355 80 W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle, 350 mm (13.8 in) excl. handle
Length:
531 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle, excl. knobs
456 mm (17.9 in) excl. handle, incl. knobs
434 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet, 134.5 mm (5.3 in) excl. feet
Weight: Approx 9.5 kg (20.9 lbs) excl. accessories

Environmental Data

Meets requirements of MIL-T-28800 C, Class 5, Style D
Temperature
Rated Range of Use: +10°C...+40°C
Operating Range: 0°C...+40°C
Storage: -40°C...+75°C
Altitude
Operating: 4500 m (15000 ft)
Transport: 12000 m (40000 ft)
Vibration: Frequency 5...55 Hz, 15 minutes along each of the 3 axes, with a maximum acceleration of 3 g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Shock: Operating and non operating: Max acceleration 30 g, 1/2 sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD-810 method 516,procedure V
Safety: Meets requirements of IEC 348 class 1, VDE 0411, UL 1244, CSA 556B
Included with the instrument: Operating manual, blue contrast CRT filter, 2 x 10:1 passive probes with scale factor readout

Ordering Information

Models

PM 3350A/00n 100 Ms/s, 60 MHz DSO
PM 3352A/00n 100 Ms/s, 60 MHz DSO, rackmounted
PM 3355/00n 250 Ms/s, 60 MHz DSO
PM 3357/00n 250 Ms/s, 60 MHz DSO, rackmounted
Note:n specifies power cord required

Options

When ordering, select on of the standard model numbers listed above and add configuration number listed below as suffix:
PM 335./40n IEEE-488 (GPIB) interface
PM 335./50n RS 232 interface

Accessories

Passive Probes

PM 8922/501 1:1 or 10:1 probe, cable length 1.5 m (5 ft)
PM 8924/001 1:1 probe, cable length 1.5 m (5 ft)
PM 8924/201 1:1 probe, cable length 2.5 m (8 ft)
PM 8926/591 10:1 probe with readout, cable length 1.5 m (5 ft)
PM 8926/291 10:1 probe with readout, cable length 2.5 m (5 ft)
PM 8931/091 20 MΩ 100:1 probe with readout
Active Probes
PM 8917/00n Video line selector
PM 8940/09n High voltage isolation amplifier with readout
PM 8943/00n 650 MHz FET probe
PM 9355/09n AC current probe with readout

Other Accessories

PM 9051/001 BNC to 4 mm banana adapter
PM 9381/001 Oscilloscope camera
PM 8902/001 12 V dc power convertor
PM 8991/041 Oscilloscope trolley
PM 8999/001 Oscilloscope stand
PM 8992/651 Accessory pouch
PM 8957A/001 Retrofittable IEEE-488 (GPIB) interface
PM 8958A/001 Retrofittable RS 232 C interface
PM 8988/001 Protective front panel cover
PM 9076/011 Analog plot cable to Amphenol connector
PM 9076/021 Analog plot cable to banana plug
PM 2195/09 Probe Switch 400 MHz
PM 2122 50 Ω coaxial switch
PM 223x Instrument Drivers Software
PM 2240 TestTeam Software
PM 2260 Oscilloscope Signal Processing Software

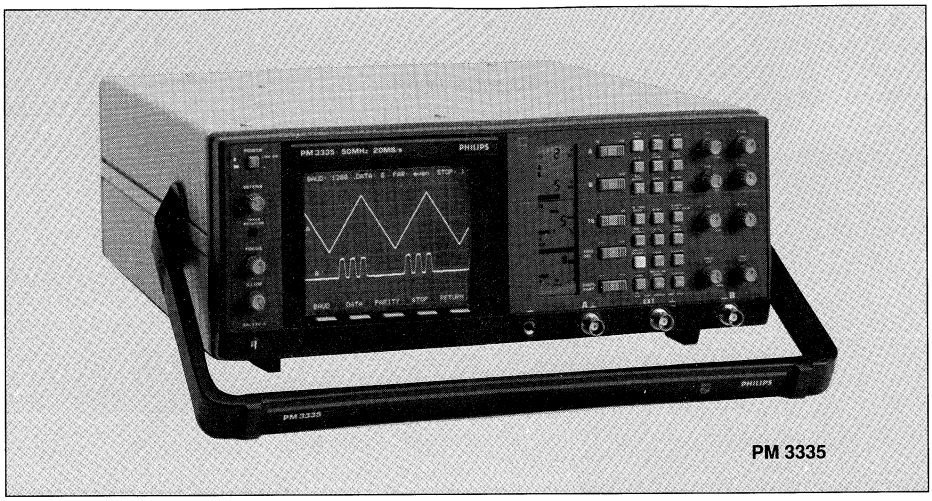
For full details of all accessories, see page 44

PM 3335

T&M EXPRESS LINE

GPIB IEEE-488

RS-232



PM 3335, 60 MHz, 20 MS/s Digital Storage Oscilloscope

- 20 MS/s sample rate on each channel simultaneously
- 60 MHz real time analog bandwidth
- Deep 8 kbytes x 8-bit waveform acquisition memory even at max. sample rate
- Second reference memory for comparison of waveforms
- Analog oscilloscope plus full function Digital Storage Oscilloscope
- AUTOSET for instant on-screen trace display
- Standard cursors for many on-screen measurements
- GPIB/IEEE-488 and RS 232 interface options

Two Scopes in One

Philips new PM 3335 sets a standard in performance and economy. This instrument is two professional scopes in one: it operates as a real-time 60 MHz analog oscilloscope and at the touch of a button, becomes a full function digital oscilloscope for advanced applications. Now, for the first time in a cost-effective scope, you have the power for digital capture and analysis of elusive single shots with a full 20 MS/s sample rate on each channel simultaneously. Unlike some scopes in this class, the full sample rate is maintained for all channel combinations, giving a single event resolution of 50 ns for both channels. Repetitive signal analysis is also possible up to 60 MHz in analog oscilloscope mode. A x10 expansion allows 5 ns sweep speeds for detailed viewing and furthermore, with the 100 MHz trigger bandwidth, you have a higher trigger sensitivity over the full range.

Extensive Memory Capability

It is vital in a DSO, that the memory be large enough to capture all the data in the intended areas of use. The PM 3335 will be used in automotive, medical, mechanical, video and general electronics industries, as well as in education and training. Here, scopes must capture typical waveforms over a full cycle and have an adequate sample resolution to show fine details within cycle. Typical examples here are in video waveforms or engine injection cycles. With its deep 8 kbytes x 8-bit acquisition memory and 20 MS/s sample rate, the PM 3335 fully meets this requirement — indeed no other instrument in this price class has such a large memory.

For waveform comparison, a second reference memory is available. The full 8 kbytes x 8-bit memory allows storage and display of up to 2 reference waveforms. Together with the 2 live waveforms from the acquisition memory, a total of 4 waveforms can be displayed.

Measurement Cursors as Standard

Independent voltage and time cursors make signal parameter extraction both accurate and fast. Along with measurement of voltage and time differences (dV, dt), the measurement functions include selection of ratio, phase and track. To aid the user further, a simple frequency calculation is made by 1/dt.

Positioning cursors on the easily identified 10% and 90% of peak-to-peak value gives a rise/fall time readout. Cursors are particularly valuable in dc measurements where any point on the captured waveform can be measured to reference ground. This further extends use of the cursors so that readouts can show not only difference results on a single trace, but also from trace to trace.

Powerful Triggering

The PM 3335's deep memory can also be used to show extensive pretrigger information. Unlike a conventional scope, a DSO can pretrigger, i.e. capture and display events prior to a trigger. A DSO continuously acquires data until stopped by detection of a valid trigger signal, rather than starting the sweep on detection of the trigger, like an analog oscilloscope. Thus all samples captured by the DSO are effectively in "negative time" and contain pretrigger waveform information.

This function is very useful in showing, for example, the complete leading edge of a pulse waveform for rise/fall time measurement (compared to an analog scope that can only show the edge form from the trigger moment on). Another example is to examine preshoot signals or transients leading up to the trigger edge. In the PM 3335, up to 20 divisions of pretrigger information can be captured and analyzed.

Two Interfaces in One

The PM 3335 has communication facilities normally only expected in instruments in much higher price ranges. Its optional interface has both RS 232 and GPIB/IEEE-488* capability. Either can control instrument set-up and transfer waveform data in remote control applications. When combined with the increasing range of programming and control packages, the PM 3335 is ideal for automatic signal capture and analysis. In particular, the software package for Oscilloscope Signal Processing (OSP) PM 2260 enables cross-correlations, algebraic manipulations, FFT and many other manipulations on acquired traces.

Mass storage of captured waveforms is also possible via the interfaces. If the large internal memory of 8 kbytes is insufficient, connect the scope to a PC and run the OSP. Simply answer 'yes' to the prompt 'mass storage?' and the software automatically routes all captured data to external storage. Since PM 2260 is a package specifically designed for handling data from scopes, you need not become involved in making the scope communicate with the external storage — that's all done for you by OSP.

Advanced Plot and Print Capability

The PM 3335 has so many functions not usually found in competitive instruments, it should not come as a surprise that it has extensive plot and print capabilities. The plot function outputs screen copies to industry standard plotters and printers via the optional interface card. Plot language is HPGL or Philips GL, covering virtually all available XY plotters. Screen copies can also be sent to HP Thinkjet, EPSON FX 80 printers or compatible over both interfaces.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3335

Simple to Operate

The PM 3335 offers capabilities never before seen in a cost-effective scope, but this is not at the expense of ease of use. Ergonomics was a vital element in design of the instrument. All the innovations first introduced by on Philips SMART scope range of 60 MHz and 100 MHz analog oscilloscopes are shared by the PM 3335. Innovations such as:

- Direct parameter read-out of the present set-up on an LCD panel for at-a-glance checking of information, avoiding the need to look at control settings on a crowded text plate.
- Fast action up/down controls give finger tip setting of range values quickly and securely. Reliability is guaranteed by cold switching through microprocessor control. All rocker keys are located directly next to the clear LCD for read-out and immediate confirmation of set-up.
- Front panel layout is logical, with similar functions grouped together for instant recognition. All controls that relate to variable settings such as Y-pos or VAR are located on the right hand side of the front panel resulting in a clear layout.
- Softkeys are positioned directly under the CRT display, mounted flush in the screen bezel. Softlabels appear on the screen just above these keys with a readily understandable menu sequence and selection. After acquisition of the signal, attention is focused on the display, avoiding mistakes that can occur when selections are out of the field of vision.

The result is an instrument that is readily understood and easy to use, while offering a versatile capability for fast problem solving.

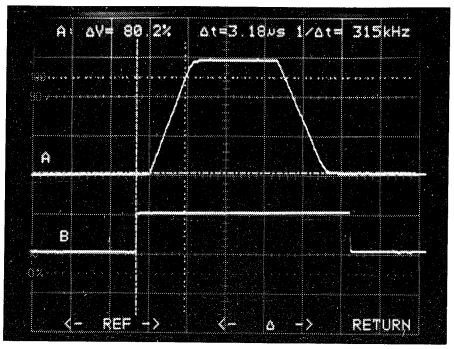
Autoranging, Autoscaling and Autoset

Another first for the PM 3335 is its full function Autoset. A single push of the Autoset button and any signal is automatically scanned and an optimum display of the trace is provided. It is not a factory preset, but is a full autoranging of timebase and amplitude parameters depending on the incoming input signal. In addition, each channel is searched for a signal and if no signals are present, that channel is not displayed to avoid confusing information. Moreover, the Autoset selects the best trigger source for maximum trace stability. No other manufacturer gives you all these facilities for such a low price.

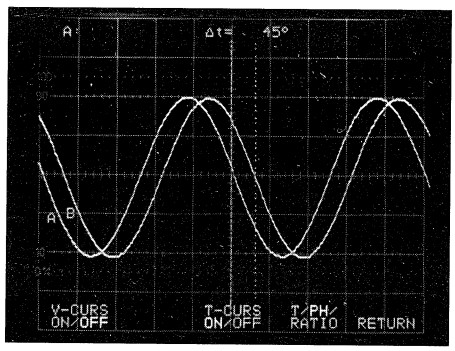
Modular Construction

The PM 3335's modular design and construction gives unparalleled serviceability. Swing up PCB's allow easy access to all circuits, for quick and efficient repair and service. Built in test routines with on screen prompts guide the service engineer quickly to the problem; and a quick check and adjust facility provides verification of the correct functioning of the instrument for reliable measurement results.

The modular construction also allows thorough testing of each module in production, before being built into the complete instrument, after which final functional tests and adjustments are made. This results in reliable instruments that give trouble free operation throughout their life.



Phase measurements between channels are quickly and accurately made thanks to the extensive cursor facilities and the simultaneous acquisition on both channels. Without this simultaneous sampling the timing difference between the channels would result in measurement faults.



Rise times or delay times between channels are simply measured using the 'four way' cursors on the PM 3335.

Specifications

Technical Specifications

Analog Mode

Vertical
Display Modes: ChA, ChB, -ChB, ChA+ChB, ChA-ChB (ALTernate or CHOPped)

Frequency Response:
DC...>60 MHz, -3 dB (20 mV/div...10V/div);
DC...>35 MHz, -3 dB (2 mV/div...10 mV/div);
AC, lower 3 dB point is <10 Hz
Risetime: <5.8 ns (20mV/div...10V/div);
<10 ns (2 mV/div...10 mV/div)
Deflection Coefficient: 2 mV/div...10V/div in 1, 2, 5 sequence
Error Limit: ±3%, continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting
Input Impedance: 1 MΩ ±2%;//20 pF ±2 pF
Maximum Input Voltage: 400V (DC + AC peak)
Dynamic Range: >24 div at 10 MHz,
>8 div at 60 MHz
CMRR: 100:1 at 1 MHz

Horizontal
Display Modes: Timebase, or XY displays using ChA and/or ChB (vertical) and ChA, ChB or Ext (horizontal)
Timebase: 0.5s/div...50 ns/div
in 1, 2, 5 sequence
Expansion: x10, fastest sweep speed 5 ns/div
Error Limit: ±3%; ±4% in x10; continuous control between steps with ">" flashing on LCD panel as warning symbol for uncalibrated setting

Triggering
Trigger Modes: Auto (free run), non-auto triggered, single sweep
Trigger Sources: ChA, ChB, composite (ChA, ChB), Ext (DC or AC); line LCD indicates not-triggered, triggered or armed status
Trigger Coupling: Auto peak-to-peak (P-P), DC, TVF, TVL
Trigger Sensitivity:

	Int	Ext
10 MHz	0.5 div	50 mV
60 MHz	1.0 div	150 mV
100 MHz	3.0 div	500 mV
TVF/TVL	0.7 div sync	70 mV sync
Level range	±8 div	±800 mV

Slope: Positive or negative, TVF or TVL positive or negative

X-Deflection
Deflection Coefficient:
Via Ch A or Ch B, 2 mV/div...10 V/div;
via Ext input, 100 mV/div
Frequency Response: DC to 2 MHz
Error Limit: ±5%
Phase Shift: <3° (at 100 kHz)
Ext Input Impedance: 1 MΩ ±2%;//20 pF ±2 pF
Max Input Voltage: 400V (DC + AC peak)

Digital Mode

All specifications as analog part unless otherwise stated

Vertical
Resolution: 8-bit
Display Modes: ChA, ChB, -ChB
Frequency Response: DC...>10 MHz, -3dB (2 mV/div...10V/div)

Horizontal
Display Modes: Recurrent, single shot, multiple shot (up to 2)

Timebase
Recurrent, Single, Multiple Shot: 5μs/div... 10 μs/div
Timing Accuracy: ±0.1%
Display Expansion: x1...x32

Horizontal Resolution
Single Channel: 8192 samples/channel
Dual Channel: 4096 samples/channel

Signal Acquisition
Maximum Sample Rate: 20 MS/s, synchronously for both channels
Trigger Delay: 20 divisions of pretrigger
Display Expansion: x1...x32 horizontal

Memory
Storage Memories: 2
Number of Traces Stored in Each Memory: up to 2
Depth of Acquisition Memory: 8192 words
Depth of Reference Memory: 8192 words
Vertical Memory Resolution: 8-bit
Display Modes: ChA, ChB (from acquisition memory), Reg A, Reg B (from reference memory) in any combination

Cursors
Horizontal Resolution: (all display modes) 1:1000 over 10 divisions
Vertical Resolution: 1:200 over 8 divisions
Read Out Resolution: 3 digits amplitude and time
Calculation Functions: dV, dt, 1/dt, ratio, phase

Interface Option (/40n)
Contains both IEEE-488 and RS 232C capability

IEEE-488
Bus Driver: E2 (three state)
Function Repertoire: SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

RS 232C
Handshake: Software XON/XOFF, hardware DSR/DTR and CTS/RTS
Baud Rate: Transmit and receive 75...4800 bits/sec
Stop Bits: 1 or 2
Parity: Odd, even or none
Character Length: 7 or 8 bits

Interface Option (/50n)

RS 232 C data dump only
Handshake: Software XON/XOFF, Hardware DSR/DTR and CTS/RTS
Baudrate: Transmit 75 ...4800 bits/sec
Stop bits: 1 or 2
Parity: Odd, even or none
Character length: 7 or 8 bits

Digital Plot (Option /40n or /50n)

Language: HPGL or Philips GL dependent on plotter type selected
Plotter Select: Philips PM 8153/1*, PM 8153/6*, PM 8154*, PM 8155, HP 7450, HP 7475A
Pen Select:
Pen 1 for ChA
Pen 2 for ChB
Pen 3 for Register A
Pen 4 for Register B
Pen 5 for graticule and alphanumerics
Plot Area: Softkey selectable
Dot Matrix Printer Screen Dump: Compatible with Epson FX80 and HP Thinkjet ® graphics protocol or compatibles
Drawing Area: 10 cm x 10 cm
**Not available in North America*

General Specifications

Display

Screen: CRT with 8 x 10 cm viewing area; P31 phosphor, 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
Graticule: Parallax-free with continuously variable illumination.
LCD Display: Separate constantly backlit LCD for display of status information, settings, etc.

Power Supply

Line Voltage Range: 100V...240V AC ±10%
Line Frequencies: 50 Hz...400 Hz ±10%
Power Consumption: 70W

Mechanical Data

Width: 387 mm (15.2 in) incl. handle, 350 mm (13.8 in) excl. handle
Length:
531 mm (20.9 in) incl. handle and knobs
518 mm (20.4 in) incl. handle, excl. knobs
456 mm (17.9 in) excl. handle, incl. knobs
434 mm (17.1 in) excl. handle and knobs
Height: 146.5 mm (5.8 in) incl. feet, 134.5 mm (5.3 in) excl. feet
Weight: Approx 9.5 kg (20.9 lbs) excl. accessories

Environmental Data

Temperature
Rated Range of Use: +10°C...+40°C
Operating Range: 0°C...+50°C
Storage: -40°C...+75°C

Altitude
Operating: 4500 m (15000 ft)
Transport: 12000 m (40000 ft)
Vibration: Frequency 5 Hz...55 Hz, 15 minutes along each of the 3 axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found
Shock: Operating and non operating: Max acceleration 30g, $^1/_2$ sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
Bench Handling: MIL-STD-810 method 516, procedure V
EMI: Meets requirements of MIL-STD-461 class B, VDE 6871 and VDE 0875 Grenzwertklasse B
Safety: Meets requirements of IEC 348 class 1, VDE 0411, UL 1244, CSA556 B
Included with Instrument: Operating Manual, 2 x 10:1 probes, power cord.

Ordering Information

Models

PM 3335/00n 60 MHz, 20 MS/s DSO
PM 3337/00n Rackmount 60 MHz, 20 MS/s DSO
Note: n specifies power cord required

Optional Configuration

When ordering, select the standard model numbers listed above and add configuration number listed below as suffix:
PM ..../40n Scope with IEEE-488 (GPIB) and RS 232 Interface
PM ..../50n Scope with RS 232C dump only interface

Accessories

Passive Probes
PM 8922/501 1:1 or 10:1 Probe, cable length 1.5 m (5 ft)
PM 8924/001 1:1 Probe, cable length 1.5 m (5 ft)
PM 8924/201 1:1 Probe, cable length 2.5 m (8 ft)
PM 8926/501 10:1 Probe, cable length 1.2 m (4 ft)
PM 8922/591 10:1 Probe with readout, cable length 1.2 m (4 ft)
PM 8926/291 10:1 Probe with readout, cable length 2.5 m (8 ft)
PM 8931/091 20 MΩ 100:1 Probe with readout

Active Probes
PM 8940/09n High Voltage Isolation Amplifier with readout
PM 8943/00n 650 MHz FET Probe
PM 9355/09n AC Current Probe with readout

Other Accessories
PM 9051/001 BNC to 4 mm Banana Adapter
PM 9381/001 Oscilloscope Camera
PM 8902/001 12V dc power converter
PM 8991/041 Oscilloscope Trolley
PM 8992/651 Accessory Pouch
PM 8959/001 Retrofittable IEEE-488 (GPIB) and RS 232 Interface
PM 8961/001 Retrofittable RS 232 C dump only interface
PM 8917/00n Video Sync Separator and Line Selector
PM 8988/001 Protective Front Panel Cover
PM 8989/001 Traveller carry case
PM 2195/09 Probe Switch 400 MHz
PM 2122 50Ω Coaxial Switch
PM 223x Instrument Drivers Software
PM 2240 TestTeam Software
PM 2260 Oscilloscope Signal Processing Software

Accessories

Accessories

Many Philips oscilloscope accessories are available to enhance the performance of the instruments. The following pages give details on the large range of accessories offered and their performance characteristics.

Use this chart to see which oscilloscope accessories are compatible with the Philips oscilloscopes models listed on the right.		PM 3208 PM 3209	PM 3050 PM 3055	PM 3065 PM 3070	PM 3285A PM 3286A	PM 3295A PM 3296A	PM 3335	PM 3350A PM 3355 PM 3365A PM 3375	PM 3323 PM 3320A	PM 3340
Passive Probes										
PM 8911/081 PM 8911/091 PM 8912/081 PM 8912/091	Low impedance wide bandwidth probe				• •	• •			• •	+ •
PM 8922/501	Switchable 1:1 or 10 : 1 probe	•	•	•			•	•		
PM 8924/001 PM 8924/201	Modular 1:1 probe	• •	• •	• •	• •	• •	• •	• •	• •	
PM 8926/501 PM 8926/591	General Purpose 10:1 probe	•	• +	• +			• +	• +		
PM 8926/201 PM 8926/291	Modular general Purpose 10:1 probe	•	• •	• •			• •	• •		
PM 8929/091 PM 8929/191 PM 8929/291 PM 8929/391	Modular wide bandwidth probe				+ • •	• + • •			• • • +	
PM 8931/001 PM 8931/091	High impedance 100 : 1 probe	•	• •	• •	• •	• •	• •	• •	• •	
Active Probes										
PM 8940/09n	Isolation amplifier	•	•	•	•	•	•	•	•	
PM 8943/00n	FET probe	•	•	•	•	•	•	•	•	•
PM 9355/09n	Current probe	•	•	•	•	•	•	•	•	
PM 8917/00n	Video Line selector	•	•	•	•	•	•	•	•	
Battery Pack and Power Converters										
PM 8901/00n	Battery pack		•							
PM 8902/001	12V DC to AC Power converter[1]	•	•	•			•	•		
Accessory Pouches and Carry Cases										
PM 8992/801	Full size pouch		•	•	•	•			•	•
PM 8992/651	Half size pouch						•	•		
PM 8989/001	Traveller carry case		•	•			•	•		
Viewing Hoods										
PM 9310/001	Collapsable viewing hood				•	•				
PM 9311/001	Long rigid viewing hood				•	•				
Rackmounts										
PM 8964/001 PM 8964/401 PM 8969/001	Retrofittable rack mount		• •	• •			• •	• •	• •	• •
Cart and Stand										
PM 8991/041	Oscilloscope cart	•	•	•	•	•	•	•	•	•
PM 8999/001	Oscilloscope stand	•	•	•			•	•		
Camera and Adapters										
PM 9398/001	Camera kit for hand held use	•	•	•	•	•	•	•		
PM 8977/001	Camera bezel adaptor for fixed use				•	•				

+Supplied with instrument
[1] only for 115V instruments

Use this chart to see which oscilloscope accessories are compatible with the Philips oscilloscopes models listed on the right.		PM 3208 PM 3209	PM 3050 PM 3055	PM 3065 PM 3070	PM 3285A PM 3286A	PM 3295A PM 3296A	PM 3335	PM 3350A PM 3355 PM 3365A PM 3375	PM 3323 PM 3320A	PM 3340
Adapters and Terminators										
PM 9051/001	BNC (m) to Banana (f)	•	•	•	•	•	•	•	•	
PM 9053/001	BNC (f) to Banana (m)	•	•	•	•	•	•	•	•	
PM 9061/001	BNC (f) to BNC (f)	•	•	•	•	•	•	•	•	
PM 9063/001	N type (m) to BNC (f)									•
PM 9067/001	BNCT piece (m,m,f)	•	•	•	•	•	•	•	•	
PM 9591/091	Attenuator 10 : 1, 50Ω		•	•	•	•	•	•	•	
PM 9596/091	Attenuator 100 : 1, 50Ω		•	•	•	•	•	•	•	
PM 9598/091	Attenuator 10 : 1, 75Ω		•	•	•	•	•	•	•	
PM 9599/091	Set of three attenuators above		•	•	•	•	•	•	•	
Coaxial Cables										
PM 9071/001	Banana to Banana, 135Ω									
PM 9072/001	BNC to Banana, 135Ω									
PM 9074/001	BNC to BNC, 50Ω									
PM 9075/001	BNC to BNC, 135Ω									
Interface cards, Cables and Adapters										
PM 2295/051	IEEE 488, 0.5m (1.5 ft)		•	•	•	•	•	•	•	•
PM 2295/101	IEEE 488, 1m (3 ft)		•	•	•	•	•	•	•	•
PM 2295/201	IEEE 488, 2m (6 ft)		•	•	•	•	•	•	•	•
PM 8950/951	Retrofittable IEEE 488 interface				•	•				
PM 8953A/001	Free standing IEEE 488 interface		•	•						
PM 8956A/001 PM 8957A/001	Retrofittable IEEE 488 interface							•	•	
PM 8958A/001	Retrofittable RS232interface							•		
PM 8959/001	Retrofittable IEEE 488 /RS232 interface						•			
PM 8961/001	Retrofittable RS232 dump only interface						•			
PM 9076/011	Analog plot cable to amphenol connector							•		
PM 9076/021	Analog plot cable to banana plug							•		
Y 1709	RS232C printer cable 1m (3 ft) male/female						•	•	•	
PM 2122/001	Four way 50Ω switch (needs PM2101)				•	•			•	•
PM 2195/001	High imp. 10 : 1 probe switch (needs PM2125)		•	•	•	•	•	•	•	
Miscellaneous										
PM 8988/001	Front cover		•	•			•	•		
PM 8998/001	Memory back up		•	•						

Passive Probe Specifications

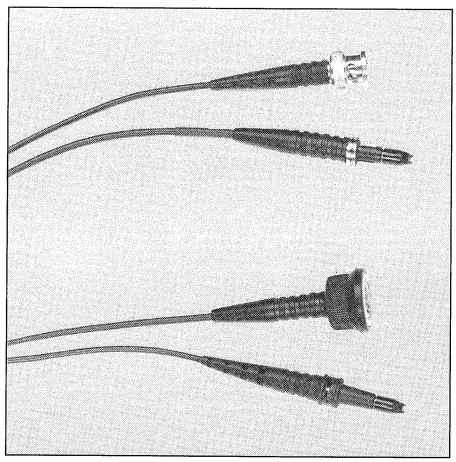
Type Number	Attenuation Factor	Useful BW (MHz)	Impedance Ω/pF	Max. Input Voltage (DC + AC PK)	Compensating Range (pF)	Cable Length M (ft)	Auto Range Indication
PM 8911/081	10 : 1	2000	500//1	15	—	1.5 (5)	yes
PM 8911/091	10 : 1	1500	500//1	15	—	1.5 (5)	yes
PM 8912/081	100 : 1	2000	5k//1	50	—	1.5 (5)	yes
PM 8912/091	100 : 1	1500	5k//1	50	—	1.5 (5)	yes
PM 8922/501[4]	1 : 1 10 : 1	6 50	1M//130 10M//15	[2] 500	— 15-35	1.2 (4)	no
PM 8924/001	1 : 1	15[3]	1M//74[1]	42	—	1.5 (5)	no
PM 8924/201	1 : 1	12	1M//74[1]		—	2.5 (8)	no
PM 8926/201	10 : 1	75	10M//16	500	5-40	2.5 (8)	no
PM 8926/291	10 : 1	75	10M//16	500	5-40	2.5 (8)	yes
PM 8926/501[4]	10 : 1	100	10M//14	500	15-35	1.2 (4)	no
PM 8926/591[4]	10 : 1	100	10M//14	500	15-35	1.2 (4)	yes
PM 8929/091	10 : 1	300	10M//13,5	500	5-20	1.5 (5)	yes
PM 8929/191	10 : 1	400	10M//12	500	5-20	1.0 (3)	yes
PM 8929/291	10 : 1	250	10M//16,5	500	5-20	2.5 (8)	yes
PM 8929/391	10 : 1	325	10M//12	500	5-20	1.5 (5)	yes
PM 8931/001	100 : 1	300	20M//2,4	4000	5-30	1.5 (5)	no
PM 8931/091	100 : 1	300	20M//2,4	4000	5-30	1.5 (5)	yes

1) Plus input capacity of oscilloscope
2) Refer to maximum input voltage of oscilloscope
3) Probe only bandwidth
4) Only with test clip and ground lead

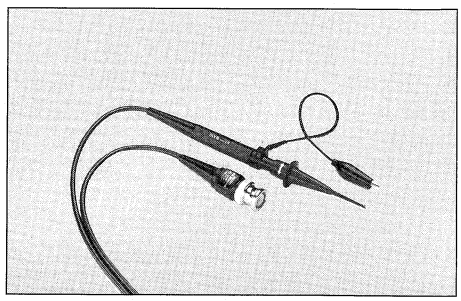
Alternatives for Obsolete Probes

Obsolete Probe	Current Alternative Probe
PM 8921	PM 8924/001
PM 8921L	PM 8924/201
PM 8922/001	PM 8922/501
PM 8923	PM 8922/501
PM 8926/001	PM 8926/501
PM 8926/091	PM 8926/591
PM 8927A	PM 8926/501
PM 8927AL	PM 8926/201
PM 8926AS	PM 8926/591
PM 8928	PM 8926/501
PM 8932	PM 8931/001
PM 8933	PM 8926/591
PM 8935	PM 8929/001
PM 8935L	PM 8929/201
PM 8936/091	PM 8926/591 (2 pcs)
PM 9326	PM 8922/501
PM 9237	PM 8922/501
PM 9328	PM 8922/501
PM 9336	PM 8926/501

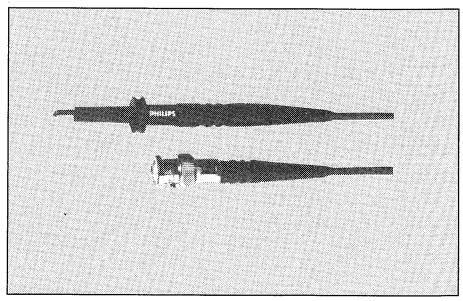
Passive Probes



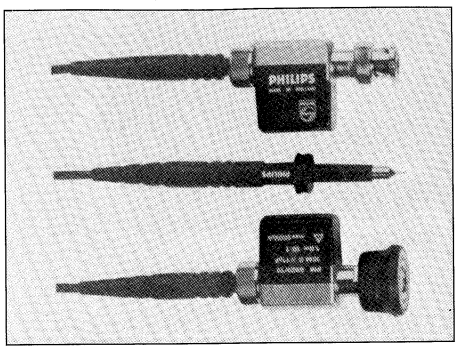
PM 8911/081
PM 8911/091
PM 8912/081
PM 8912/091
Modular UHF bandwidth probes with low capacitive loading for oscilloscopes with 50Ω inputs



PM 8922/501
Switchable 10 : 1 and 1 : 1 probe for applications up to 100 MHz

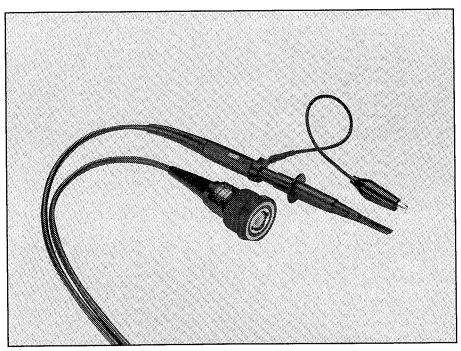


PM 8924/001
PM 8924/201
Modular 1:1 probe for high sensitivity low bandwidth applications



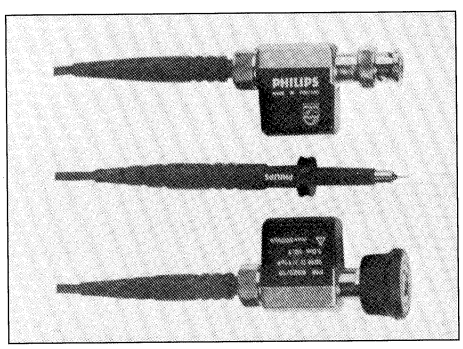
PM 8926/001
PM 8926/201
PM 8926/091
PM 8926/291

Modular 10 : 1 probes with low capacitive loading and wide compensation range for general purpose applications up to 100 MHz



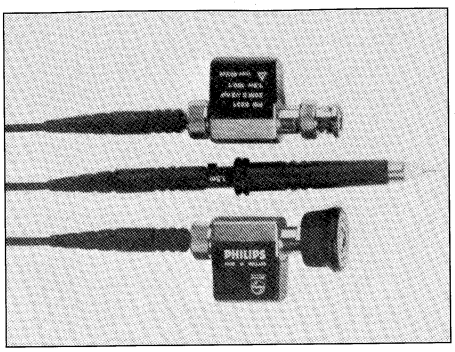
PM 8926/501
PM 8926/591

General purpose 10 : 1 probes with low capacitive loading for applications up to 100 MHz



PM 8929/091
PM 8929/191
PM 8929/291
PM 8929/391

Modular 10 : 1 probes with low capacitive loading and wide compensation for applications up to 400 MHz



PM 8931/001
PM 8931/091

Modular 100x probes for high voltage measurements and/or measurements requiring extremely low input capacitances at the probe tip

Active Probes



PM 8917/00n Video Line Selector

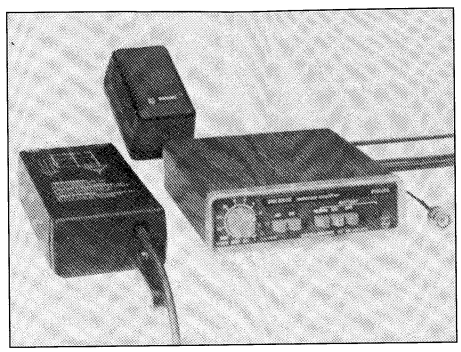
Stand-alone signal processor used to separate the sync signal from a composite video signal of PAL or NTSC standard. Two BNC connectors are provided for feed-through. A third front panel mounted BNC is output of Line sync signal. Rear panel mounted BNC connectors provide TV Line sync and TV Frame or Field sync (switchable). Selection of NTSC or PAL is automatic. A thumb wheel switch permits selection of any video line to trigger a scope.

Technical Specification

Systems: CCIR/FCC 525 line or CCIR/EBU 625 line system. Selection is automatic, and indicated by LED.
Input: 0.7 ... 3 V composite video
Impedance: 1 MΩ//30 pF 75Ω when terminated with 75Ω
Max Input: 50 V (DC + AC peak)
Outputs: TV Frame (Vert sync) or TV Field, TV Line, selected TV Line
Output Voltage: 1 V pp into 75Ω
Trigger Outputs:

Frame pulse	0.5 x frame width
Field pulse	1.8 µs
Line pulse	1.8 µs
Selected line pulse	35 µs for line 0 64 µs for all other lines

Power: 90...264 VAC in one range, 45...66 Hz, 7 W

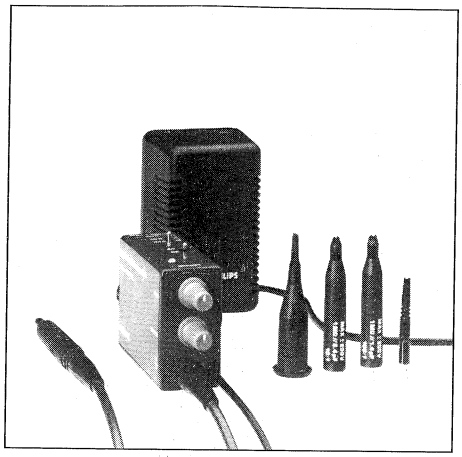


PM 8940/09n Isolation Amplifier

The PM 8940/09 is an isolation amplifier which permits small signals which may be present on high common mode voltages to be safely measured with oscilloscopes or other types of measuring devices. The transfer sensitivity can be as high as 5 mV/div, depending on the PM 8940's attenuator setting, at the same time isolating and suppressing common mode voltages of up to 650 VAC RMS. Isolation is obtained through the use of opto-isolation.The PM 8940/09 consists of two parts, permanently connected by a heat and chemical resistant cable. The actual input is made entirely of plastic and is battery operated, and has screw-type input terminals. It is the user's responsibility to connect the input signals to the inputs in a safe manner. Battery life is approximately 4 hours. The "Control Box" provides controls for AC and DC coupling, as well as an input sensitivity switch and must be grounded to safety ground at all times.
Applications are in power electronics, SCR's, industrial electronics, utilities, transport companies etc.

Technical Specification

Frequency Response: DC coupled DC ... 1.5 MHz (-3 dB), AC coupled 3 Hz ... 1.5 MHz (-3 dB)
Defl coeff: 50 mV/div ... 200 V/div (HI), or
5 mV/div ... 20 V/div (LO)
Dynamic range: 20 div. at scope setting of 20 mV/div
Diff input impedance: 10 MΩ// 9 pF (HI)
1 MΩ//5 pF (LO)
Max. diff. input voltage: 650 V RMS
Common mode rejection: <= 0.5 div deflection with common mode of 650 V RMS, up to 60 Hz
Power: 115 or 220 VAC (-10%...+20%), 45...440 Hz, 10 VA



PM 8943/00n 650 MHz FET Probe

The PM 8943 enables high frequency measurements, or measurements on systems with fast transient times and high source impedances, with no loss of input sensitivity and extremely low input capacitance at the probe tip. The PM 8943 can be used with all oscilloscopes, or counters, or any other type of measuring instrument having 1 MΩ or 50Ω input impedances.

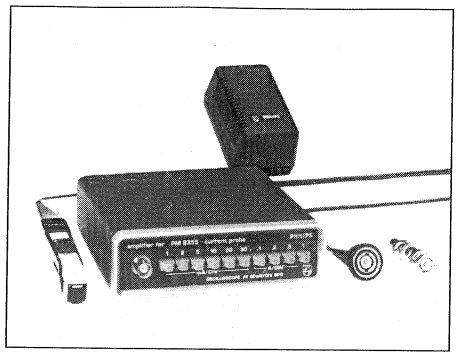
Technical Specification

Frequency range: DC ... 650 MHz (-3 db) with 50Ω termination (in AC position 1.1 Hz ... 650 MHz)
Attenuation factor: x1, x10, x100.

Attenuator x1	x10	x100	
Dynamic range	±0,6V	±6V	±60V
Input Resistance	1 MΩ	1 MΩ	1 MΩ
Input Capacitance	3.5 pF	2.2 pF	1.4 pF
Offset range±5V	±50V	±500V	
Max. input±100V	±200V	±200V	

voltage (at 20 kHz)

Power: 110, 120, 220, or 240 VAC (±10%), 45...440 Hz, 10 VA
NOTE: The dynamic range of this FET probe is not affected by the amount of offset used.



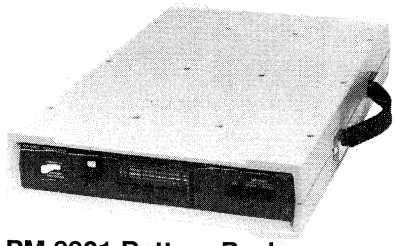
PM 9355/09n AC Coupled Current Probe.

The PM 9355 provides a wide bandwidth and calibrated conversion from current signals to be measured into voltages to be accepted by the oscilloscope. It consists of a passive AC current sensing transformer, which plugs into an active amplifier / equalization circuit. The combination of these two guarantees a frequency response between 12 Hz and 70 MHz. The amplifier section is equipped with its own sensitivity settings, calibrated in mA/div or A/div. To ensure proper calibration of the dimensions set on the PM 9355, the oscilloscope input (with which it is used) must be set for a sensitivity of 20 mV/div. With most Philips oscilloscopes, this setting is automatically accomplished by the range indication on the BNC connector of the PM 9355.

Technical Specification

Max wire diameter: 3 mm.
Frequency Response: 12 Hz.. 70 MHz at 5mA/div...1A/div, 12 Hz... 45 MHz at 1 mA/div and 2 mA/div
Sensitivity: 1 mA/div ... 1 A/div (10 ranges in a 1, 2, 5 sequence). Scope input set at 20 mV/div
Max current: 12 A pp (For frequencies over 300 Hz) Derated to 1 A at 100 Hz or lower.
Max voltage on conductor to be measured: 600 V (DC+AC peak) with probe closed
Dynamic output range: - 6 to + 6 div.
(at > 300Hz within the limits of max. input current)
Power: 110 or 220 VAC (-10%...+20%), 45...440 Hz, 10 VA

Battery Pack and Power Converter

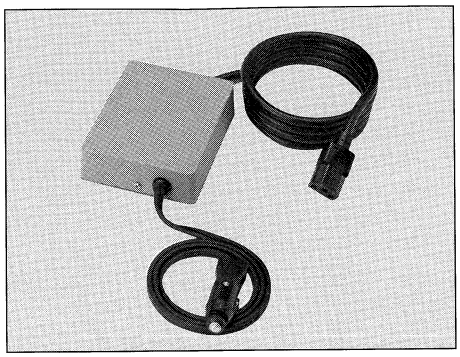


PM 8901 Battery Pack

Battery pack with 180 Wh of 24 V sealed lead-acid rechargeable batteries, with a 24 VDC/330 VDC invertor built in to provide battery operation for a number of oscilloscopes. The PM 8901 charges in approx 10 hours for a full 100 % charge or in approx 8 hours to 90 %, and is protected against over charge. It has its own line cord and plugs directly in to a line outlet. A standard line socket output powers oscilloscopes capable of running on 330 VDC, and a 24 VDC socket powers oscilloscopes running on 24 VDC. Both outputs are overload protected.

Technical Specification

For HI output (330 VDC)
Capacity at 20°C: @ P out=20 W 6.5 hours
@ P out= 40 W 3 hours
For LO output (24 VDC)
Capacity at 20°C: @ I out= .75 A 9 hours
@ I out= 1.5 A 4 hours
Weight: 9.5 kg (21 lbs) incl. batteries
Dimensions (w,h,d): 32.7 x 7.8 x 50 cms
(12.8 x 3 x 19.7 in)



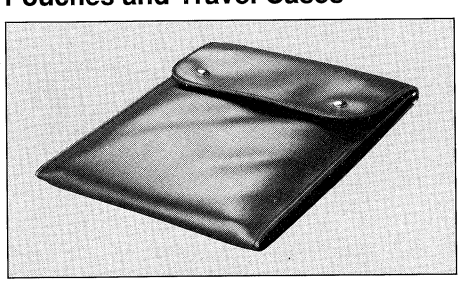
PM 8902/001 DC to AC Converter

The PM 8902 provides the capability to run any of the Philips oscilloscopes up to 100 MHz from a 12 V DC supply.This highly compact and highly efficient converter has a 115 VAC output which directly plugs into the mains connector at the rear of the oscilloscope.

Technical Specifications

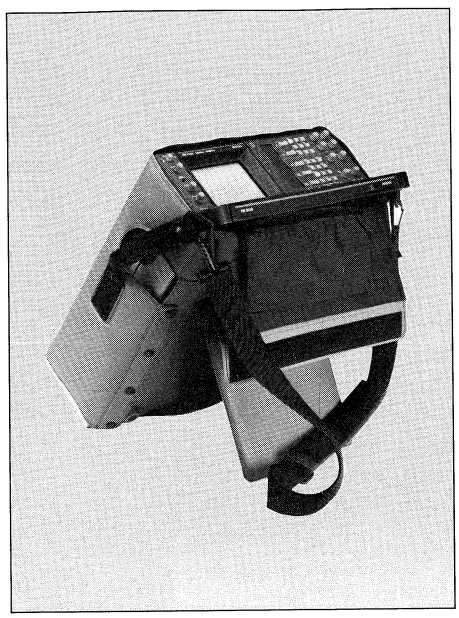
Input Voltage: 10...15 VDC
Low Battery Alarm: audible alarm at 10.7 VDC Max. Current Drawn: 9A at output power of 100 W
No Load Current Drawn: 60 mA
Output Voltage: 115 VAC (RMS), modified sine wave
Voltage Regulation: ±5 % (for 11...14 VDC input)
Output Frequency: 60 Hz ±1%
Max. Continuous Output: 100 W at 25°±C, 80 W at 40°C
Maximum Short Term Output: 175 W for 1 min, 150 W for 10 min
Overload Protection: Electronic shut down at 70°C, restart at 65°C
Dimensions: 11.5 x 9.0 x 3.0 cms. (4.6 x 3.6 x 1.2 in)
Weight: 0.4 kg. (0.9 lb)
Connection to DC source: Cigar lighter plug
Supplied with unit: Fixed line cord, fuse, 2 m (6 ft) cigar lighter extension cable

Pouches and Travel Cases



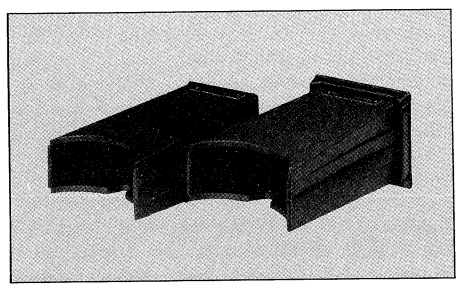
PM 8992/801 Full Size Pouch
PM 8992/651 Half Size Pouch

Adds storage space to portable oscilloscope models for most frequently used accessories when the oscilloscope is used in portable, or field service applications.



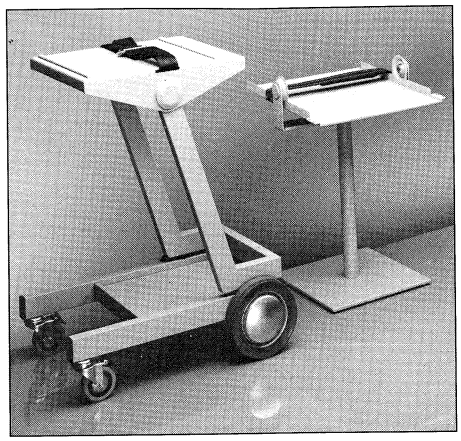
PM 8989/001 Traveller Carry Case

This rugged carry case provides protection of the oscilloscope during transport. The integral shoulder strap enables the oscilloscope to be easily carried from location to location and provides storage for both probes and manual.The oscilloscope can be used without removing it from the carry case and a tilt stand gives an ideal viewing angle when the oscilloscope must stand on the floor.



PM 9310/00 Collapsible Viewing Hood
PM 9311/00 Long Rigid Viewing Hood

These viewing hoods enhance study of low light level traces by shielding ambient light from the CRT screen.

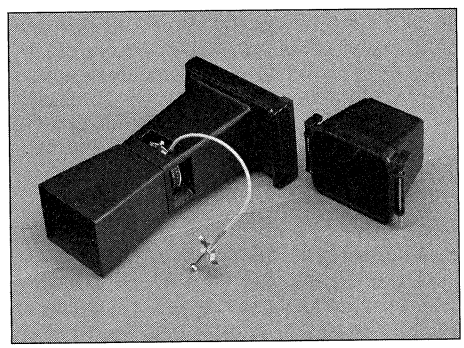


PM 8991/041 Oscilloscope Cart

The PM 8991 provides oscilloscope support next to the lab table, and an easy way to move oscilloscopes around in labs, or factory floors. With a large footprint for stability, and large wheels with roller bearings for smooth operation, easy movement over thresholds, cables etc. is realized. The front wheels have casters for maneuverability. The angle of the table is continuously adjustable between 15° downward to + 70° upwards and once set is securely locked.

PM 8999/001 Oscilloscope Stand

A convenient oscilloscope stand for both bench and floor use where space is at a minimum. This stand is adjustable in both height and viewing angle.



PM 9381/001 Polaroid® Camera

Camera system for instant photographic recording of oscillograms. It can be used as a hand held camera, or used with spacer body and oscilloscope bezel for fixed installation and longer exposure times.

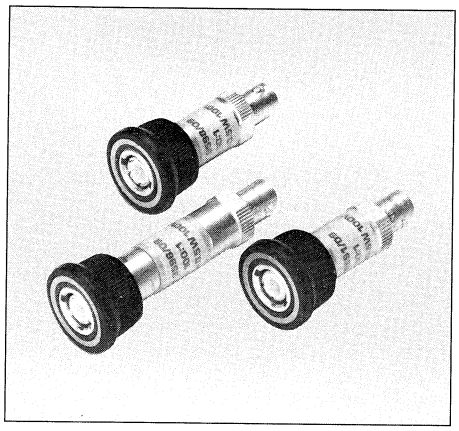
Camera specifications

Object to image ratio: 1 : 0.85
Lens: 70 mm f/3.5
Shutter: Self cocking, mechanical, 1s ...1/125s Sync contact for event triggering
Film back: Fixed, suitable for Polaroid type 107.
Fixed mounting adaptor for PM 3285A/86A/95A/96A:PM 8977/001

Accessories

Rackmount Kits

Oscilloscope	Rackmount	Height E	mm	in	Length mm	in	Width mm	in
PM 3050/55/65/70	PM 8969/001	3E	133.4	5.25	392	15.4	483	19
PM 3323/PM 3320A	PM 8964/001	4E	177.8	7	variable		483	19
PM 3335/50/55/65/75	PM 8969/001	3E	133.4	5.25	392	15.4	483	19
PM 3340	PM 8964/401	4E	177.8	5.25	variable		483	19



PM 9591/091 10:1 50Ω Attenuator
PM 9596/091 100:1 50Ω Attenuator
PM 9598/091 10:1 75Ω Attenuator
PM 9599/091 Set of 3 Attenuators

These products provide attenuation of wide bandwidth VHF signals, with proper termination of 50Ω and 75Ω cables respectively. Each attenuator has BNC male female connectors and 50Ω output. On Philips oscilloscopes so equipped, the scale factor readout and input impedances are automatically set.

Technical Specifications

	PM 9591/001	PM 9596/091	PM 9598/091
Attenuation	10:1	100:1	10:1
Input Resistance	50Ω	50Ω	75Ω
Output Resistance	50Ω	50Ω	50Ω
Max Input Voltage	100 V	100 V	100 V
Max Power Dissipation	0.5 W	0.5 W	0.5 W

PM 2195/09 Probe Switch Unit

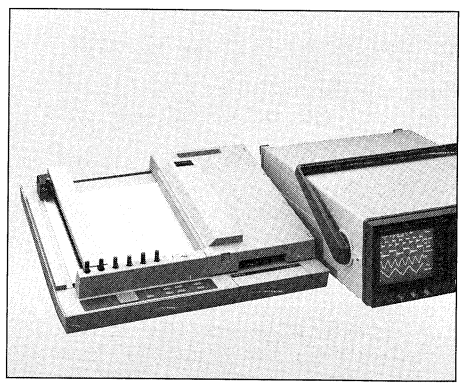
The PM 2195/09 Probe Switch is a solution to the problems which can occur when switching waveforms in typical GPIB systems. It consists of a 4-input selector switch and 4 attenuator probes. Each probe can be individually adjusted, to ensure a bandwidth of 400 MHz (-3 dB) with and oscilloscope with and input capacitance of less than 10 pF. The probe switch compact enough to be plugged directly to the input of an oscilloscope. A maximum of 4 probe switches by a PM 2125 probe switch driver, via the GPIB. For more information.

PM 2260 Oscilloscope Signal Processing Software

PM 2260 Oscilloscope signal processing software is a package for the PC, consisting of software drivers to transfer data from Philips DSOs to the PC, and the ASYSTANT™-GPIB software package for waveform analysis, display and storage functions. Processing functions include FFT power spectrum, inverse FFT, differentiation, integration, Blackman window, curve fitting, cross correlation and many more. The entire package is menu-oriented and requires no programming skill.

PM 2240 TestTeam and PM 2230 Instrument Driver Software

PM 2240 TestTeam offers a complete, multiple window programming and debugging environment for GPIB application programs. It is easy to use, as the programmer is guided through the package with pull-down windows, pop-up screens and a context sensitive help facility. TestTeam contains instrument, graphics and optional analysis libraries, so programming of GPIB instruments and graphical presentation of data is as easy as filling in a screen panel on the PC.
The debugging facilities os TestTeam include syntax checking, breakpoints, single-step execution and variable tracing and programs can be written in QuickBASIC or C.
PM 223x are libraries of instrument drivers for most Philips/Fluke GPIB instruments, which make programming of these instruments as simple as setting the instrument via the front panel. All drivers include extensive error checking procedures to guarantee the reliability of test results. Drivers are available in BASICA/ GWBASIC, Microsoft Pascal, Microsoft C and QuickBASIC.



PM 8155 Full DIN A3 Plotter

The PM 8155 full DIN A3 plotter can be linked to any DSO in this catalog to give hard copies. With eight pen colors, individual traces are easily identified. Its large 297 mm x 410 plotting area can be used for multiple plots. Alternatively, the automatic sheet feeder option can be used for many smaller individual plots. With a 32 kbyte internal buffer data transfer occurs at full speed before plotting is complete. This prevents the oscilloscope from being restricted by the plot speed as with smaller buffers.

Basic Specifications:

Interface Type: RS 232 or IEEE-488
Graphics Language: HPGL and Philips GL
Plotting Area: 297 x 410 mm
Sheet Feeder: Optional for ANSI-A or ISO A4 sizes

Limited Availability

GPIB
IEEE-488

RS-232



The PM 3266 captures repetative or single events and stores them for upto 1 hour. In addition to being a full 100 MHz analog oscilloscope with delayed time base two storage modes are available. In the Fast mode writing speeds of 1000 div/µs are possible, while the WRITE mode has a variable persistance capability.

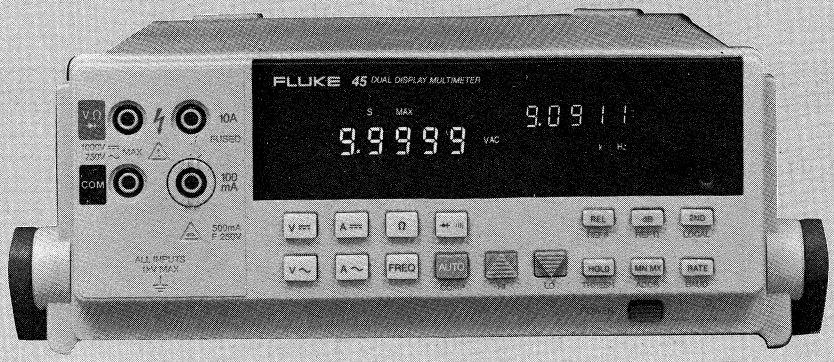
Full trigger capabilities and high sensitivity to 2 mV/div make this instrument ideal for fast research applications.

Ordering Information

PM 3266/00n 100 MHz Transfer Storage Oscilloscope

Bench/System Multimeters

NEW



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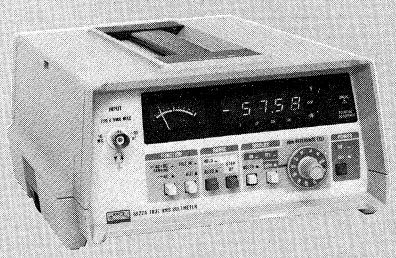
PM 2525 Page 66

NEW



8922A Page 100

NEW



Fluke 37 Page 87



8842A Page 60

This category of digital multimeters (DMMs) features all the Fluke and Philips bench and system meter line. Included are high speed instruments for use in automated test and measurement systems, and more compact, inexpensive models for less demanding jobs on the workbench or, with battery or battery pack, in the field.

Fluke and Philips bench/system multimeters are available with 3½ to 7½ digits of resolution and a variety of accuracy levels. All system meters are available with either GPIB/IEEE-488 or RS-232C interfaces which allow easy system integration.

See the selection guide on the following page for a comparison of basic specifications and features.

Selection Guide	Page 54
Bench/System Multimeters	Page 55
Bench/Portable Multimeters	Page 87
Logic Multimeter/ Signal Analyzer	Page 95
Digital Voltmeters	Page 100
AC Millivoltmeters	Page 103
Analog Meters	Page 104

Selection Guide

Models	Basic Features			Special Features							Interfaces			DC Volts			AC Volts				AC/DC Amp		Ohms, Etc.				
	Max Number of Digits	Display	Autoranging	Burst Memory	dB, dBm Readout	Offset/Relative Ref	Touch-Hold	Counter Timer	Capacitance	Other	IEEE-488	RS-232-C	Parallel/BCD	Basic 90 Day Accuracy, %	Max Resolution, µV	Max Voltage, w/o Probe	True-RMS	Basic 90 Day Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, mΩ*	Max Resistance, MΩ	Diode Test	Conductance (Low) >20 MΩ	Page Number
Bench/System Multimeters																											
Fluke 45	5	VF*	(1)		•	•	•	–	–	(6)	Δ	•	–	0.01	1.0	1000	(5)	0.2	1.0	100k	10MHz	1.0	1.0	300	•	–	55
8840A	5½	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.004	1.0	1000	Δ	0.14	1.0	100k	10k	2.0	1.0	20	–	–	60
8842A	5½	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.0025	0.1	1000	Δ	0.07	1.0	100k	1k	2.0	0.1	20	–	–	60
8840A/AF	5½	VF*	(1)	–	–	•	–	–	–	–	Δ	–	–	0.004	1.0	1000	Δ	0.14	1.0	100k	10k	2.0	1.0	20	–	–	60
PM 2525	5½	LCD	(1)	–	•	•	Δ	•	•	(5,8)	Δ	Δ	Δ	0.02	1.0	1000	•	0.3	10	100k	0.1	100	10	100	–	–	66
8505A	7½	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	0.1	1200	Δ	0.1	1.0	1M	0.1	1.28	0.01	265	–	–	71
8506A	7½	LED	(1)	–	–	•	–	–	–	–	Δ	Δ	Δ	0.001	0.1	1200	•	0.016	1.0	1M	0.1	1.28	0.01	265	–	–	71
8520A	5½	LED	(1)	•	Δ	•	–	–	–	–	•	–	–	0.005	1.0	1000	•	0.1	10	1M	–	(3)	0.1	20	–	•	76
8522A	5½	LED	(1)	•	•	•	–	–	–	–	–	–	•	0.005	1.0	1000	•	0.1	10	1M	–	(3)	0.1	20	–	•	76
PM 2528	5½	LCD	(1)	–	–	•	–	–	–	–	•	–	–	0.01	1	600	(6)	0.1	10	500k	0.01	(2)	0.001	2000	–	–	80
PM 2534	6½	LCD	(1)	•	–	–	Δ	–	–	–	•	–	–	0.0025	0.1	600	(6)	0.2	10	100k	100	(3)	0.1	300	–	–	83
PM 2535	6½	LCD	(1)	•	•	–	Δ	–	–	–	•	–	–	0.0025	0.1	600	(6)	0.2	10	100k	100	(3)	0.1	300	–	–	83
Bench/Portable Multimeters																											
Fluke 37	3½	LCD	(1)	–	–	•	•	–	–	–	–	–	–	0.1**	100	1000	–	0.5	100	30k	100	10.0	100	32	•	•	87
8050A	4½	LCD	–	–	•	•	(4)	–	–	–	–	–	–	0.03**	10	1000	•	0.5	10	50k	10	2.0	10	20	•	•	89
8010A	3½	LCD	–	–	–	–	(4)	–	–	–	–	–	–	0.1**	100	1000	•	0.5	100	50k	100	10	100	20	•	•	92
8012A	3½	LCD	–	–	–	–	(4)	–	–	–	–	–	–	0.1**	100	1000	•	0.5	100	50k	100	2.0	1.0	20	•	•	92
Logic Multimeter/Signature Analyzers																											
PM 2544	4½	LCD	(1)	–	–	–	Δ	•	–	–	–	–	–	0.2	100	630	–	0.5	100	20k	10k	10	100	10	–	–	97
Wideband True-RMS AC Digital Voltmeters																											
8920A	3½	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	100
8921A	3½	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	20M	–	(3)	–	–	–	–	100
8922A	3½	LED	(1)	–	•	•	–	–	–	–	Δ	–	Δ	(2)	(2)	(2)	•	0.5	1.0	11M	–	(3)	–	–	–	–	100
Analog Meters																											
PM 2554		Analog	–	–	•	–	–	–	–	–	–	–	–	–	–	–	•	1.5	10	12M	–	–	–	–	–	–	103
PM 2504		Analog	–	–	•	–	–	–	–	–	–	–	–	1	100	1500	–	1.5	100	200k	10k	30	0.1	100	–	–	104
PM 2505		Analog	–	–	•	–	–	–	–	–	–	–	–	(1.5)	1000	1000	–	2.5	1000	60	10k	0.3	1000	30	•	•	106

• Standard
Δ Optional
– Not applicable
** Vacuum fluorescent*
*** 1-year accuracy*

(1) Or Manual ranging
(2) Will measure dc in ac-dc mode
(3) Use 80J-10 or A90 Shunt for up to 10A
(4) Use 80T-H Probe
(5) Temperature with PT 100 Probe
(6) AC-coupled RMS
(7) Nine measurement parameters: (D, Q, Rp, Rs, Z, Ls or Lp, Cs or Cp and Cs 2V bias)
(8) Counter-Timer
(9) Dual Display and Frequency Counter

For Handheld Multimeters see Section 4.
For Multimeter Accessories see Section 5.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

I&M EXPRESS LINE

GPIB IEEE-488

RS-232

NEW



Fluke 45

45 Dual Display Multimeter

- Multifunction vacuum fluorescent dual display
- True rms voltage and current, including ac + dc
- RS-232 interface standard, GPIB/IEEE-488.2 option
- Frequency measurement to 1 MHz
- dB measurements with selectable reference impedances of 2Ω to 8,000Ω and audio power from 2Ω to 16Ω
- Compare (Hi/Lo/Pass) function for quick in-tolerance tests
- 0.05% dc current accuracy for 4-20 mA current loop service
- Touch Hold,® Relative and Min Max
- Audible continuity and diode test
- Optional rechargeable battery, carrying case, rack mount kit & PC Software Package
- Closed-case calibration

The Fluke 45 is a feature-rich 5 digit, 100,000 count DMM with a unique multifunction dual display, allowing measurement of two signal parameters from a single test connection. The 45 offers high performance and versatility for manufacturing test, depot and field service, and research and development. A standard RS-232 makes it ideal for PC instrument applications.

Dual Display

The Fluke 45 is the first DMM with a multifunction "dual display," allowing the user to select a wide variety of measurement combinations. It is particularly useful in applications requiring two different measurements of the same signal; i.e. power supply testing, where V dc output can be viewed on the primary display while the V ac ripple is shown on the secondary display.

Standard RS-232 Interface

The RS-232 interface, standard in each instrument, allows measurement data to be filed, manipulated, printed or transmitted by modem. The print mode automatically formats measurment data for printing on an RS-232 printer. Rates for automated printing over RS-232 are adjustable from 1 reading every 70 ms to 1 reading every 5.6 hours. The optional "QuickStart 45" Software Package allows automated communications and filing of measurements with the Fluke 45 and an IBM-PC or compatible via RS-232.

dB Measurement

The Fluke 45 provides digital readout of decibels with front panel selection of any of twenty-one reference impedances from 2Ω to 8,000Ω. For 2Ω, 4Ω, 8Ω and 16Ω impedances, the meter automatically calculates and displays audio power in watts.

Compare Function

The Fluke 45 has a compare function for fast in-tolerance limits testing. Upper- and lower-limits are entered through the front panel. Readouts show both a Hi/Lo/Pass evaluation and measured value.

Touch Hold® Relative and Min Max

Touch Hold captures the measurement, beeps and locks it on the digital display until you are ready to view it. It automatically updates with each new stable measurement. The Relative mode remembers a reading and shows the change (difference) between it and any readings that follow. Min Max records the highest and lowest values measured. Either can be recalled and displayed at any time.

Optional Battery and Case

An optional rechargeable battery and soft carrying case are available for precision field service applications. These options, coupled with a 30 mA dc current range and 0.05% accuracy, allow calibration of 4-20 mA loops in process control applications. The battery is available as a factory installed option or can be user-installed at a later date.

Optional GPIB/IEEE-488.2 and Rack Mount

The Fluke 45 may be used with GPIB/IEEE-488.2* systems, including existing IEEE-488 implementations. The IEEE-488.2 option is available as a factory installed option, or can be user installed and does not require removal of the RS-232 interface. A rack mount kit is also available.

Closed-Case Calibration

Calibration can be performed via the RS-232 (or optional IEEE-488.2) interface or manually from the front panel. No internal adjustments are required.

Standard Equipment

Each Fluke 45 Dual Display Multimeter includes an operator's manual, quick reference guide, line cord, and test leads.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

Accuracy specifications are given as ± ([% of reading] + [number of least significant digits]) at 18°C to 28°C with relative humidity up to 90%, for a period of one year after calibration. Six months specifications are also provided for dc volts. AC inputs are ac-coupled and true-rms responding.

Display

Dual vacuum fluorescent displays, 99,999 counts each display. Annunciators: m, M, k, V, A, Ω (ohms), Hz, ⊣▷+ diode test,))))) (audible continuity), REMOTE, EXT TRIG, SMF (reading rates), MAX, MIN, dB, HOLD, REL, AUTO, [- +] (low battery). Resolution and accuracy are dependent on selectable reading rates of 2.5 (slow), 5 (medium) or 20 (fast) readings per second.

Rate	Readings Per Second	Full Range Display Counts
Slow	2.5	99,999
Medium	5	30,000
Fast	20	3,000

RS-232 and IEEE-488 Reading Transfer Rates

Internal Trigger Operation (TRIGGER 1)	
Rate	**Readings Per Second**
Slow	2.5
Medium	4.5
Fast	4.5
External Trigger Operation (TRIGGER 4)	
Rate	**Readings Per Second**
Slow	1.5
Medium	2.4
Fast	3.8
Print Mode Operation (Print set at 1)	
Rate	**Readings Per Second**
Slow	2.5
Medium	5.0
Fast	13.5

DC Voltage

Range	Resolution			Accuracy (6 Month)	Accuracy (1 Year)
	Slow	Medium	Fast		
300 mV	—	10 µV	100 µV	0.02% + 2	0.025% + 2
3V	—	100 µV	1 mV		
30V	—	1 mV	10 mV		
300V	—	10 mV	100 mV		
1000V	—	100 mV	1V		
100 mV	1 µV	—	—	0.02% + 6	0.025% + 6
1000 mV	10 µV	—	—		
10V	100 µV	—	—		
100V	1 mV	—	—		
1000V	10 mV	—	—		

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Rejection Ratio: >80 dB at 50 or 60 Hz, slow and medium rates; >54 dB for frequencies between 50 and 440 Hz, slow and medium rates; >60 dB at 50 Hz, fast rate
Common Mode Rejection Ratio: >90 dB at dc, 50 or 60 Hz (1 kΩ unbalanced, slow & medium rates)
Maximum Input: 1000V dc or peak ac on any range

AC Voltage (true-rms, ac coupled)

Range	Linear Resolution			Range	Linear Resolution		
	Slow	Medium	Fast		Slow	Medium	Fast
300 mV	—	10 µV	100 µV	100 mV	1 µV	—	—
3V	—	100 µV	1 mV	1000 mV	10 µV	—	—
30V	—	1 mV	10 mV	10V	100 µV	—	—
300V	—	10 mV	100 mV	100V	1 mV	—	—
750V	—	100 mV	1V	750V	10 mV	—	—

Decibels Resolution	
Slow/Medium	**Fast**
0.01 dB	0.1 dB

Frequency	Linear Accuracy			dB Accuracy		Power*	Max Input Upper Freq
	Slow	Medium	Fast	Slow/Med	Fast		
20-50 Hz	1%+100	1%+10	7%+2	0.15	0.72	2%+10	750V
50 Hz-10 kHz	0.2%+100	0.2%+10	0.5%+2	0.08	0.17	0.4%+10	750V
10-20 kHz	0.5%+100	0.5%+10	0.5%+2	0.11	0.17	1%+10	750V
20-50 kHz	2%+200	2%+20	2%+3	0.29	0.34	4%+20	400V
50-100 kHz	5%+500	5%+50	5%+6	0.70	0.78	10%+50	200V

**Error in power mode will not exceed twice the linear accuracy specification*

Accuracy specifications apply within the following limits, based on reading rate:
Slow: Between 15,000 counts and full range
Medium: Between 1,500 counts and full range
Fast: Between 150 counts and full range
Input Impedance: 1 MΩ in parallel with <100 pF
Maximum Crest Factor: 3.0
Common Mode Rejection Ratio: >60 dB at 50 or 60 Hz (1 kΩ unbalanced medium rate)
Maximum Input: 750V rms, 1000V peak
2×10^7 volt-hertz product on any range, normal mode input
1×10^6 volt-hertz product on any range, common mode input

AC + DC Voltage (calculated)

Total Measurement error will not exceed the sum of the separate ac and dc accuracy specifications, plus one display count.

Ohms

Range	Resolution			Accuracy	Typical Full Scale Voltage	Max Current Thru Unknown
	Slow	Medium	Fast			
300Ω	—	10 mΩ	100 mΩ	0.05% + 2 + 0.02Ω	0.25	1 mA
3 kΩ	—	100 mΩ	1Ω	0.05% + 2	0.24	120 µA
30 kΩ	—	1Ω	10Ω	0.05% + 2	0.29	14 µA
300 kΩ	—	10Ω	100Ω	0.05% + 2	0.29	1.5 µA
3 MΩ	—	100Ω	1 kΩ	0.06% + 2	0.30	150 nA
30 MΩ	—	1 kΩ	10 kΩ	0.25% + 3	2.25	320 nA
300 MΩ	—	100 kΩ	1 MΩ	2%	2.90	320 nA
100Ω	1 mΩ	—	—	0.05% + 8 + 0.02Ω	0.09	1 mA
1000Ω	10 mΩ	—	—	0.05% + 8 + 0.02Ω	0.10	120 µA
10 kΩ	100 mΩ	—	—	0.05% + 8	0.11	14 µA
100 kΩ	1Ω	—	—	0.05% + 8	0.11	1.5 µA
1000 kΩ	10Ω	—	—	0.06% + 8	0.12	150 nA
10 MΩ	100Ω	—	—	0.25% + 6	1.50	150 nA
100 MΩ	100 kΩ	—	—	2% + 2	2.75	320 nA

Open Circuit Voltage: 3.2V max on 100Ω, 300Ω, 30 MΩ, 100 MΩ & 300 MΩ ranges; 1.5V max on all other ranges
Input Protection: 500V dc or ac rms on all ranges

DC Current

Range	Resolution			Accuracy	Typical Full Scale Burden Voltage
	Slow	Medium	Fast		
30 mA	—	1 µA	10 µA	0.05% + 3	0.45V
100 mA	—	10 µA	100 µA	0.05% + 2	1.4V
10A	—	1 mA	10 mA	0.2% + 5	0.25V
10 mA	100 nA	—	—	0.05% + 20	0.14V
100 mA	1 µA	—	—	0.05% + 5	1.4V
10A	100 µA	—	—	0.2% + 7	0.25V

Maximum Input: To be used in protected, low-energy circuits only, not to exceed 250V or 4800 volt-amps
mA: 300 mA dc or ac rms. Protected with a 500 mA, 250V, IEC 127 sheet 1 fast blow fuse
A: 10A dc or ac rms continuous or 20A dc or ac rms for 30 seconds maximum. Protected with a 15A, 250V, 10,000A interrupt rating fast blow fuse

AC Current (true-rms, ac coupled)

Range	Resolution			Typical Full Scale Burden Voltage
	Slow	Medium	Fast	
10 mA	100 nA	—	—	0.14V
30 mA	—	1 µA	10 µA	0.45V
100 mA	1 µA	10 µA	100 µA	1.4V
10A	100 µA	1 mA	10 mA	0.25V

Range	Frequency	Accuracy		
		Slow	Medium	Fast
mA	20-50 Hz	2% + 100	2% + 10	7% + 2
mA	50 Hz-10 kHz	0.5% + 100	0.5% + 10	0.8% + 2
mA	10-20 kHz	2% + 200	2% + 20	2% + 3
A (1A to 10A)	20-50 Hz	2% + 100	2% + 10	7% + 2
A (1A to 10A)	50 Hz-2 kHz	1% + 100	1% + 10	1.3% + 2
A (0.5A to 1A)	20-50 Hz	2% + 300	2% + 30	7% + 4
A (0.5A to 1A)	50 Hz-2 kHz	1% + 300	1% + 30	1.3% + 4

Accuracy specifications apply within the following limits, based on reading rate:
Slow: Between 15,000 counts and full range
Medium: Between 1,500 counts and full range
Fast: Between 150 counts and full range

Maximum Input: To be used in protected, low-energy circuits only, not to exceed 250V or 4800 volt-amps
mA: 300 mA dc or ac rms. Protected with a 500 mA, 250V, IEC 127 sheet 1 fast blow fuse
A: 10A dc or ac rms continuous or 20A dc or ac rms for 30 seconds maximum. Protected with a 15A, 250V, 10,000A interrupt rating fast blow fuse
Maximum Crest Factor: 3.0

AC + DC Current (calculated)

Total measurement error will not exceed the sum of the separate ac and dc accuracy specifications, plus one display count

Diode Test/Continuity

Accuracy	Maximum Reading	Resolution
Slow	999,99 mV	10 µV
Medium	2.5V	100 µV
Fast	2.5V	1 mV

Test Current: Approximately 0.7 mA when measuring forward bias junction
Audible Tone: Continuous tone for continuity. Brief tone for normal forward biased diode or semiconductor junction
Open Circuit Voltage: 3.2V maximum
Continuity Capture Time: 50 µs maximum, 10 µs typical
Input Protection: 500V dc or ac rms

Frequency

Frequency Range: 5 Hz to >1 MHz
Accuracy: 0.05% + 1, except 1000 Hz range, 0.05% + 2

Range	Resolution	
	Slow/Medium	Fast
1000 Hz	10 MHz	100 MHz
10 kHz	100 MHz	1 Hz
100 kHz	1 Hz	10 Hz
1000 kHz	10 Hz	100 Hz
1 MHz*	100 Hz	1 kHz

** Specified to 1 MHz, usable to 8 MHz when overdriven*

Sensitivity of AC Voltage	
Frequency	Level
5 Hz-100 kHz	30 mV rms sinewave
100 kHz-300 kHz	100 mV rms sinewave
300 kHz-1 MHz	1V rms sinewave
Above 1 MHz	Not specified

Sensitivity Level of AC Current		
Frequency	Input	Level
5 Hz-20 kHz	100 mA	+ 3 mA rms sinewave
45 Hz-2 kHz	10A	+ 3A rms sinewave

Environmental

Warmup Time: 1 hour to rated specifications
Temperature Coefficient: <0.1 times the applicable accuracy specifications per degree C from 0°C to 18°C and from 28°C to 50°C, (32°F to 64.4°F and 82.4°F to 122°F)
Operating Temperature: 0°C to 50°C (32°F to 122°F)
Storage Temperature: -40°C to 70°C (-40°F to 158°F). Elevated temperature storage of battery will accelerate battery self-discharge. Maximum storage time before battery must be recharged:

20°C to 25°C	1000 days
50°C	180 days
70°C	40 days

Relative Humidity (non-condensing): Up to 90%, 0°C to 28°C (32°F to 82.4°F); up to 80%, 28°C to 35°C (82.4 °F to 95°F); up to 70%, 35°C to 50°C (95°F to 122°F), except 70%, 0°C to 50°C (32°F to 122°F) for the 1 MΩ, 3 MΩ, 10 MΩ, 30 MΩ, 100 MΩ and 300 MΩ ranges.
Altitude: Operating, 0 to 10,000 feet; non-operating, 0 to 40,000 feet
Vibration: 3G @ 55 Hz per MIL-T-28800D, Class 3, Style E
Shock: Half-sine 40G per MIL-T-28800D, Class 5, Style E. Bench handling. Shipping container.

General Specifications

Maximum Common Mode Voltage: 1000V dc or peak ac from any earth input
Power: 90 to 264V ac (no switching required), 50 and 60 Hz <15 VA minimum
Standards: IEC 664 Installation Category II, Pollution Degree 2, complies with IEC348, UL1244, part 15 subpart J of FCC rules, VDE 0871 and CSA bulletin 556B
RS-232: Baud rates: 300, 600, 1200, 2400, 4800, and 9600. Odd, even or no parity. One stop bit, eight data bits.
External Trigger Input: VIH 1.35V minimum. VIL 1.25V maximum. Input threshold hysteresis, 0.6V maximum.
Size: 9.3 cm H x 21.6 cm W x 28.6 cm D (3.67 in H x 8.5 in W x 11.27 in D)
Weight: 2.35 kg (7 lb) net, 4.8 kg (10.5 lb) shipping
Included with Instrument: TL70 Test Leads, user's manual, quick reference guide and power cord

Options

IEEE-488.2: Capability codes SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, E1, TE0, LE0 and C0
Battery: Type — lead acid. Operating time — 8 hours typical, annunciator warns when less than 1/2 hour of battery operation remains. Recharge time — 16 hours typical, instrument off; trickle charge maintains charge on battery with instrument on. Operating and storage temperature same as for instrument.

Ordering Information

Model

Fluke 45 Dual Display Multimeter
Fluke 45-01* w/Battery
Fluke 45-05* w/IEEE-488.2
Fluke 45-15* w/Battery & IEEE-488.2

** Factory installed*

Options

-01K Rechargeable Battery Kit
-05K IEEE-488.2 Interface Kit

Accessories (Also see Section 5)

AC70 Alligator Clips
C25 Soft Carrying Case
C40 Soft Carrying Case
LCA-10 Line Current Adapter
TL20 Industrial Test Leads
TL70 Right-Angle Test Leads
Y8101 AC Current Probe
Y8134 Universal Test Lead Kit
Y8140 Slim-Flex Test Leads
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
80i-kW Current/Power Probe, 100A, 330 kW
80J-10 Current Shunt
80K-6 High Voltage Probe
80K-40 High Voltage Probe
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80T-150U Universal Temperature Probe
80TK Thermocouple Module
80PK-1 Bead Probe
80PK-2A Immersion Probe
80PK-3 Surface Probe
80PK-4A Air Probe
80PK-5 Piercing Probe
80PK-6A Exposed Probe

QuickStart 45

NEW



PC Software for the Fluke 45

The QuickStart 45™ software package helps you take advantage of the Fluke 45's standard RS-232 interface and your PC's resident RS-232 interface to harness the full computing power of your PC to the measurement capablities of the Fluke 45.

QuickStart 45 lets even a non-programmer quickly get on-line and communicate with the Fluke 45 over RS-232. With QuickStart 45, you can set up tests to run on an IBM PC® or compatible, take readings from the Fluke 45, and file them in .PRN format allowing access from Lotus 1-2-3® and other popular personal computer applications programs.

Easy Tests Controlled by Your PC

QuickStart 45 aids you in the creation of your own test procedures for the Fluke 45. You select the test parameters and QuickStart 45 generates the command syntax, making test generation easy for even non-programmers. Those procedures may then be saved and run with the touch of a single function key, enabling the easy call-up of test procedures.

A simplified editor which allows you to write and modify programs is also provided by QuickStart 45. The editor allows you to insert, delete or modify Fluke 45 remote commands, QuickStart 45 commands, programmer comments, operator messages and branching labels.

The QuickStart 45 editor allows you to create programs which call up other programs, branch to labeled program statements, loop, customize the startup sequence and much more. Programs written or edited by any text editor that saves files in ASCII can be run with QuickStart 45.

Set Intervals and Limit Conditions

QuickStart 45 lets you set measurement intervals to meet your particular data needs. Readings from both displays can be displayed, filed, printed or charted, and data can be stored with a time stamp.

You may also enter limit conditions for out-of-tolerance measurements, and specify actions to be taken based on these limit conditions. Limit statements cause a conditional action to be performed when a measurement returned from the multimeter is above or below a user-defined limit. Such actions include sounding an alarm and printing or filing out of limit data.

Turn Your Fluke 45 and PC Into a Chart Recorder

QuickStart 45 also has a chart mode which converts the data to a chart recorder-style presentation. Chart data from both Fluke 45 displays can be printed on the PC display or a printer.

The Interact Window

The interact window has a "meter" display which emulates the front panel of the Fluke 45. It gives the current status of the instrument, such as the functions in the primary and secondary displays; whether the modifiers dB, Rel, Min/Max or TouchHold® are active; and the reading rate of the instrument. From this screen you can send remote commands to the Fluke 45 and receive measurement data and configuration information in response.

The remote command generator of QuickStart 45 lets you send remote commands to the Fluke 45 without having to memorize command names and syntax. Fluke 45 commands can be selected through a sequence of menu selections and command prompts or entered from the keyboard.

Save Data, Commands or Both

QuickStart 45 allows you to save the data sent from the Fluke 45, commands sent to the Fluke 45, or both. Saving commands is a quick way to create a measurement program from a session in the interact window.

System Requirements

- IBM PC, PC/XT,® PC/AT,® PS/2® or fully compatible computers
- IBM DOS, version 2.1 or above
- RS-232 Serial Interface (i.e. com 1, com 2)

QuickStart 45 screen drivers directly address the following standard IBM (or compatible) display boards:

- Standard monochrome display
- Enhanced Graphics Adapter (EGA)
- Color Graphics Adapter (CGA)
- Video Graphics Array (VGA)

QuickStart 45 Includes:

- QuickStart 45 user's manual
- One 5¼" double-sided, double density diskette (360K byte)
- One 3½" double-sided diskette (770K byte)
- Fluke 45 Quick Reference Guide
- Slip case and binder for both the QuickStart 45 and the Fluke 45 user's manuals

Ordering Information

Model

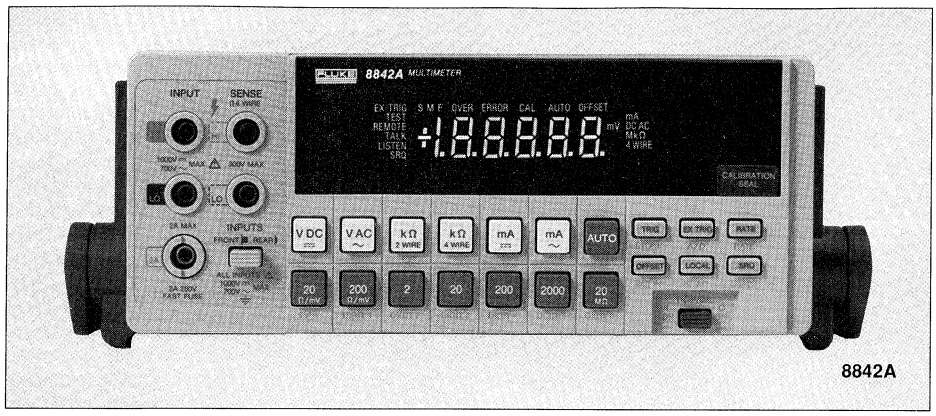
S45 QuickStart 45
RS40 RS-232 Terminal Cable (6')
(DB-9 to DB-25 female connector, connects to PC, PC/XT or PS/2)*
RS41 RS-232 Modem Cable (6')
(DB-9 to DB-25 male connector)

** For PC/AT, join both RS40 and RS41*

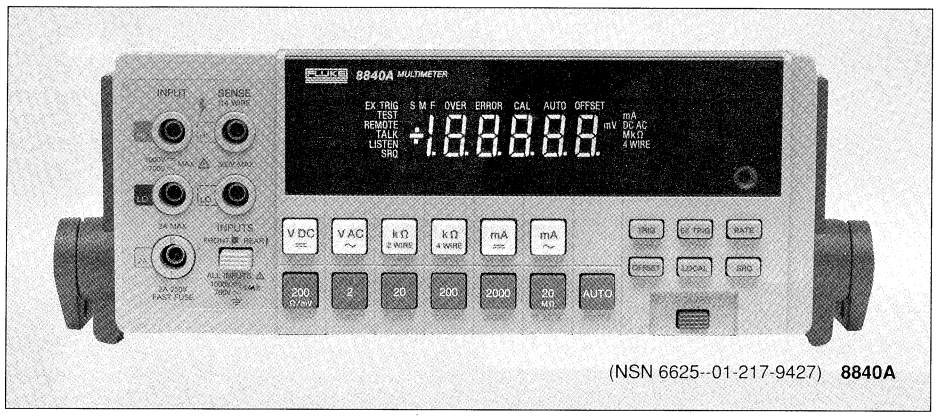
8840 Series

T&M EXPRESS LINE

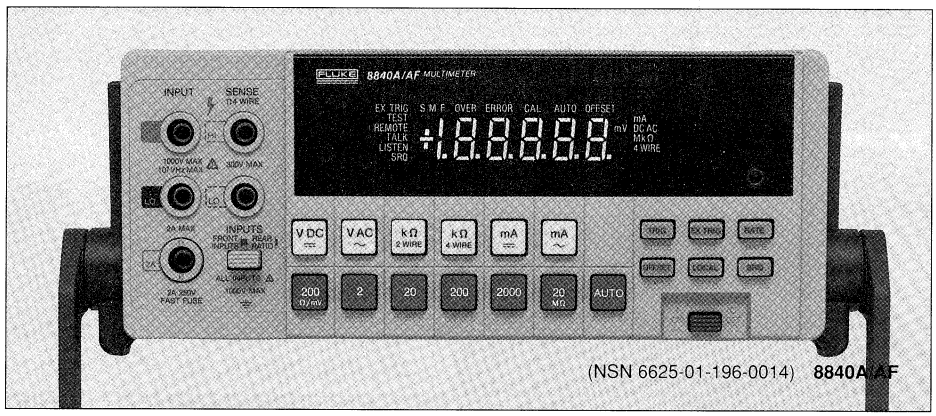
GPIB IEEE-488



8842A



(NSN 6625--01-217-9427) **8840A**



(NSN 6625-01-196-0014) **8840A/AF**

8840 Series 5½ Digit Multimeters

- Basic 1-year dc accuracies to 0.003%; ohms accuracy to 0.008%
- Ohms and dc current standard • AC voltage and current optional (8842A, 8840A)
- Full system capability with optional GPIB/IEEE-488 interface
- Up to 100 readings/second system speed
- Vacuum fluorescent display
- Closed-case calibration • Comprehensive self test

Performance

The 8840 Series has performance you would expect in multimeters costing much more. Basic dc accuracies to 0.003% and basic ac accuracies to 0.08% at one year are available. See the specifications that follow for complete information on measurement ranges and accuracy.

Closed-Case Calibration

No internal adjustments are required for calibration. After you initiate calibration via a recessed front panel switch, you are led through a software controlled procedure that even double checks to ensure that appropriate reference inputs have been applied. Calibration can be performed under front panel or GPIB/IEEE-488* control.

Self Testing

The 8840 Series automatically performs a digital self-test each time it is powered up. Additionally, you can initiate a comprehensive analog and digital diagnostic self-test from the front panel or through the IEEE-488 interface.

Powerful System Capabilities

Adding the inexpensive IEEE-488 interface option to the 8840 Series provides system capability which includes complete system control of functions, ranges, and reading rates. Front and rear panel inputs are switch-selectable from the front panel (and you can sense the status of the switch over the bus). Calibration and self-test can also be controlled over the bus.

Powerful yet simple device dependent IEEE -488 code allows the 8840 Series DMMs to be easily integrated into your system. System software written for the 8840A is compatible with the 8842A and 8840A/AF.

The mechanical design also contributes to performance and convenience in system applications. The 8840A Series' metal case provides EMI shielding to ensure measurement integrity. The unit can be mounted in a half-rack slot simply by removing the handle, turning the "twist-away" rear feet, and bolting on rackmount brackets.

Embodying all these features, the 8840 Series DMMs are fully programmable, powerful digital multimeters within reach of every system builder.

Technology

A monolithic A/D converter uses CMOS IC designed to achieve the superb accuracy, speed, and reliability of the 8840 Series.

Analog switch ICs developed by Fluke replace discrete switching devices to create superior performance, reliability, and serviceability.

A voltage reference device similar to that found in the Fluke 732A DC Reference Standard provides unmatched stability.

Precision thin film resistor networks establish the accuracy and maintain the stability of the 8840 Series.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Now You Can Choose The 8840 Series DMM To Meet Your Performance Needs

8842A: Premium Performance

The 8842A, top of the 8840 line, delivers all the features of the popular 8840A plus new hermetically sealed thin film resistors. These resistors make possible:

- **Increased measurement power:**
  100 nV resolution with a 20 mV range
  1 µA °C resolution with 200 mA range
  100 µΩ resolution with a 20Ω range
- **Enhanced accuracy in V dc, V ac, Ω**
  0.003% basic dc accuracy at 1 year
  0.08% basic ac accuracy at 1 year
  0.006% basic Ω accuracy at 1 year
- **Extended cal cycles, with 2 year specifications**
  0.005% basic dc accuracy at 2 years
- **Two year warranty**

8840A: The Original Value Leader

The original 8840A continues to provide an outstanding combination of low price and high performance. These features, common to all members of the 8840 Series, are responsible for the popularity of the 8840A.

- 0.005% basic dc accuracy at 1 year
- Ease of IEEE-488 system integration
- Closed case calibration
- Extensive self-test
- High reliability
- Vacuum fluorescent display
- Fluke's one year warranty applies

8840A/AF: For Tough Assignments

The 8840A/AF delivers all of the 8840A capabilities plus:

- Expanded environmental envelope
- Compliance with MIL-T-28800C Type II, Class 3, Style B
- True rms ac voltage/current capability is standard
- 1000V rms ac maximum allowable input
- Enhanced EMI/RFI protection
- Fluke's one year warranty applies
- DC voltage ratio

8842A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
20 mV	19.9999 mV	0.1 µV	1 µV	≥10,000 MΩ
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4½ digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20 mV [2]	0.0050+20	0.0070+30	0.0100+30	0.0120+40
200 mV [2]	0.0030+2	0.0045+3	0.0070+3	0.0100+4
2V	0.0015+2	0.0025+2	0.0030+2	0.0050+3
20V	0.0015+2	0.0030+2	0.0035+2	0.0060+3
200V	0.0015+2	0.0030+2	0.0035+2	0.0060+3
1000V	0.0020+2	0.0035+2	0.0045+2	0.0070+3

[1] Relative to calibration standards
[2] Within one hour of dc zero, using offset control.

Medium and Fast Rates: In medium rate, add 2 counts (20 counts on 20 mV range) to number of counts. In fast rate, use two 4½ digit counts (20 counts on 20 mV range) for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5 [5]	Analog & Digital	>98 dB	20V or 2xFS[4]	>140 dB
M	20 [6]	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.
[2] Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz±0.1% is 85 dB in S rate and 35 dB in M rate
[3] Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates
[4] 20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V
[5] Reading rate – .31 rdg/sec in the 20 mV, 20Ω, 200 mA dc ranges
[6] Reading rate – 1.25 rdg/sec in the 20mV, 20Ω, 200 mA dc ranges

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
200mV	199.999 mV	1 µV	10 µV	1 MΩ
2V	1.99999V	10 µV	100 µV	shunted
20V	19.9999V	100 µV	1 mV	by
200V	199.999V	1 mV	10 mV	<100 pF
700V	700.00V	10 mV	100 mV	

**4½ digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sineware inputs ≥10,000 counts[1] (5% of range)

Freq (Hz)	24 Hour[2] 23 ±°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100	1.2+100
45-200	0.3+100	0.35+100	0.4+100	0.5+100
200-20k (200 mV)	0.06+100	0.08+100	0.10+100	0.20+100
(2-200V)	0.05+80	0.07+80	0.80+80	0.15+80
(700V)	0.06+100	0.08+100	0.10+100	0.20+100
20-50k	0.15+120	0.19+150	0.21+200	0.25+250

[1] For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz
[2] Relative to calibration standard

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz
Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor 1.0 to 1.5	Crest Factor 1.5 to 2.0	Crest Factor 2.0 to 3.0
45 Hz to 20 kHz	0.05%	0.15%	0.3%
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2%	0.7%	1.5%

Operating Characteristics

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 Volt-Hertz product (whichever is less) for any range
Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20k-20k	Frequency in Hertz 20k-50k	Frequency in Hertz 50k-100k
≥10,000 counts	0.019+9	0.021+9	0.027+10
≥1,000 counts	0.019+12	0.021+15	0.027+21

Common Mode Rejction: >60 dB at 50 Hz or 60 Hz with 1 kΩ in either lead

8840 Series

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution	
		5½ Digits	4½ Digit [1]
200 mA [2]	199.999 mA	1 µA	10 µA
2000 mA	1999.99 mA	10 µA	100 µA

[1] *4½ digits at the fastest reading rate*
[2] *200 mA range is dc only*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	90 Days 23 ±5°C	1 Year 23 ±5°C	2 Years 23 ±5°C
200 mA	0.04+40	0.05+40	0.08+40
2000 mA			
≤1A	0.04+4	0.05+4	0.08+4
>1A	0.1+4	0.1+4	0.15+4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4½ digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy: (Requires Option -09)

Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz		
	20-45	45-100	100-5k*
One Year	2.0 + 200	0.5 + 200	0.4 + 200
Two Years	3.0 + 300	0.7 + 300	0.6 + 300

** Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4½ digit counts and frequencies >100 Hz, the accuracy is ± (0.2 % of reading + 30 counts)

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Frequency in Hertz		
	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 5 kHz	0.05	0.15	0.3
20 Hz to 45 Hz	0.2	0.7	1.5

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Current Through Unknown
		5½ Digits	4½[1] Digits	
20Ω[2]	19.9999Ω	0.1 mΩ	1 mΩ	1 mA
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

[1] *4½ digits at the fastest reading rate*
[2] *4-wire ohms only*

Accuracy

Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C	2 Year 23 ±5°C
20Ω[3]	0.007+30	0.009+40	0.012+40	0.015+40
200Ω	0.0040+3	0.007+4	0.010+4	0.012+4
2 kΩ	0.0025+2	0.005+3	0.008+3	0.010+3
20 kΩ	0.0025+2	0.005+3	0.008+3	0.010+3
200 kΩ	0.0025+2	0.006+3	0.010+3	0.012+3
2000 kΩ	0.023+3	0.025+3	0.027+3	0.030+3
20 MΩ	0.023+3	0.040+4	0.042+4	0.050+4

[1] *Within one hour of ohms zero, using offset control*
[2] *Relative to calibration standards*
[3] *4-wire ohms only*

Medium and Fast Reading Rates: In medium rate, add 2 counts to the number of counts for the 200Ω through 200 kΩ ranges, 3 counts for the 2000 kΩ and 20 MΩ ranges, and 20 counts for the 20Ω range. In fast reading rate, use three 4½ digit for the number of counts for the 200Ω range, 20 4½ digit counts for the 20Ω range, and two 4½ digit for all other ranges

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire (20Ω range is 4-wire only)

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates and Ranging

Reading Rates With Internal Trigger (readings per second)

Rate	Power Line Frequency [1]		
	50 Hz	60 Hz	400 Hz
S	2.08 (.26[2])	2.5 (.31[2])	2.38 (.30[2])
M	16.7 (1.04[2])	20 (1.25[2])	19.0 (1.19[2])
F	100	100	100

[1] *Sensed automatically at power-up.*
[2] *In the 20 mV, 20Ω, and 200 mA ranges. The 8842A does not autorange down into these ranges. To access these ranges, select the specific range, from the front panel or over the bus.*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, CT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground
Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage
Humidity Range: 80% RH from 0°C to 35°C; 70% to 50°C
Warmup Time: 1 hour to rated specifications
Power: 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-288000C for Type III, Class 3, Style E equipment
Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in H x 8.5 in W x 14.6 in D)
Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)
Warranty Period: Two years

Included with Instrument: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verification record and serialized and dated calibration sheet

Ordering Information

Models

8842A* Basic Digital Multimeter (DC only)
8842A/05 w/IEEE-488 Interface
8842A/09 w/True-RMS AC
8842A/059 w/IEEE-488 & True-RMS AC
** Option /09 or /059 needed to measure ac*

Options (for 8842A)

-05K* IEEE-488 Interface Field Kit
-09K* True-RMS AC Option Field Kit
** Requires recalibration*

Accessories (Also see Section 5)

Y8834 3½" Rack Mount Kit Offset, Single
Y8835 3½" Rack Mount Kit, Dual
Y8836 3½" Rack Mount Kit, Center
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8077 Four Terminal Short
A90 6-Range Current Shunt

8840A Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale $5^1/_2$ Digits	Resolution $5^1/_2$ Digits	Resolution $4^1/_2$* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

$4^1/_2$ digits at the fastest reading rate

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV [2]	0.003+3	0.007+4	0.008+4
2V	0.002+2	0.004+3	0.005+3
20V	0.002+2	0.005+3	0.006+3
200V	0.002+2	0.005+3	0.006+3
1000V	0.003+2	0.005+3	0.007+3

[1] *Relative to calibration standards*
[2] *Using offset control*

Medium and Fast Rates: In medium rate, add 2 counts. In fast rate, use two $4^1/_2$ digit counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of reading + 0.3 count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50 Hz, 60 Hz or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] *Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail*
[2] *Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate*
[3] *Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates*
[4] *20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V*

True-RMS AC Voltage Option (-09)

Input Characteristics

Range	Full Scale $5^1/_2$ Digits	Resolution $5^1/_2$ Digits	Resolution $4^1/_2$* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	1 MΩ
2V	1.99999V	10 µV	100 µV	shunted
20V	19.9999V	100 µV	1 mV	by
200V	199.999V	1 mV	10 mV	>100 pF
700V	700.00V	10 mV	100 mV	

$4^1/_2$ digits at the fastest reading rate

Accuracy

Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥10,000 counts [1] (5% of range)

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100
45-200	0.3+100	0.35+100	0.4+100
100-20k	0.07+100	0.14+100	0.16+100
20-50k	0.15+120	0.19+150	0.21+200
50-100k	0.4+300	0.5+300	0.5+400

[1] *For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.*
[2] *Relative to calibration standards*

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 $4^1/_2$ digit counts and >100 Hz

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz 20k-20k	20k-50k	50k-100k
≥10,000 counts	0.019 +9	0.021+9	0.027 +10
≥1,000 counts	0.019 +12	0.021+15	0.027 +21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency conponents ≤100 kHz, add the following % of reading to the accuracy specifications.

Fundamental Frequency	Crest Factor 1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05%	0.15%	0.3%
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2%	0.7%	1.5%

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 Volt-Hertz product (whichever is less) for any range
Common Mode Rejection: >60 dB at 50 Hz or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale $5^1/_2$ Digits	Resolution $5^1/_2$ Digits	Resolution $4^1/_2$ Digit *
2000 mA	1999.99 mA	10 µA	100 µA

$4^1/_2$ digits at the fastest reading rate

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Time	90 Days 23 ±5°C	1 Year 23 ±5°C
≤1A	0.04 +4	0.05 +4
>1A	0.1 +4	0.1 +4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two $4^1/_2$ digit counts (20 counts on 200 mA range) for number of counts
AC Accuracy: (Requires Option -09)
Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz 20-45	45-100	100-5k*
One Year	2.0 +200	0.5 +200	0.4 +200

Typically 20 kHz

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 $4^1/_2$ digit counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C
Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse
Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale $5^1/_2$ Digits	Resolution $5^1/_2$ Digits	Resolution $4^1/_2$ * Digits	Current Through Unknown
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

$4^1/_2$ digits at the fastest reading rate

3

8840 Series

Accuracy
Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω	0.004+3	0.011+4	0.014+4
2 kΩ	0.0028+2	0.01+3	0.013+3
20 kΩ	0.0028+2	0.01+3	0.013+3
200 kΩ	0.0028+2	0.01+3	0.013+3
2000 kΩ	0.023+3	0.027+3	0.028+3
20 MΩ	0.023+3	0.043+4	0.044+4

[1]Using offset control
[2]Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4½ digit counts for the 200Ω range and two 4½ digit counts

Operating Characteristics
Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C
Measurement Configuration: 2-wire or 4-wire
Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges
Input Protection: To 300V rms

Reading Rates

Reading Rates with Internal Trigger (readings per second)

Rate	Power Line Frequency*		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

** Sensed automatically at power-up*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground
Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage
Humidity Range: 80% RH from 0°C to 35°C; 70% to 50°C
Warmup Time: 1 hour to rated specifications
Power: 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment
Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in H x 8.5 in W x 14.6 in D)
Weight: Net, 3.4 kg (7.5 lb); shipping, 5 kg (11 lb)
Warranty Period: One year

Included with Instrument: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verification record and serialized/dated calibration certification sheet

Ordering Information

Models

8840A* Basic Digital Multimeter (DC only)
8840A/05 w/IEEE-488 Interface
8840A/09 w/True-RMS AC
8840A/059 w/IEEE-488 & True-RMS AC

**Option /09 or /059 needed to measure ac*

Options (for 8840A)

-05K* IEEE-488 Interface Field Kit
-09K* True-RMS AC Option Field Kit

**Requires recalibration*

Accessories (Also see Section 5)

Y8834 3½" Rack Mount Kit Offset, Single
Y8835 3½" Rack Mount Kit, Dual
Y8836 3½" Rack Mount Kit, Center
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8077 Four Terminal Short
A90 6-Range Current Shunt

8840A/AF Specifications

Technical Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.9999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4½ digits at the fastest reading rate*

Accuracy
Normal (S) Reading Rates: ±(% of Reading + Number of Counts)

Range	24 Hour [1] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200 mV [2]	0.003+3	0.007+4	0.008+4
2V	0.002+2	0.004+3	0.005+3
20V	0.002+2	0.005+3	0.006+3
200V	0.002+2	0.005+3	0.006+3
1000V	0.003+2	0.005+3	0.007+3

[1]Relative to calibration standards
[2]Using offset control

Medium and Fast Rates: In medium rate, add 2 counts; In fast rate, use two 4½ digit counts

Operating Characteristics
Temperature Coefficient: >±(0.0006% of Reading + 0.3 count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50 Hz, 60 Hz or 400 Hz

Rate	Readings/ Second [1]	Filter	NMRR [2]	Peak NM Signal	CMRR [3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS [4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	–	1xFS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail
[2] Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz ± 0.1% is 85 dB in S rate and 35 dB in M rate
[3] Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates
[4] 20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V

True-RMS AC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution 5½ Digits	Resolution 4½* Digits	Input Resistance
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by >100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4½ digits at the fastest reading rate*

Accuracy
Normal (S) Reading Rates: ±(% of Reading + Number of Counts) for sinewave inputs ≥5% of range (10,000 counts[1])

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
20-45	1.2+100	1.2+100	1.2+100
45-100	0.3+100	0.35+100	0.4+100
100-20k	0.07+100	0.14+100	0.16+100
20-50k	0.15+120	0.19+150	0.21+200
50-100k	0.4+300	0.5+300	0.5+400

[1] For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz
[2] Relative to calibration standards

Medium and Fast Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz

Operating Characteristics
Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz		
	20k-20k	20k-50k	50k-100k
≥10,000 counts	0.019+9	0.021+9	0.027+10
≥1,000 counits	0.019+12	0.021+15	0.027+21

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor		
	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05%	0.15%	0.3%
20 Hz to 45 Hz & 20 kHz to 50 kHz	0.2%	0.7%	1.5%

Maximum Input: 1000V rms or 2 x 10^7 Volt-Hertz product (whichever is less) for any range
Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution	
		5½ Digits	4½ Digit *
2000 mA	1999.99 mA	10 µA	100 µA

**4½ digits at the fastest reading rate*

DC Accuracy
Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Current	90 Days 23±5°C	1 Year 23±5°C
≤1A	0.04+4	0.05+4
>1A	0.1+4	0.1+4

Medium and Fast Rates: In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4½ digit counts (20 counts on 200 mA range) for number of counts

AC Accuracy
Normal (S) Reading Rate: ±(% of Reading + Number of Counts) 23°±5°C, for sinewave inputs ≥10,000 counts

Time	Frequency in Hertz		
	20-45	45-100	100-5k*
One Year	2.0+200	0.5+200	0.4+200

** Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4½ digit counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics
Temperature Coefficient: Less than 0.1 x accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C
Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse
Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Current Through Unknown
		5½ Digits	4½* Digits	
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 µA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 µA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 µA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 µA

** 4½ digits at the fastest reading rate*

Accuracy
Normal (S) Reading Rate: ± (% of Reading + Number of Counts)[1]

Range	24 Hour [2] 23 ±1°C	90 Day 23 ±5°C	1 Year 23 ±5°C
200Ω	0.004+3	0.011+4	0.014+4
2 kΩ	0.0028+2	0.01+3	0.013+3
20 kΩ	0.0028+2	0.01+3	0.013+3
200 kΩ	0.0028+2	0.01+3	0.013+3
2000 kΩ	0.023+3	0.027+3	0.028+3
20 MΩ	0.023+3	0.043+4	0.044+4

[1] Using offset control
[2] Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4½ digit counts for the 200Ω range and two 4½ digit counts

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire
Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges
Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second)

Rate	Power Line Frequency*		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

** Sensed automatically at power-up*

IEEE-488 Interface Option (-05)

Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

General Specifications

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground
Temperature Range: 0°C to 55°C operating; -62°C to 85°C storage
Humidity Range: 95% RH, +5% to 0%
EMI: Complies with CE01, CE03, CS01, CS02, CS06, and REO2 as specified in MIL-STD-461
Altitude: 4,500m (15,000 ft) operating; 12,000m (40,000 ft) non-operating
Warmup Time: 1 hour to rated specifications
Power: 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment
Safety: ANSI C39.5 and IEC 348, Class I and VDE 0411 Marks License
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.47 in H x 8.5 in x W x 14.6 in D)
Weight: Net, 3.4 kg (7.5 lb); shipping, 5 kg (11 lb)
Warranty Period: One year

Included with Instrument: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, (with Option -05 only), instrument performance verification record and serialized/dated calibration certification sheet

Ordering Information

Model
8840A/AF Digital Multimeter

Options (for 8840A/AF)
-05 IEEE-488 Interface
-05K IEEE-488 Interface Field Kit

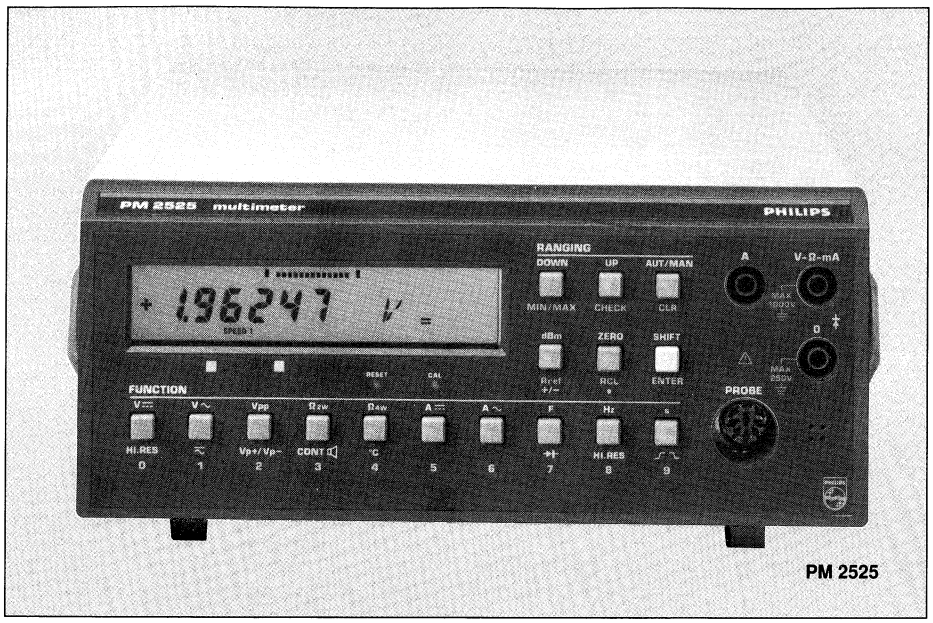
3

PM 2525

T&M EXPRESS LINE

GPIB IEEE-488

RS-232



PM 2525 Digital Multifunctional Multimeter

- 4-1/2 to 5-1/2 digit meter with 0.1 nA resolution (±0.4% of reading ±0.15% of range)
- More measurement functions (Hz, Time, Capacitance, Temp, etc.)
- Battery option for field use
- GPIB/IEEE-488, RS-232C and analog output options for system operation
- Simple command structure for system programming
- Comprehensive overload protection

PM 2525 Measurement Center

The PM 2525 is a very high specification instrument, offering a full range of standard DMM measurement features plus a range of unique extra functions, making it a complete "**measurement center.**"

Besides standard functions such as 8 current, 5 voltage and 7 resistance ranges, the PM 2525 also has the additional features of measurement of frequency, time, temperature, capacitance, dB and continuity.

For precision measurements the PM 2525 includes a 21,000 count facility plus a high resolution mode of 210,000 counts. This gives a resolution down to 1µV for Vdc; 100 pA for ac and dc current; 10 mohm for resistance; and 1 pF for capacitance.

Bench, Battery or System Versions

The PM 2525 is available in five versions covering most applications:

1. **Basic benchtop model:** For use in laboratory, workshop and production environments.
2. **Battery model:** For field use. Rechargeable battery for 5 hrs operation included.
3. **Instrument with an analog output:** For analog registration of the results.
4. **GPIB/IEEE-488* interface version:** For operation with IEEE systems.
5. **RS-232 instrument:** For operation with a computer.

The last two interface versions allow remote control of all instrument settings and downloading of measured values to a computer or system controller. These versions are supplied with special interface software which has the same command structure, in plain English, used by Philips system multimeters. Meters with an interface also have an additional high speed mode which provides 3-1/2 digit Vdc measurements at a rate of approximately 10 measurements/sec.

Current Measurement with Low Voltage Drop

For measurements up to 1 mA the PM 2525 is equipped with a unique current-compensation system that virtually eliminates voltage drops across the meter input, eliminating a common source of significant errors in low current measurements.

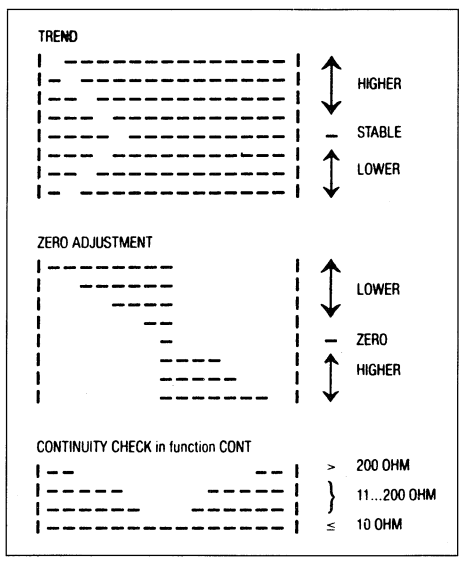
** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

More Functions, More Value

	Ranges	Max. Res.	Accuracy
VDC	5	1 µV	0.02%
VAC	5	10 µV	0.2%
Vt rms	5	10 µV	0.3%
Vpeak	4	1 mV	1.0%
IDC	8	100 pA	0.1%
IAC	8	100 pA	0.4%
R (2-wire)	7	10 mΩ	0.1%
R (4-wire)	5	10 MΩ	0.1%
Hz	4	0.1 Hz	0.01%
Capacitance	6	1 pF	1.0%
Time	5	10 µsec	0.01%
Temperature	—	0.1°C	0.3%
Diode	—	100 µV	
dBm	5	0.1 dB	1.0%

Trend Display with an Analog Bargraph

The PM 2525 has an analog bargraph display for optimal presentation of signal trends and precision detection of peak, through or null value, which is particularly valuable for peak tuning of communication equipment, for example. The rotating bargraph indicator on the LCD display steps in proportion to the voltage trend. With a 5V signal, the resolution is 0.01V per step, much higher than can normally be achieved with conventional analog multimeters.



Relative Measurements

Adjustments are easily made by presetting a value as a reference zero by a single touch of the zero-set button. Deviation, positive or negative from the set zero, is then immediately and clearly displayed. Also the bargraph function can be used in the same way so that the bargraph then acts as a very sensitive minus-null-plus indicator.

Overload Protection

The PM 2525 also includes comprehensive overload protection. All voltage ranges can handle peak transients of up to 2.5 kV without damage, while all other ranges are protected against accidental connection to normal power supplies. The instrument is electronically protected on current ranges up to 1 mA and by a fuse for the 10 mA and 100 mA ranges. The 1A and 10A ranges have a separate input socket.

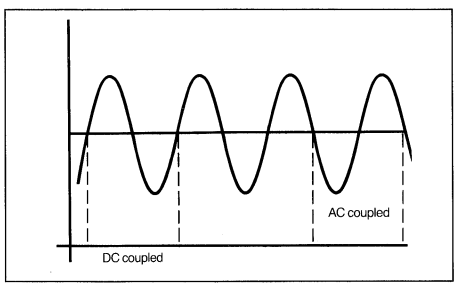
Fast Result with MIN/MAX, Peak-Peak, dBm

A number of special measuring capabilities not only makes measurement easier but allows the user to reach conclusions faster. For practically all measurements the MIN/MAX function can be switched in. This function displays the maximum and minimum reading over a given period, for all measurement functions. Volt peak-peak gives the instant peak voltage. A selection can be made for positive, negative or peak-to-peak values. So, too, can adjustments be made more easily by using the dBm function.

For both current and voltage, the measurement can be read in dBm's. And, since the reference resistance can be easily selected as well, levels can be quickly compared to a known reference.

Choice of AC- or DC-Coupled True RMS Measurements

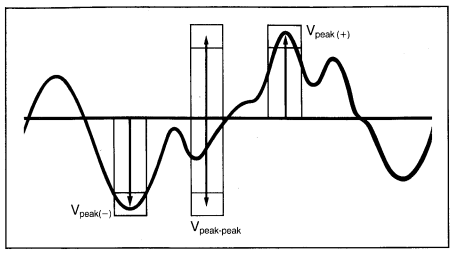
For accurate measurements of AC and AC + DC signal voltage components regardless of the waveform.



True RMS measurements are only possible with DC coupling since the DC component is an important part of the total signal energy. But AC coupling is essential for accurate measurements of AC components on large DC signals. The PM 2525's RMS measurement function always gives accurate RMS readings in both AC- and DC-coupled modes and even with highly distorted signal waveforms.

Accurate Measurement of Peak Values

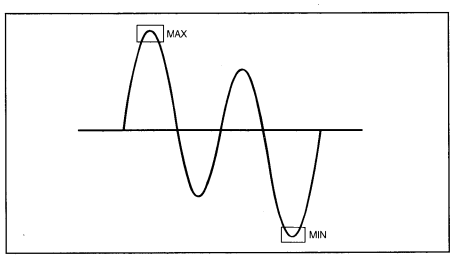
Direct measurement of positive, negative and peak-to-peak values.



This function is valuable for measuring ignition or discharge voltages, as well as for measuring crosstalk between lines, and in electronic circuit design. In combination with Min./Max. mode, the V_{peak} function allows the peak value of disturbances on a signal to be measured over an extended monitoring period.

Convenient Min/Max Measurements

For minimum and maximum values over extended monitoring periods.

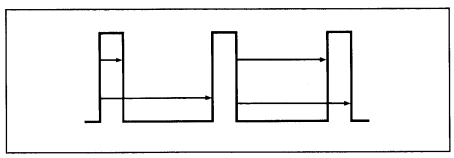


Min./Max. level monitoring throughout the duration of a measurement is easy and convenient with the PM 2525. Measured Min./Max. values are stored until replaced by lower or higher values, and can be recalled and displayed at any time.

This function is useful to measure low-frequency signals (in order of 1 Hz), when the maximum and minimum values can be readout within a few seconds. It also allows highest and lowest temperature values over extended periods to be measured simply and conveniently.

Time and Frequency Measurements

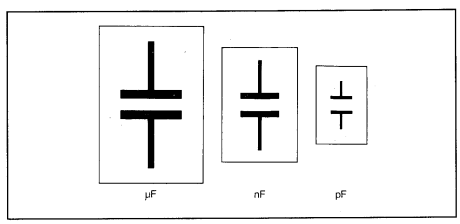
Extra versatility through high-resolutions time and frequency functions.



One of the PM 2525's extra measuring capabilities is a useful time function with a range of up to 100,000s and a maximum resolution of 10 µs. Freely programmable start and stop edges enable all periods and pulse width measurements to be made in a repetitive or single trigger mode. Two different frequency measurements are possible. In the normal mode there is a resolution of 1 Hz, but in the 'High resolution' mode a resolution of 0.1 Hz can be achieved. Maximum frequency is 20 MHz.

Capacitance Measurements

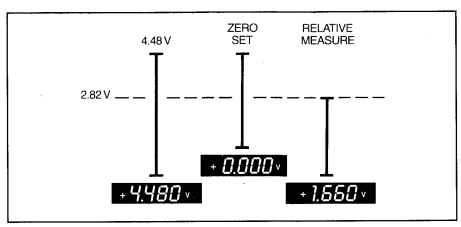
For measuring unknown devices or lead capacitances.



The PM 2525's capacitance function is unmatched in its class. The capacitance of any unknown device, or even of PCB tracks, can be measured directly in a wide range from 20 nF right up to 200 µF, down to a resolution of 1 pF. High noise immunity ensures stable readings at all times, even when using normal DMM test leads, thereby eliminating the need for special guarded leads. Cable capacitance can even be compensated using the zero-set function.

Simple Zero-Setting for Relative Measurements

Direct measurement of tolerances or deviations from any preset value.

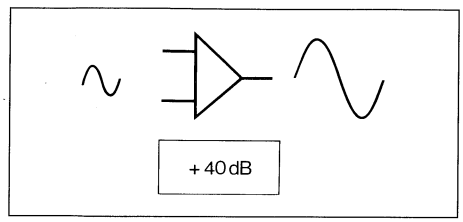


Zero-setting to use any value for relative reference measurements is done simply with the PM 2525, simply by pressing the ZERO button. This principle allows tolerance measurements, or component deviations from specified values, to be measured directly, and eliminates the need to make all measurements as absolute values.

PM 2525

Direct dB Read-Out

AC and DC voltages shown as dB values to any zero reference level. And with user programmable reference resistance.



This function allows VAC and VDC measurements to be read-out directly as dB values, saving time-consuming calculations. dB measurements are made against an absolute or selectable zero reference level. It is also possible to program a different reference resistance.

Direct dB read-outs are essential for measurements on amplifier gains and losses, or on communications equipment. The dB function can also be used in conjunction with the zero-set mode for 'end-to-end' amplifiers measurements.

Simple Command Structure

The PM 2525 can be used within a system via its IEEE-488 bus interface. In such a system, procedures are programmed using a simple command structure which eliminates complex codes by using straight-forward English statements.

To ease communication with both user and computer, the PM 2525 accepts numeric ranging values in either decimal or exponential notation, and automatically rounds-off to the correct range. To overcome the often lengthy and complex task of splitting the numerical data from the output string, the PM 2525 has an "OUT N" command by which only the numeric value is transferred.

Closed-Case, Electronic Calibration

The PM 2525 can be electronically calibrated and tested without opening the case, if the unit is equipped with an IEEE-488 or RS 232 interface. This function offers substantial time and cost savings and ensures that measurements are always made at optimum accuracy.

Multipoint, Multifunction Measurements

If a system measurement application requires measurements to be made at a number of different points the PM 2525, combined with the Philips System 21 switching system and a IEEE-488 controller, is the cost-effective answer.

This high performance combination can handle any number of single-, dual- or 4-pole measurements at a much lower cost than would be possible with normal large and expensive scanners. Moreover, as it is based around the PM 2525, functions such as frequency, time and peak measurement are also possible, further extending the versatility of remote controlled operation.

Specifications

Technical Specifications

DC Voltage

Range: 200 mV...1000V
Resolution: 10 µV (1 µV in high resolution mode)
Counts: 21.000 (210.000 in high resolution mode)
Accuracy: ±0.02% of reading ±0.01% of range
Temperature Coefficient: ±0.002% of reading ±/°C
Input Impedance: ≥10 MΩ//≤90 pF
Offset Current in Input: <20 pA
SMMR (line frequency): >80 dB
Maximum SM Signal: 2 x range (except 2000V range)
CMRR (For DC and line frequency): >120 dB
Maximum CM Voltage: 250V RMS: 350V peak
Response Time: Without ranging 0.8s
With ranging 1.5s
Maximum Input Voltage
Hi and Lo: 1000V RMS
Hi and Earth: 1000V RMS
Lo and Earth: 250V RMS
Max. V-Hz Product of Input Signal: 10^7

AC Voltage True RMS (AC or DC Coupled)

Range: 200 mV...750V
Resolution: 10 µV
Counts: 21.000
Accuracy*
20...40 Hz: ±0.6% of reading ±0.2% of range
40...100 Hz: ±0.2% of reading ±0.1% of range
100 Hz...20 KHz: ±0.8% of reading ±0.2% of range
20...50 KHz: 2,5% of reading ±0.5% of range
50...100 KHz: 4.0% of reading ±0.5 of range
Temperature Coefficient: ±0.025% of reading ±0.005% of range/°C
Input Impedance: ≥10 MΩ//≤90 pF
CMRR: For DC: 120 dB; line frequency: 60 dB
Response Time: Without ranging 0.8s
With ranging 2.5s
Crest Factor: 2 at full scale, increasing down scale
Maximum Input Voltage
Hi and Lo: 750V RMS
Hi and Earth: 750V RMS
Lo and Earth: 250V RMS
Maximum V-Hz Product: 10^7
**Additional error for DC-component ±0.2% of reading ±0.1% of range. Range 2000V max 70 Hz*

DC Current

Ranges: 1 µA...10A
Resolution: 0.1 nA
Counts: 11.000
Accuracy: ±0.1% of reading ±0.05% of range
Temperature Coefficient: ±0.01% of reading ±0.005% of range/°C
Voltage Drop Full Scale
1 µA...1 mA: <2.5 mV
10 mA/1A: <40 mV
100 mA/10A: <400 mV
Response Time: Without ranging 0.8s
With ranging 1.5s
Protected for 1 µA...100 mA up to: 250V RMS
Max. CM Voltage: 250V RMS, 350V peak
Max. Input Voltage: 250V RMS

AC Current RMS

Ranges: 1 µA...10A
Resolution: 0.1 nA on 1 µA range
Counts: 11.000
Accuracy (5% - 100% of range):
±0.4% of reading ±0.15% of range (40...200 Hz)
±0.6% of reading ±0.2% of range (20...500 Hz)
Temperature Coefficient:
±0.04% of reading ±0.015 % of range/°C
Frequency Range: 20 Hz...500 Hz
Voltage Drop
1 µA...1 mA: <2.5 mV
10m and 1A: <40 mV
100 mA and 10A: <400 mV
Crest Factor: 4 at full scale, increasing down scale
Response Time: Without ranging 1.5s
With ranging 3s
Protected for 1 µA...100 mA up to: 250V RMS
Max. CM Voltage: 250V RMS, 350V peak
Max. Input Voltage: 250V RMS

Ohms

Ranges two-wire: 200Ω..200 MΩ
Ranges four-wire: 200Ω...2 MΩ
Maximum Lead Resistance (4 wire): 2Ω
Resolution: 10 mΩ
Counts: 21.000 (200Ω...20 MΩ)
2100 (200 MΩ)
Accuracy
200Ω - 200 KΩ: ±0.1% of rdg ±0.05% of range
2 MΩ - 20 MΩ: ±0.5% of rdg ±0.05% of range
200 MΩ: ±3% of reading ±1% of range
Temperature Coefficient
200Ω- 200 KΩ: ±0.01% of reading ±0.005% of range/°C
2 MΩ - 20 MΩ: ±0.05% of reading ±0.01% of range
200 MΩ: ±0.5% of reading ±1% of range/°C
Measuring Current for each Range: 1 mA, 1 mA, 100 µA, 10 µA, 1 µA, 100 nA, 10 nA
Open Input Voltage: 4V
Response Time (200Ω - 200 KΩ)
Without ranging: 0.8s; With ranging: 2.5s
Response Time (2 MΩ - 20 MΩ)
Without ranging: 2s; With ranging: 3.5s
Response Time (100 MΩ)
Without ranging: 9s; With ranging: 10s
Input Protection: Up to 250V RMS
Max. Input Voltage: 250V RMS

Peak Voltage

Range: 2V...1000V
Resolution: 1 mV

Counts: 2100
Accuracy: ±1% of reading ±10 digits
Temperature Coefficient: ±0.15% of rdg/°C
Input Impedance: ≥10 MΩ//≤90 pF
Measuring Time: 500 ms
+Continuous Wave Mode:
min pulse width: 5 µs
min period: 100 µs for min duration of 500 ms
+Single Shot Mode:
min pulse width: 350 ms
min period: 500m sec synchronized with trigger
Frequency Range (except DC): 20 Hz...100 KHz*
Response Time:
Peak without ranging: 1s
Peak with ranging: 2.5s
Peak-peak without ranging: 1.5s
Peak-peak with ranging: 5s
Maximum Input Voltage
Hi and Lo: 600V AC or DC or 850V peak
Hi and Earth: 600V AC or DC
Lo and Earth: 250V AC or DC
Max. V-Hz Product: 10^7
CMMR: For DC: 120 dB; for line frequency: 60 dB
** For 2000V range max. 60 Hz*

Frequency

Ranges: 10 kHz...20 MHz
Minimum Frequency: 10 Hz
Resolution: 1 Hz; (0.1 Hz in high resolution mode)
Counts (10 KHz...10 MHz): 10.000 (100.000 in high resolution mode)
Counts (20 MHz): 2.000 (20.000 in high resolution mode)
Accuracy: ±0.01% of reading ±2 digits
Temperature Coefficient: ±0.001% of rdg /°C
Response Time (100 KHz...20 MHz)
Without ranging: Normal mode 0.3s
With ranging: Normal mode 0.5s
Without ranging: High resolution 2.5s
With ranging: High resolution 3s
Response Time (10 KHz)
Without ranging: Normal mode 1.5s
With ranging: Normal mode 2s
With ranging: High resolution 13s
Impedance: 10 MΩ//50 pF
Coupling: AC
V-Hz Product for Voltage <5V max.: 10^7
Maximum Input Voltage: 250V
Sensitivity
10 Hz...100 Hz: 1V peak
100 Hz...10 MHz: 250 mV peak
10 MHz...20 MHz: 500 mV peak

Time

Range: 1...10^5s
Resolution: 10 µs
Counts: 99.999
Accuracy: 0.01% of reading
Temperature Coefficient: ±0.001% of rdg /°C
Hold-Off Time: 30 µs
Start/Stop: Positive or negative slope selectable
Trigger Level: <1V
Modes: Repetitive or single trigger

Capacity

Ranges: 20 nF...2000 µf
Resolution: 1 pF
Counts: 21.000 (2100 in 2000 µF range)
Accuracy: ±1%** of reading ±0.1% of range
Temperature Coefficient: ±0.1%* of reading ±0.01% of range/°C
Measuring Current (for each range): 100 nA, 1 µA, 10 µA, 100µA, 1 mA, 1 mA
Open Input Voltage:≤2.5V
Polarity Input Socket: + on Lo
Response Time:
without ranging: 1s
with ranging: 1.5s
Protected up to: 250V
** For 2000 µF range 10%*
*** For 2000 µF range 1%*

Continuity

Driving Current: 1 mA
Short circuit: Audible tone from 0...10Ω
Isolation: Resistance <10Ω no tone
Response Time: <0.15s

Diode

Driving Current: 1 mA
Response Time: 0.8s
Range: 2000.0 mV
Resolution: 0.1 mV
Counts: 20.000
Polarity Input Socket: + on Lo
Max. Input Voltage: 250V

Temperature*

Range:-100°C...+850°C
Resolution: 1°C (0.1°C in high resolution mode)
Number of Counts: 850 (8500 in high resolution mode)
Accuracy (excl. probe): ±0.3% of rdg ±0.3°C
Temperature Coefficient: ±0.03% of reading ±0.03% of range/°C
Measuring Current: 1 mA
Response Time (excl. probe): 0.5s
Linearization: Probe characteristics is linearized within limits stated in DIN 43760
** For temperature additional PM 9249/01 or Pt 100 element is required.*

dB Measurement (General)

dB Reference: 1 mW in reference resistance
Reference Resistor (programmable): 0.0001...9999Ω
Resolution: 0.1 dB (signals >1 mV)
Number of Counts: 8500
Accuracy: ±0.2 dB
Input Impedance: <10 MΩ//<90 pF
CMMR (DC): <120 dB
Response Time: 1.5s (3s for AC)

dB Measurement (DC Ranges)*

Range (600Ω): -77...+62.2 dB
Resolution of Signal >1 mV: 0.1 dB
Counts if signal >1 mV: 999
Accuracy (if signal >1 mV): ±0.1 dB
Temperature Coefficient: ±0.0005 dB/°C

dB Measurement (AC Ranges)*

Range (600Ω): -51.7...+59.7 dB
Accuracy (20 Hz...20 KHz): ±0.2 dB
Add. Accuracy for DC Component: ±0.2 dB
Temperature Coefficient: ±0.02 dB/°C
** If not specified: see DC VOLTAGE and AC VOLTAGE True RMS. Signals <2 mV displayed as UL (under load)*

Interfaces

Three interfaces are available:

(1) The **GPIB** (PM 2525/52x only) (IEEE-488/IEC-625 compatible) makes it possible to operate in an automatic measurement environment.
Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1
Programmable: All functions and all ranges

(2) The **RS-232** interface (PM 2525/62x only) offers a low cost solution for computer control of the interface. The so-called 'Multidrop' mode allows a number of devices to be controlled by the same computer. Selection of the device is made by SOH or STX followed by a selected character.
Interface Functions
Baud Rate: 110...9,600 baud
Stop Bits: 1 or 2
Parity: Odd, even or no
Length: 7 or 8
Input connector: 25 pin male
Handshake: Hardware or software

(3) The **analog output** (PM 2525/72x only) allows the selective monitoring of a part of the digital display and is scaled between 0 and 1 Volt. A selection can be made which part of the display will be sent to the output.
Output Voltage: 0...1V
Accuracy: ±0.25% of reading ±0.25% of range
Temperature Coeff.: ±0.025% of reading ±0.01% of range
Output Resistance: 200Ω

General Specifications

Power Supply
High Range: 196V...258V, 50 Hz
Low Range: 98V...129V, 60 Hz
Power Consumption: 12 VA
Operating Time (Full Charge): >5 hrs*
Charging Time: <15 hours*
Temp. Limits of Operation: 0...+45°C*
Low Battery Indication: On display*
** PM 2525/22x only*

Environmental Conditions

Reference Temperature: +23°C ±5°C
Rated Range of Use: 0°C...+40°C
Operating Range: 0°C...+55°C
Storage and Transport Range: -40°C...+70°C
Humidity Operating Limits: 20...80%
Maximum Dew Point: +26°C
Storage and Transport: 5...95%

PM 2525

Emission: CISPR publ. 11 and 14, VDE 871-B, VDE-875-K acc. to Vfg 1046/84
Safety Class: IEC 348 class II (class I for PM 2525/52x, PM 2525/62x and PM 2525/72x)
Calibration Interval: 1 year
Calculated MTBF: 10.000h

Mechanical Specifications

Dimensions: 287 L x 210 W x 86 H mm (11.3 in L x 7.3 in W x 3.4 in H)
Weight: 2.5 kg (5.5 lb)
Included With Instrument: 2 measuring leads and probes, Operating manual

Ordering Information

Models

PM 2525/02x Standard Digital Multimeter
PM 2525/22x with Battery Pack
PM 2525/52x with GPIB/IEEE-488 Interface
PM 2525/62x with RS 232 Interface
PM 2525/72x with Analog Output
x = Power option

Power Options

Instruments are normally delivered in accordance with local power requirements. If an alternative power option is required, the instrument can be supplied with a different power setting and cord. In such cases, please specify one of the following options:
/**..1** Universal European 220V/16A/50 Hz
/**..2** Standard North America 100V/16A/60 Hz
/**..4** United Kingdom 240V/13A/50 Hz
/**..5** Switzerland 220V/10A/50 Hz

Accessories

Delivered with the instrument:
PM 9266/03 Set of safety test leads with probes (UL-aproved)
4822 872 30375 Operating Manual for PM 2525
And if applicable:
4822 872 30376 Operating Manual for analog output section of PM 2525/71
4822 872 30392 Operating Manual for battery section of PM 2525/21
4822 872 35308 Service Manual for PM 2525/01, /21, /51, /61, /71
4822 253 20015 Spare Fuse 630 mA slow blow

Optional available:
PM 9053 Adaptor Banana (m) - BNC (f)
PM 9071 Measuring cable 135Ω Banana (m) - Banana (m)
PM 9072 Measuring cable 135Ω BNC (m) - Banana (m)
PM 9210/00 High Frequency 10 mV Probe 10 kHz...1 GHz
PM 9212/00 Accessoires for HF probe PM 9210
PM 9213/00 High Frequency 10 mV probe 10 kHz...100 MHz
PM 9244/00 AC and DC current shunt up to 31.6A
PM 9245/00 AC current transformer 10A...150A
PM 9246/03 High tension probe
PM 9249/01 Temperature probe
PM 9260/00 Set of test leads with probes
PM 9266/02 Set of safety test leads with probes
5322 321 20506 4-wire ohms cable
PM 9264/01 Data hold probe
PM 9877 J Thermocouple linearizer J-type
PM 9877 K Thermocouple linearizer K-type
PM 2193/01 19-inch rackmount
4822 872 35308 Service manual for PM 2525/01, /21, /51, /61, /71

8505A & 8506A

GPIB IEEE-488



(NSN 6625-01-126-3154) **8505A**
(NSN 6625-01-234-4134) **8506A**

8505A Digital Multimeter

- 5 ppm dc accuracy, 100 nV (nanovolt) sensitivity
- 500 readings per second with 6½ digit resolution
- AC (8505A only), ohms, current module options
- GPIB/IEEE-488, RS-232-C, and parallel interfaces
- Front-rear switchable input standard in basic mainframe
- Software calibration from front panel or remote interface
- Modular construction for application flexibility

8506A Thermal RMS Digital Multimeter

- 8505A features plus
- 120 ppm 24 hour ac accuracy, 40 Hz to 20 kHz
- Full accuracy for crest factors as high as 8:1
- 25 ppm short-term ac stability
- Frequency response specified to 1 MHz
- AC-DC transfer accuracies with DMM speed & convenience

The 8505A and 8506A Digital Multimeters are Fluke's most advanced bench/system DMMs. Both models excel in dc accuracy, resolution, versatility and speed.

The 8506A uses a fast thermal rms sensing technique for measuring ac which very significantly advances the state-of-the-art for ac measurements using a system DMM. It is several times more accurate than the calculating type of true-rms converter and is unmatched by any other DMM. Basic ac accuracy uncertainty is reduced to 120 parts per million, 24 hours for frequencies from 40 Hz to 20 kHz. That approximates the accuracy you can expect using traditional thermal transfer techniques that typically take several minutes for each measurement. Short term stability is 25 ppm. Accuracy is specified from 10 Hz to 1 MHz and non-sinusoidal waveforms having crest factors as high as 8 to 1 can be measured with full 90-day accuracy.

Software Calibration

Both the 8506A and 8505A have a "software calibration" feature that makes it easy to store correction factors for every range of any measurement function. You can update the 24-hour accuracy specifications daily, or whenever the need arises without having to remove the covers. Nor do you need to use a cardinal point standard for a reference. Any reference having a suitably accurate value between 60% of range and full scale will do. This "software calibration" is managed with a few keystrokes on the front panel or even remotely when used as part of a test and measurement system.

Measurement Speed

Most system DMM manufacturers use an integrating technique for A-to-D conversion. That means there must be a compromise between resolution and reading speed. The 8505A and 8506A use a Fluke patented "recirculating remainder" technique for A-to-D conversion that does not compromise 6½ digit resolution at reading speeds up to 500 per second for dc voltage measurements. Front or rear measurement inputs are switch-selectable from the front panel. For system applications the position of the switch can be sensed through the interface. An external trigger input is included to control the timing of measurements remotely. And, to control the switching time of an external scanner, scanner-advance output pulses are available at the rear panel.

Either GPIB/IEEE-488,* RS-232-C, or an 8-bit/16-bit parallel interface option may be used for systems applications. The parallel interfaces will work with DEC computer interfaces DR11C or DRV11.

Math Power

The 8506A and 8505A are controlled by an internal microprocessor and have built in math power to add, subtract, multiply, and divide as well as store and compare numerical information. Each measurement may be made a part of a calculation before being displayed or recorded. Stored HI and/or LO limit values may be repeatedly compared to measured values to determine out-of-tolerance conditions, HI, LO, or PASS indications may appear directly in the display. The highest and lowest values in a series of measurements may be stored and later displayed. And measurements may all be in terms of ± deviations from a stored "offset" value. In general, any calculation is possible based on the general formula.

$$Y = mx+b$$

Where m = scaling factor (multiplier),
x = value measured,
b = the ± offset, and
Y = the numerical result

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8505A & 8506A

8506A & 8505A Differences

The 8505A is Fluke's lowest cost DMM having top dc accuracy, resolution, and speed. Two options for measuring ac voltage are available, either an ac average-sensing, rms-indicating option (-01) for sinewaves or an ac true-rms option (-09A) for either sinewaves or non-sinusoidal waveforms. An option for measuring current (-03) and an option for measuring resistance (-02A) are also available for the 8505A. For measuring ac current, an ac voltage option (-01 or 09A) must also be installed. An 8505A, when fully equipped, will measure dc and ac voltage, dc and ac current, and resistance.

The 8506A and 8505A have identical dc measurement capabilities but the 8506A requires no option for measuring ac voltage. State-of-the-art ac voltage measurement capabilities are built in. An option for measuring dc current may be installed (-03) or an option for measuring resistance may be installed (-02A), but not both at the same time. Any external dc reference voltage up to 40 volts that is applied at the rear panel may be compared and the relative values displayed as a ratio. The same interface options are available for the 8506A as for the 8505A.

8506A Specifications

Technical Specifications

DC Voltage

All dc voltage accuracy and stability specifications apply after a two-hour warm-up unless otherwise noted. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale $6^1/_2$ Digits	Resolution		Input Resistance
		$7^1/_2$* Digits	$6^1/_2$ Digits	
100 mV	200.0000 mV	–	100 nV	≥10,000 MΩ
1V	2.000000V	–	1 µV	≥10,000 MΩ
10V	20.00000V	1 µV	10 µV	≥10,000 MΩ
100V	128.0000V	–	100 µV	10 MΩ
1000V	1200.000V	–	1 mV	10 MΩ

**In AVG operating mode*

Accuracy, Normal Mode, $6^1/_2$ Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C	
		Up to 90 Days	Add Per Mo Over 90 Days
100 mV	0.0018+15	0.0025+40	0.00017+5.6
1V	0.0008+7	0.0015+8	0.0001+0.1
10V	0.0006 or 6**	0.0010+8	0.0001+0.1
100V	0.0010+6	0.0018+8	0.00013+0.1
1000V	0.0008+6	0.0018+8	0.00013+0.1

**After 4-hour warm-up & within 1 hour of zeroing dc*
***Whichever is greater*

Accuracy, AVG Mode, $6^1/_2$ Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term 18°C to 28°C	
		Up to 90 Days	Add Per Mo Over 90 Days
100 mV	0.0010+8	0.0020+8	0.0001+0.1
1V	0.0005+4	0.0012+6	0.0001+1**
10V	0.0005 or 50***	0.0008+60**	0.00008+1**
100V	0.0005+5	0.0015+6	0.0001+0.1
1000V	0.0005+5	0.0015+6	0.0001+0.1

**After 4-hour warm-up & within 1 hour of zeroing dc*
*** $7^1/_2$ digit mode of operation*
**** Whichever is greater*

Accuracy, Software Calibration

Fully restores above "24-hour" accuracy for 24 hours each time performed within 30 days after hardware calibration is performed. After 30 days add the following number of counts to the 24-hour accuracy specifications.

Time Since Internal (Hardware) Calibration	Number of Counts to be Added	
	$6^1/_2$ Digits	$7^1/_2$ Digits
Less than 30 Days	0	0
30 to 90 Days	1	10
90 Days to 1 Year	2	20
More than 1 Year	3	30

Temperature Coefficient: ±(% of Rdg+Counts) /°C

Range	0°C to 18°C and 28°C to 50°C
100 mV	0.0003+5
1V	0.0003+1
10V	0.0002+0.5*
100V	0.0003+1
1000V	0.0003+0.5

** With $6^1/_2$ digit display. For $7^1/_2$ digit display, multiply Number of Counts by 10.*

Input Bias Current

At Time of Adjustment	1 Year 23°C ±1°C	Temperature Coefficient
<±5 pA	<±30 pA	<±1 pA/°C

Zero Stability: Less than 5 µV for 90 days after a four-hour warm-up. Front panel pushbutton zero is provided for permanent storage of a zero correction for each range. Zero may be turned off at any time.

Normal Mode Rejection

Line Frequency	Filter Mode	4 Samples Per Reading	32 Samples Per Reading	128 Samples Per Reading
50 Hz	Fast	60 dB	70 dB	75 dB
50 Hz	Slow	85 dB	90 dB	95 dB
60 Hz	Fast	60 dB	70 dB	75 dB
60 Hz	Slow	90 dB	95 dB	100 dB

Common Mode Rejection: 160 dB at 60 Hz with 1 kΩ in series with either lead, and 4 samples or more per reading. Greater than or equal to 100 dB with less than 4 samples per reading.

Analog Settling Time

Filter Mode	Filter Command	To 0.01% of Step Change	To 0.001% of Step Change
Fast	F0 or F3	40 ms	50 ms
Slow	F or F2	400 ms	500 ms

Digitizing Time (Line Synchronous): For 2^0 to 2^{17} samples per reading the digitizing time is from 4 ms to 9 minutes 6 seconds using a 60 Hz line. Time increases 20% using 50 Hz ac line. Selectable in 18 binary steps.

Digitizing Time (Line Asynchronous): 2 ms in 3-byte binary mode with dc zero, offset, limits and calibration factors turned off

Maximum Input: ±1200V dc or 1000V rms ac to 60 Hz, or 1400V peak above 60 Hz may be applied continuously to any dc range without permanent damage. Maximum rate of voltage change is 1000V per µs.

Ratio (External DC Reference)

Voltage, resistance, or current may be measured and compared to an external dc voltage and displayed as a ratio. Option -02A or -03 is required when measuring resistance or current. The dc reference voltage (V_{xref}) is applied to terminals on the back panel and is the denominator of the ratio.

Input Resistance: >10,000 MΩ between Ext Ref HI and LO and between either Ext Ref HI or LO and Ohms Guard or Sense LO

Max. Reference Voltage: ±40V between Ext Ref HI and LO terminals providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal

Min. Reference Voltage: ≥0.0001V when comparing voltage or current, and ≥0.0001V or 1 billionth of the absolute value of resistance, whichever is greater, when comparing resistance

Maximum Ratio Display: 10^{-9} to 10^9

Source Impedance: Resistive unbalance (Ext Ref HI to LO) <4 kΩ. Total resistance to Sense LO from either Ext Ref HI or LO <20 kΩ

Overload Voltage: ±180V dc or peak ac relative to Ohms Guard or Sense LO. ±360V dc or peak ac (Ext Ref HI to LO)

Normal Mode Noise Rejection: ≥100 dB for line frequency and 2x line frequency

Common Mode Noise Rejection: ≥75 dB for dc, line frequency, and 2x line frequency

Ratio Accuracy

External Reference Voltage	Accuracy
±20V to ±40V	±(A + B + 0.001%)
$\pm V_{min}$ to ±20V	±(A + B + (0.02% $\lvert V_{xref} \rvert$))

A = 10V dc range accuracy for the appropriate period of time
B = Input signal function and range accuracy for the appropriate period of time
V_{min} = Minimum allowable external reference voltage
$\lvert V_{xref} \rvert$ = Absolute value of the external reference voltage

Digitizing Time: 196 ms to 9 minutes and 6s for 2^0 to 2^{17} samples per reading using 60 Hz line, increasing 20% using 50 Hz line.

AC Voltage (Thermal RMS)

All ac voltage accuracy and stability specifications for 5½ digit displays using at least 25% of full scale after a 2-hour warm-up. Except where noted, ac coupling is used to block dc. The 24-hour specifications are relative to the calibration standards used and within 1 hour of dc zero.

Range	Full Scale 5½ Digits	Resolution 6½* Digits	Resolution 5½ Digits	Input Impedance
100 mV	125.000 mV	–	1µV	
300 mV	400.000 mV	–	1 µV	
1V	1.25000V	1 µV	10 µV	1 MΩ
3V	4.00000V	1 µV	10 µV	±1%
10V	12.5000V	10 µV	100 µV	shunted by
30V	40.0000V	10 µV	100 µV	<180 pF
100V	125.000V	100 µV	1 mV	
500V	600.000V	100 µV	1 mV	

**In AVG operating mode*

Settling Time

High Accuracy Mode: Sample time is 3.5 seconds, hold time is 2.5 seconds. Measurement time is 6 seconds – the sum of sample time and hold time. If the state of the instrument is unknown, two complete measurement cycles will be required to guarantee a correct reading. Use of an external trigger will allow a 6-second measurement cycle.
Enhanced Mode: The first reading requires the same time as the high accuracy mode. Subsequent readings occur every 500 milliseconds. If the input changes 0.1% the analog settling time to 90-day mid-band accuracy is 1.5 seconds.
Normal Mode: Settling time for large changes is non-linear. Zero to full scale changes require 2.0 seconds to settle to 90-day, mid-band specifications. Full scale to 10% of full scale changes require 3.0 seconds to settle to mid-band, 90-day specifications. Small changes (<1%) settle to mid-band specifications in <1.5 seconds.
Autoranging: Upranges when input is higher than full scale. Downranges when reading is less than approximately 28% of full scale.

Accuracy, High-Accuracy Mode: ±(% of Reading)[1] 24 Hours, 23°C ±1°C[2]

Ranges	Frequency in Hertz 10** to 40	40 to 20k	20k to 50k	50k to 100k	100k to 200k	200k to 500k	500k to 1M
100 mV	0.08	0.02*	0.04*	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.012	0.04	0.2	0.5	1.5	3.5
30V	0.08	0.012	0.05	0.2	0.5	3.5	12
100V	0.08	0.012	0.04	0.2	1.0	3.5	–
500V[3]	0.08	0.012	0.04	0.2	–	–	–

90 Days, 18°C to 28°C

100 mV	0.08	0.026*	0.06	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.016	0.06	0.2	0.5	1.5	3.5
30V	0.08	0.016	0.06	0.2	0.5	3.5	12
100V	0.08	0.016	0.06	0.2	1.0	3.5	–
500V	0.08	0.016	0.06	0.2	–	–	–

>90 Days, 18°C to 28°C, per month. Add to the 90-day specification the following % of reading.

All	0.008	0.001	0.0025	0.012	0.021	0.06	0.11

**Add 5 digits (5 µV) to the % of reading*
***With Slow filter*

Accuracy, Enhanced Mode: Add the following (% of reading + number of digits) to the accuracy specifications of the high accuracy mode –

Ranges	Time Since First Reading <5 Min	Time Since First Reading >5 and <30 Min
All except 500V	0 + 0	0.003 + 4
500V	0 + 0	0.003 + 6

Accuracy, Normal Mode: Add the following % of reading to the accuracy mode specification of the high accuracy mode –

Segment of Scale	24 Hour 90 Day	<90 Day Add Per Month
0.25 x to 1 x full scale	0.4	0.044
0.1 x to 0.25 x full scale	0.6	0.055

DC-Coupled (AC+DC) Accuracy: ±(1.1 times the appropriate ac-coupled specifications + a calculated "Adder" from the following table)

Range	Adder
100 mV-1V	±(150 µV x (dc volts/total rms volts))
3V & 10V	±(1 mV x (dc volts/total rms volts))
30V & 100V	±(10 mV x (dc volts/total rms volts))
500V	±(50 mV x (dc volts/total rms volts))

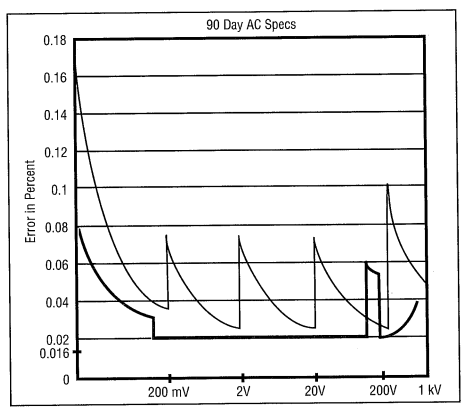
[1] AC coupled, 5½ digits, input level >0.25 x full scale. For 6½ digits multiply Number of Counts by 10. For input levels between 0.1 x and 0.25 x full scale, add 5 counts for the 100 mV, 1V, 10V, and 100V ranges, add 15 counts for the 300 mV, 3V, 30V ranges, and add 25 counts for the 500V range.
[2] Relative to calibration standards, within 1 hour of dc zero.
[3] Add 0.02 x (Input voltage/600)^2 % of Reading to the specification.

Stability: 40 Hz to 20 kHz, <1°C Temperature Change

Range	±(% of Rdg + Counts)* 24 Hours	±(% of Rdg + Counts)* 90 Days
100 mV, 1V, 10V, 100V	0.0025 + 1	0.004 + 1
300 mV, 3V, 30V	0.0025 + 3	0.004 + 4
500V	0.0025 + 5	0.004 + 6

**For 5½ digit resolution*

Crest Factor: Up to 8:1, with 90-day or greater accuracy for input signals with peaks less than two times full scale and high frequency components within the 3 dB bandwidth. Up to 4:1 for signals with peaks less than four times full scale, with the addition of 0.03 to the percent-of-reading specification.
3 dB Bandwidth (Typical): 3 MHz for the 100 mV range and 10 MHz for the 300 mV, 1V, 3V and 10V ranges
Maximum Input Voltage: ±600V dc or rms ac, 840V peak, or 1x10^7 volt-hertz product
Temperature Coefficient: One tenth of the 90-day accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Common Mode Rejection: >120 dB from dc to 60 Hz with 100Ω in series with either lead



This graph compares the total ac uncertainty of the 8506A's thermal rms converter to that of a typical computing rms converter used in other DMMs. The effects of floor error which cause large uncertainties at the beginning of each range are non-existent in the 8506A from 125 mV ac to 125V ac.

3

8506A Option Specifications

Resistance Option (-02A)

All resistance accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale $5^1/_2$ Digits	Resolution*		Current Through Unknown
		$6^1/_2$* Digits	$5^1/_2$ Digits	
10Ω	20.0000Ω	10 μΩ	100 μΩ	10 mA
100Ω	200.0000Ω	100 μΩ	$6^1/_2$ Digits Only	10 mA
1kΩ	2.000000kΩ	1 mΩ		1 mA
10 kΩ	25.0000 kΩ	10 mΩ		78 μA
100 kΩ	250.000 kΩ	100 mΩ		7.2 μA
1 MΩ	4.10000 MΩ	1Ω	10Ω	4.5 μA
10 MΩ	35.0000 MΩ	10Ω	100Ω	0.45 μA
100 MΩ	265.000 MΩ	100Ω	1 kΩ	56 nA

** In normal operating mode, $5^1/_2$ or $6^1/_2$ digits depending on range. In AVG operating mode, $6^1/_2$ digits on all ranges.*

Open Circuit Voltage: 7V maximum from 10Ω through 100 kΩ range; 25V maximum from 1 MΩ range through 100 MΩ range
Maximum Input: ±400V dc or peak ac, continuous on any range with no damage
Analog Settling Time: 80 ms with Fast filter or 800 ms with Slow filter, to rated accuracy
Digitizing Time: Depending on sample rate and filter selection the digitizing time will vary from 145 ms to 9 minutes 6 seconds using a 60 Hz ac line. Time increases 20% using a 50 Hz line.

Accuracy, $5^1/_2$ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
10Ω	0.003+20	0.005+20	0.00056	0.0008+15
100Ω	0.002+1.4	0.003+1.4	0.00033	0.0007+0.2
1 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
10 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
100 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.5
1 MΩ	0.002+0.8	0.003+0.8	0.00033	0.001+0.5
10 MΩ	0.0075+0.8	0.02+0.8	0.0022	0.005+0.5
100 MΩ	0.026+0.8	0.05+1	0.0056	0.02+0.5

**From 18°C to 0°C or 28°C to 50°C*
***For $6^1/_2$ digit display, multiply number of counts by 10*

Measurement Configuration: Two-wire and four-wire available on all ranges
Four-Wire Lead Resistance: Source leads should not exceed 10Ω for the 10Ω and 100Ω ranges, 100Ω for the 1 kΩ range, or 1 kΩ for the 10 kΩ or higher ranges

DC Current Option (-03)

All current accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used. No ac current option is available for the 8506A.

Input Characteristics

Range	Full Scale $5^1/_2$ Digits	Resolution		Voltage Burden
		$6^1/_2$* Digits	$5^1/_2$ Digits	
100 μA	250.0000 μA	0.1 nA	1 nA	≤100 mV
1 mA	2.00000 mA	1 nA	10 nA	≤100 mV
10 mA	16.0000 mA	10 nA	100 nA	≤200 mV
100 mA	128.000 mA	100 nA	1 μA	≤200 mV
1A	1.28000A	1 μA	10 μA	≤500 mV

** In AVG operating mode 100 μA ac range is $5^1/_2$ digits only*

Accuracy, $5^1/_2$ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term 18°C-28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Day, Add to % of Rdg Per Month	
100 μA	0.02+10	0.03+10	0.0022	0.0025+0.6
1 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
10 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
100 mA	0.03+20	0.05+20	0.0056	0.0035+0.6
1A	0.03+20	0.05+20	0.0056	0.0035+0.6

**From 18°C to 0°C or 28°C to 50°C*
***For $6^1/_2$ digit display, multiply number of counts by 10*

Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5A fuse.
Settling and Digitizing Time: Same as for dc volts

IEEE-488 Interface Option (-05)

This interface incorporates the following subset of the IEEE Standard 488-1978; SH1, AH1, T5, L4, SR1, RL2, DC1, DT1, and E1. The interface allows full control of all instrument functions and the transfer of ASCII or binary data. In the binary mode the instrument is capable of 500 readings per second.

RS-232 Interface Option (-06)

This interface is a bit serial asynchronous interface providing either voltage or 20 mA current loop level signals. The interface allows selection of baud rate from 50 to 9600, either one or two stop bits, and odd or even parity. Up to 40 ASCII character readings per second are possible with Option -06. No handshakes are provided.

Bit-Parallel Interface Option (-07A)

Permits you to connect the instrument to DEC PDP11 minicomputer interfaces (DR11C and DRV11). The interface permits either 8- or 16-bit parallel ASCII transfers or 8- or 16-bit parallel binary transfers. In the binary mode the instrument is capable of up to 500 readings per second.

8505A Specifications

Technical Specifications

DC Voltage

Same specifications as for 8506A

Ratio (External DC Reference)

Same specifications as for 8506A for dc ratio. AC/AC ratio available upon special request

8505A Option Specifications

True-RMS AC Voltage Option (-09A)

All true-rms ac voltage accuracy and stability specifications apply to readings between 0.1% of range to full scale after a 2-hour warm-up. Options -09A and -01 may not be installed at the same time.

Input Characteristics (-09A and -01)

Range	Full Scale $5^1/_2$ Digits	Resolution		Input Impedance
		$6^1/_2$* Digits	$5^1/_2$ Digits	
1V	2.50000V	1 μV	10 μV	MΩ shunted by <100 pF
10V	20.0000V	10 μV	100 μV	
100V	160.000V	100 μV	1 mV	
100V	1000.00V	1 mV	10 mV	

** In AVG operating mode*

Accuracy: ±(% of Rdg + % of Full Scale)*

Frequency	90 Days, 19°C to 28°C		
	% of Input	+ % FS (AC)	+ % FS (AC + DC)
DC	0.1	–	0.03
10 Hz-20 Hz	1.0	0.04	0.06
20 Hz-50 Hz	0.5	0.012	0.03
50 Hz-10 kHz	0.1	0.012	0.03
10 kHz-30 kHz	0.2	0.04	0.06
30 kHz-50 kHz	0.3	0.1	0.12
50 kHz-100 kHz	1.0	0.3	0.3
100 kHz-300 kHz	2.0	0.5	0.5
300 kHz-1 MHz	3.3	1.8	1.8

**Slow filter must be used below 400 Hz. For inputs greater than 500V multiply the accuracy specification by: (200 + reading) ÷ 2000*

Common Mode Rejection: >120 dB, dc to 60 Hz, with 100Ω unbalance in either lead
Crest Factor: >7 at full scale, increasing down scale by

$$7 \times \sqrt{V_{Range} \div V_{Reading}}$$

Voltage & Frequency Limits: $1x10^7$ volt-hertz product for the 1V and 10V ranges and $2x10^7$ for the 100V and 1000V ranges
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.1% of a step change within a range
Digitizing Time: Same as for dc voltage. See 8506A specifications

Averaging-Sensing AC Voltage Option (-01)

All average-sensing ac voltage accuracy and stability specifications apply to a 5 1/2 digit display with readings between 0.1% of range to full scale after a 2-hour warm-up. Option -01 and -09A may not be installed at the same time. (See Input Characteristics -09A)

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 to 40 kHz	–	0.15 + 5
10 to 50 kHz**	0.1 + 5	–
50 to 100 kHz**	0.5 + 5	–

**Slow filter must be used below 400 Hz. For 6 1/2 digit display, multiply number of counts by 10*

***On 1-volt range add 7 counts above 10 kHz or 35 counts above 50 kHz*

Common Mode Rejection: >120 dB, dc to 60 Hz with 100Ω inbalance in either lead

Voltage & Frequency Limits: 1000V rms (1400V peak) or $2x10^7$ volt-hertz product, whichever is less

Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.05% of a step change within a range

Digitizing Time: Same as for dc voltage. See 8506A specifications

DC and AC Current Option (-03)

All accuracy and stability specifications apply after a 2-hour warm-up

Input Characteristics: Same as for 8506A

DC Current Accuracy: Same as for 8506A

AC Current Accuracy, 8505A only: ±(% of Rdg + Counts)*

Range	Frequency	90 Days, 23°C ±5°C	
		Opt -01	Opt -09A
100 µA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.8 + 9	0.8 + 35
	50 Hz - 10 kHz	0.4 + 9	0.4 + 35
	10 kHz - 20 kHz	0.7 + 9	1.0 + 110
	20 kHz - 50 kHz	1.5 + 9	1.5 + 260
	50 kHz - 100 kHz	3.0 + 9	4.0 + 760
1 mA and 10 mA	10 Hz - 20 Hz	–	1.0 + 110
	20 Hz - 50 Hz	0.5 + 9	0.5 + 35
	50 Hz - 10 kHz	0.06 + 9	0.11 + 35
	10 kHz - 20 kHz	0.11 + 9	0.2 + 110
	20 kHz - 50 kHz	0.12 + 9	0.3 + 260
	50 kHz - 100 kHz	0.51 + 9	1.0 + 760
100 mA	10 Hz - 20 Hz	–	1.0 + 150
	20 Hz - 50 Hz	0.5 + 55	0.5 + 80
	50 Hz - 10 kHz	–	0.26 + 80
	50 Hz - 100 kHz	0.24 + 55	–
1A	10 Hz - 20 Hz	–	1.0 + 160
	20 Hz - 50 kHz	0.5 + 65	0.5 + 90
	50 Hz - 10 kHz	0.24 + 65	0.26 + 90

** With 5 1/2 digit display. For 6 1/2 digit display, multiply number of counts by 10. AC Voltage Option -01 or -09A must also be installed to measure ac current*

Crest Factor: (Using Option -09A) >4.5 at full scale, increasing down scale by

$$4.5 \times \sqrt{I_{Range} - I_{Reading}}$$

Maximum Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5 fuse

Settling and Digitizing Time: Same as dc volts

Resistance Option (-02A)

Same specifications as for 8506A

IEEE-488 Interface Option (-05)

Same specifications as for 8506A

RS-232 Interface Option (-06)

Same specifications as for 8506A

Bit-Parallel Interface Option (-07A)

Same specifications as for 8506A

General Specifications

Maximum Terminal Voltage:
LO to Guard, 127V rms
Guard to Chassis, 500V rms
HI Sense to HI Source, 127V rms
LO Sense to LO Source, 127V rms
HI Sense to LO Sense, 1000V rms or 1200V dc
HI Source to LO Source, 280V rms

Trigger Input: TTL level, ±30V maximum, factory wired for falling edge; may be rewired for rising edge. Pulse width ≥10 µs

Scanner Advance Pulse: TTL level, ≥3 µs width

Shock & Vibration: Meets requirements of MIL-T-28800C for Type III, Class 5, Style E equipment

Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating

Relative Humidity: ≤80% to 18°C, ≤75% to 40°C, ≤45% to 50°C

Size: 10.8 cm H x 43.2 cm W x 42.5 cm D (4.25 in H x 17 in W x 16.75 in D)

Weight: 10 kg (22 lb) basic, 12 kg (26 lb) fully loaded

Power: 100, 120, 220 or 240 volt, 47-63 Hz, switch selectable

Included with Instrument: Manual, power cord, serialized and dated calibration certification sheet

Ordering Information

Models

8506A Thermal RMS Digital Multimeter
8505A Digital Multimeter

Options

-02A* Ohms Converter
-03* Current Converter
-05** IEEE-488 Interface
-06*** RS-232-C Interface
-07A*** Parallel Interface (for DEC PDP11, DR11C, DRV11)
-07D*** Duplex parallel interface for all others (user configured)

** Cannot install both -02A and -03 in 8506A at the same time*

*** Provides only dc current when installed in 8506A*

**** Only one interface may be installed*

Options (for 8505A only)

-01* AC Converter (Average)
-09A* AC Converter (True-RMS)

**Cannot install both -01 and -09A at the same time*

Accessories (Also see Section 20)

MIS-7011K Extender Card
MIS-7013K Bus Interconnect & Monitor
MIS-7190K Static Test Controller
MIS-7191K Test Module
M04-205-600 5 1/2" Rack Mount Kit
M00-260-610* 18" Rack Slide Kit
M00-270-610* 20" Rack Slide Kit
M00-280-610* 24" Rack Slide Kit
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8077 Four Terminal Short
Y8133 Universal Test Leads

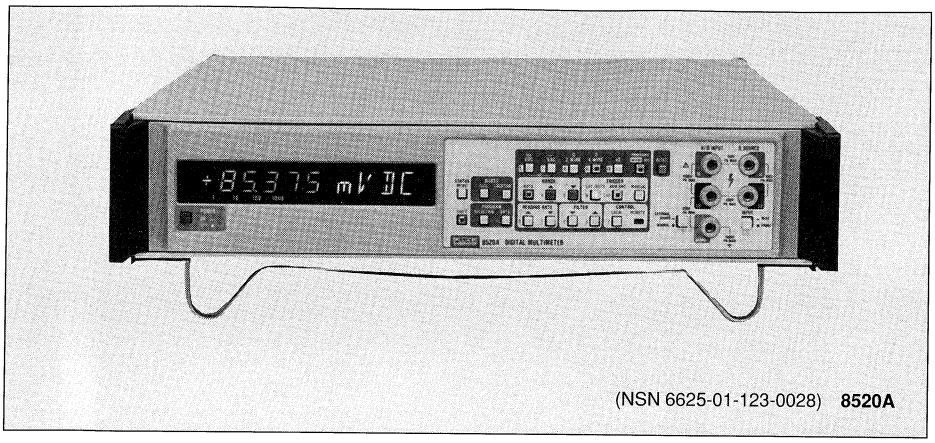
** Needs M04-205-600 Rack Mount Kit*

3

Bench/System Multimeters

8520A, 8522A, 8520A/AS-1 & 8520A/PRT

GPIB
IEEE-488



(NSN 6625-01-123-0028) **8520A**

Intelligent DMMs for Bench or System

- DC and ac volts
- 2 and 4-wire ohms
- Conductance
- 520 readings per second
- 20 ppm basic dc accuracy
- Burst memory and math capabilities
- Standard system interfaces: 8520A GPIB/IEEE-488; 8522A: Parallel and BCD
- 8520A/AS-1 MATE certified DMM

The 8520A and 8522A are designed for system and bench applications and have built-in system interface circuits. The performance specifications of the two instruments are almost identical. The principal difference is that the 8520A has an interface compatible with GPIB/IEEE-488* 1978 and the 8522A has an interface suitable for either BCD or Parallel (binary) applications.

The 8520A/AS-1 and the 8520A/PRT are unique variations of the 8520A. One, the 8520A/AS-1, is compatible with U.S. Government Modular Automatic Test Equipment (MATE) system. And the 8520A/PRT includes a Platinum Resistance Probe for extremely accurate temperature measurements.

Seven standard and seven optional math programs plus a built-in "burst" memory make these multimeters exceptionally intelligent stand-alone units. A choice of dc volts, true-rms ac volts, 2-wire or 4-wire ohms, and the Fluke exclusive conductance function make the instruments very versatile. The conductance function provides a simple way to measure resistance from 10 MΩ to 100,000 MΩ.

The instruments boast 50 ppm basic dc accuracy for 90 days with 5½ digit resolution. A 520 readings-per-second system rate with 4½ digits resolution is standard for high speed measurements. Or make 240 readings per second (with 60 Hz line operation) with 5½ digits resolution. Inputs are switchable from front to rear too.

An unprecedented degree of prompting and operational cues are provided for skilled and unskilled technicians alike. A simple, uncluttered color-coded front panel makes operation easy.

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Math Programs

Fourteen pre-programmed functions are available for the 8520A, 8520A/AS-1, 8520A/PRT, and 8522A. The first seven are standard; eight through fourteen are standard on the 8520A/AS-1 but optional on the other models. For systems use, these powerful programs will reduce software overhead greatly. They also simplify and speed testing for ordinary bench applications. Up to three math programs can be chained or stacked for simultaneous use.

The Standard Programs

1 = TEST. Four separate internal test programs do diagnostic checks on analog circuitry, digital hardware and software, and the front panel keys and displays.

2 = ZERO. Eliminates the effect of lead resistance for ohms tests and subtracts low-level dc components in the dc voltage function.

3 = XREF (external reference). Compares an unknown voltage at the front panel to a known rear-panel input. The display is the ratio of the front and rear inputs.

4 = OSR (offset/scale/ratio). Allows you to enter any constant in the formula (X = measurement *minus* offset *times* scale *divided* by ratio) from the keyboard, the memory, or a current reading.

5 = Δ PCT (percent deviation). Compares all subsequent readings with a stored nominal value. The display appears as plus or minus a percentage deviation.

6 = PEAK. Constantly monitors the maximum and minimum readings. These values can be recalled as well as the "peak-to-peak" variation.

7 = LIM (limits). Turns the multimeter into a sorting machine. Inputs are sorted and displayed in three ways "High," "Pass" and "Low," based on previously stored upper and lower limits. You can recall the number of high, low, and pass readings, plus the total number of readings.

The Other Programs (Part of Option -010)

8 = STAT (statistics). Computes the mean, standard deviation, and variance of readings taken or data stored in memory registers.

9 = LFAC. A unique way to accurately measure low frequency ac signals from dc to 10 hertz.

10 = dB. Calculates dB, dBm or dBV of a measured value and displays dB.

11 = RTD. Implements equations which convert the resistance of a resistance temperature detector (RTD) to temperature in °C. Readouts in K or °F are also selectable.

12 = JVC (junction voltage Celsius). Computes °C, °F, or K based on inputs from a Fluke 80T-150C Temperature Probe (calibrated for °C).

13 = JVF (junction voltage Fahrenheit). For use with the Fluke 80T-150F (calibrated for °F). Performs the same operations as Program 12.

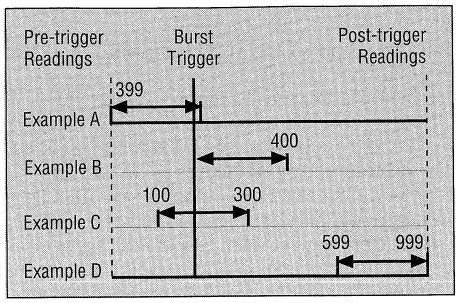
14 = THMS (thermistor linearization). Converts the resistance of a thermistor to temperature in °C, °F, or K.

Burst Memory (Reading Storage)

The unique burst memory lets you store up to 50 readings at any reading rate (400 readings with Option -010). In fact, the most recent 50 (or 400) readings are always stored in a shift register and available for recall and analysis whenever measurements cease. In the burst mode the storage operation may be independently triggered to capture a particular group of successive readings that may occur before, after, or both before and after the trigger instant. The storage of readings may be delayed after the trigger, as shown in example D.

Stored readings can be recalled individually or scanned in sequence for display on the front panel. Or they may be transferred to a controller or computer via the interfaces available in the 8520A or 8522A. Math processing can be applied to readings stored in memory as they are recalled.

Burst memory, (400 readings part of Option -010)



With Option -010, the burst memory may capture any group of 400 successive readings that occur within 399 readings prior to and 999 readings following the burst trigger. In example A, only one reading is taken after the trigger point. In example B, 400 readings immediately following the burst trigger are captured. Example C shows storage of 100 readings prior and 300 readings after the trigger point. The last example shows 400 readings being stored commencing 599 readings after the trigger.

8522A Parallel and BCD Interface

Speed and real-time measurement are key system elements available in the 8522A when the Parallel (binary) interface is selected. That interface offers both a three- and a four-wire handshake (switch-selectable) for use with the most popular parallel computer interfaces. A choice of *eight-* or *sixteen-*bit messages are selectable at the rear of the instrument.

The BCD interface emulates BCD remote operation of the Fluke 8375A and 8400A, for the convenience of customers who wish to replace these or any of a large variety of older DMMs in their system. Remote control and data output capabilities are the same as those of the 8375A and 8400A. All but the conductance function may be controlled remotely, plus the range filter and external reference.

Output of readings include five BCD digits, an overrange bit, an overload bit, polarity bit, and three coded range bits. Status output includes function, filter, external reference and remote/local.

8520A/AS-1 – for MATE Systems

The 8520A/AS-1 is equipped with a built-in interface interpreter which makes it compatible with Modular Automatic Test Equipment (MATE) systems. This capability allows a MATE Test Executive to operate the 8520A/AS-1 on the IEEE-488 bus using Control Interface Intermediate Logic (CIIL). It will operate in either the "CIIL Mode," responding only to CIIL commands or in the "native mode," responding to either CIIL commands or IEEE-488 bus commands. Data transmission is increased to 120,000 characters per second for direct memory access using the CIIL mode.

The 8520A/AS-1 was the first candidate module to become MATE certified.

8520A/PRT – Temperature Measurements

The 8520A/PRT is a temperature measurement system consisting of a Rosemount 162N Platinum Resistance Thermometer (PRT) and an 8520A containing a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001 degree resolution.

The 8520A/PRT provides a fast, low-cost way of making extremely accurate temperature measurements, or calibrating temperature measurement instruments, in the range of -200°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

Specifications

Technical Specifications

DC Voltage

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 µV	≥10,000 MΩ
1V	1.99999	10 µV	≥10,000 MΩ
10V	16.0100	100 µV	≥10,000 MΩ
100V	130.100	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of Input + Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
100 mV	0.003+5	0.0065+6	0.011+10	0.0005+0.5
1V	0.003+1	0.006+2	0.011+2	0.0005+0.15
10V	0.002+1	0.005+1	0.009+1	0.0004+0.10
100V	0.003+1	0.007+2	0.012+2	0.0005+0.15
1000V	0.0035+1	0.0065+1	0.011+1	0.0005+0.10

**From 18°C to 0°C or 28°C to 50°C*

High Speed Accuracy: ±(% of Input + LS Bit)*

Range	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C
100 mV	0.01 + 1	0.015 + 1	0.001 + 0.1
1V-1000V			0.001 + 0.05

** Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data.*

Normal Mode Rejection

Line Freq	Filter Setting Time					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	88 dB	91 dB

Common Mode Rejection: True, 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR

Maximum Input: ±1000V peak, High to Low or Guard to chassis terminals, and ±200V peak, Guard to Low terminals, for any range

Bias Current: ≤50 pA

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5½ digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4½ digits

**For local operation, 8522A is limited to ½ this rate.*

AC Voltage (True RMS)

Input Characteristics

Range	Full Scale	Resolution	Input Resistance
1V	1.99999	10 µV	
10V	16.0100	100 µV	1 MΩ
100V	130.100	1 mV	≤100 pF
650V	650.00	10 mV	

Accuracy: ±(% Input + % of Full Scale) ac or ac+dc*

Frequency	90 Days 18°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+% FS AC	+% FS AC+ DC	% of Input	+% FS AC	+% FS AC+ DC
10-20 Hz**	3.0	0.6	0.7	3.5	0.6	0.7
20-40 Hz**	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz-20 kHz	0.1	0.03	0.08	0.15	0.05	0.16
20-100 kHz	1.0	0.3	0.4	2.0	0.6	0.8
100-300 kHz	2.4	0.6	0.6	4.0	0.1	0.1
300 kHz-1 MHz	8.0	2.5	2.5	15.0	5.0	5.0

**From 0.1% of range to full scale*
***With statistics program*

Temp. Coefficient: 18°C to 0°C or 28°C to 50°C, to 20 kHz
AC Mode: ±(0.007% of input + 0.007% FS)/°C
AC+DC Mode: ±(0.007% of input + 0.14% FS)/°C

Maximum Input: ±1000V peak High to Low or Guard to Chassic terminals, and ±200V peak Guard to Low terminals

Crest Factor: ≥4:1 at full scale, increasing down scale

Maximum Reading Rate: 10 readings per second (rated accuracy, ≥400 Hz)

8520A, 8522A, 8520A/AS-1 & 8520A/PRT

Maximum Slew Rate: 177V per µs
Maximum Volt-Hertz Product: 2 x 10^7

Resistance

Input Characteristics

Range	Full Scale	Resolution	Current Through Unknown	Open Circuit Voltage
10Ω	19.9999	100 µΩ	10 mA	7V
100Ω	199.999	1 mΩ	10 mA	
1000Ω	1999.99	10 mΩ	1.0 mA	
10 kΩ	19.9999	100 mΩ	0.1 mA	
100 kΩ	199.999	1Ω	14.5 µA (max)	
1 MΩ	1.99999	10Ω	1.5 µA (max)	
10 MΩ	19.999	1 kΩ	1.5 µA (max)	

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local Remote	50 Hz	200 rdgs/sec*	5½ digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz 60 Hz	>500 rdgs/sec	4½ digits

**For local operation, 8522A is limited to ½ this rate.*

Accuracy: ±(% of Input + Digits)

Range	24 Hrs 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C*
1Ω	0.0045+6	0.0080+7	0.0140+12	0.0007+2.0
100Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
1000Ω	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
10 kΩ	0.0035+2	0.0070+2	0.0125+3	0.0007+0.2
100 kΩ	0.0040+2	0.0090+2	0.0140+3	0.0012+0.2
1 MΩ	0.0090+2	0.0160+2	0.0200+3	0.0020+0.2
10 MΩ	0.0300+1	0.0440+1	0.0450+3	0.0030+0.2

**From 18°C to 0°C or 28°C to 50°C*

Conductance

Range: 100 nS $(10\ M\Omega)^{-1}$
Full Scale: 199.99
Resolution: 0.01 nS $(100{,}000\ M\Omega)^{-1}$
Accuracy: ±(% of Input + Digits)

24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient Per °C*
0.4+5	0.05+5	0.06+5	0.004+1

**From 18°C to 0°C or 28°C to 50°C*

Maximum Input: ±400V peak
Maximum Reading Rate: 10 readings per second

External Reference

Operating Range: ±0.5V dc to ±33V dc as long as external reference Low terminal is within ±16.5V of input Low terminal
Input Impedance: 10,000 MΩ between external reference High or Low terminals and input Low terminal

Ratio Accuracy

X-Ref Voltage	Accuracy
16.5V to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	±[A + B + (400 ppm ÷ | Vref |)]

Note: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input: ±180V peak between external reference High or Low and input Low; ±360V peak between external reference High and Low

Transfer Accuracy

The following accuracy specifications apply when:

- Reading rate is 2 readings per second
- Filter settling time is 500 ms
- Warm-up is at least 2 hours
- Quantity measured has same nominal value and frequency as transfer standard
- Measurements are made in one range
- Standard is checked at least every hour
- Ambient temperature remains within ±1°C

DC Voltage

Range	±(% of Input + Digits)
100 mV	0.0020 + 4
1V	0.0020 + 1
10V	0.0010 + 1
100V	0.0020 + 1
1000V	0.0020 + 1

AC Voltage (all ranges)

Frequency	±(% of Input + % of Full Scale)
10 Hz to 20 Hz	1.0 + 0.2
20 Hz to 40 Hz	0.1 + 0.1
40 Hz to 20 kHz	0.005 + 0.009
20 kHz to 100 kHz	0.100 + 0.030
100 kHz to 1 MHz	0.500 + 0.60

Resistance

Range	±(% of Input + Digits)
10Ω	0.0030 + 5
100Ω	0.0020 + 2
1000Ω	0.0020 + 2
10 kΩ	0.0020 + 2
100 kΩ	0.0020 + 2
1 MΩ	0.0050 + 2
10 MΩ	0.0100 + 1

Conductance (100 nS Range): ±(0.02% of input + 0.02 nS)

General Specifications

IEEE-488 Interface: Standard in the 8520A, 8520A/AS-1 and 8520A/PRT
Parallel (Binary) and BCD Interface: Standard in 8522A
BCD Data Output: Standard 0V and +5V TTL levels positive true, 8-4-2-1 code. Five BCD digits with an overrange bit, overload, polarity, and three coded range bits. The output also includes the state of the instrument (function, filter, external reference, and remote or local).
BCD Remote Control: Standard TTL levels – Logic 1 equals +5V or open, Logic 0 equals 0V or contact closure. Controls all functions (except conductance), range, filter (fast, slow), and external reference. Continuous-command entry and triggered-command entry.
Parallel: In bit parallel operation all features and functions can be accessed through the remote interface. Maximum speed in this mode is 520 readings per second
Format: Select 8- or 16-bit message format with a rear panel switch
Handshake: Handshake configuration is also switch selectable 3- or 4-wire for compatibility with computers, mini-computers, and instrument controllers
Temperature: 0°C to 50°C, operating; -25°C to +75°C non-operatiing; for 8520A/AS-1, non-operating temperature range is -40°C to +75°C
Altitude: 10,000 feet operating, 40,000 feet non-operating
Relative Humidity: ≤95% to 25°C, ≤75% to 40°C, ≤40% to 50°C
Shock & Vibration: Meets MIL-T-28800C for Type III, Class 5, Style E
Power: 100, 120, 220, or 240V ac, ±10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 45.7 cm L x 43.2 cm W (3½ in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)

Included with Instrument: Manual, power cord, rear panel mating connector for analog input, serialized and dated calibration certification sheet

8520A, 8522A, 8520A/AS-1 & 8520A/PRT

Ordering Information

Models

8520A DMM w/IEEE-488 Interface
8522A DMM w/BCD and Parallel Interface
8520A/AS-1 DMM for MATE
8520A/PRT Temperature Measurement System

Option (for 8520A & 8520A/PRT)*

-010 Extended Software Package

** Included with 8520A/AS-1 and 8522A. Factory or Service Center installation only.*

Accessories (Also see Section 20)

Y9111 Trigger Cable, 0.93m (3 ft)
Y9112 Trigger Cable, 1.85m (6 ft)
Y8133 Universal Test Lead Set
Y2037 100Ω RTD Temperature Probe
Y8021 IEEE-488 Shielded Cable, 1m
Y8022 IEEE-488 Shielded Cable, 2m
Y8023 IEEE-488 Shielded Cable, 4m
Y8597 Interface Adapter for 8375A, 8400A
Y8598 3½" Rack Mount Kit w/22" slides
Y8599 3½" Rack Mount Kit only

Conversion of 8520A/AS

Conversion of 8520A/AS to 8520A/AS-1 is available from your Local Service Center. Order 8520A/AS/AS1.

PM 2528

GPIB
IEEE-488



PM 2528

PM 2528 Digital Multifunction Meter

- 5-1/2 digit meter with 1 µV resolution and 0.01% ±1 digit accuracy
- AC- and DC-coupled RMS at 100 kHz
- 16 measurements/s in high-speed mode
- Resistance up to 2.4 GΩ plus 4-wire method achieving 1 mΩ resolution
- Low-level current measurement down to 10 pA resolution
- Relative reference measurements plus options for temperature, V_{HF} and V p
- Full systems capability, including remote control

The 5-1/2 digit, system-orienntated PM 2528 is a high-grade, highly accurate digital multifunction meter featuring many sophisticated facilities. In the basic configuration it measures DC voltage, AC voltage (AC- or DC-coupled true RMS), DC and AC (DC-coupled true RMS) current, temperature (using Pt-100 probes) and resistance. Highly accurate measurement of extremely small resistance values can be achieved using a 4-wire technique which realizes a 1 mΩ resolution. This 4-wire method neutralizes all those inaccuracies normally introduced by test leads and connectors.

The current ranges are extremely sensitive. This makes the instrument capable of displaying a reading of 1 µA with a resolution of 1 in 100000.

The fully-guarded circuitry exhibits an excellent CMRR which ensures and maintains the very high levels of accuracy, stability and resolution which are the major features of this meter. Examples include the levels of 1 µV for voltage, 10 pA for current and the 1% accuracy achieved in the 2.4 GΩ resistance range. Optional accessories are available which add to the already extensive capabilities of the PM 2528. These include a Pt-100 temperature probe, peak voltage and HF measurement up to 700 MHz.

The PM 2528 has three modes of operation:

- High resolution mode (HRM) providing about 2 measurements/s at 5-1/2 digits for DC and Ω measurements
- Normal mode (NM) giving about 4 measurements/s with 1/2-digits
- High speed mode (HSM) operating at 12 to 18 measurements/s

Auto-ranging is standard, but manual ranging is possible using range 'touch' button selection.

Conventional mechanical push-buttons have been dispensed with and replaced with 'touch' buttons which illuminate when 'active'. This further simplifies operation and gives an instant indication of control settings. Polarity display is automatic, also the scale length for each of the parameters is automatically adapted to the specified accuracy and varies between 5-1/2 digits for DC and resistance measurements and 3-1/2 digits for peak voltage readings.

Relative Measurements Feature

Any measurement may be stored and then used as a 'zero' reference. This having been done, all subsequent readings are shown as either a positive or negative deviation from that value. This could be used to monitor stability, for instance, since even minute differentials could be identified.

HF Measurement to 700 MHz

As standard the PM 2528 offers AC voltage measurements up to 500 kHz. Use of the PM 9258 HF option in conjuction with the PM 9211 probe this can be extended to 700 MHz. The low 2 pF loading of this probe ensures minimizing circuit loading.

Peak Voltage Option

The option PM 9259 extends the measuring facilities to positive and negative peak voltage measurements at repetition rates of DC to 100 kHz and peak-to-peak measurements between 10 Hz and 100 kHz.

In the 'periodical peak value' mode, changes in peak value are followed at a rate of two to three measurements per second each displaying the highest value in a preceding period of 200 ms.

In the absolute peak value mode the highest value between start and stop of the measurement is displayed, with an update of the display each time a higher peak is detected. In this mode start and stop of the measuring period are controlled manually or by an external electrical signal.

Any signal of which peak value can be reached in one or more periods by a slew-rate of 7-digit/µs (in NM) is measured with full accuracy.

This includes nearly all periodical signal with frequency components up to 100 kHz and single shot phenomena with a rise time down to about 500 µs.

The peak voltage measurement facility also offers an excellent method of measuring amplitudes of signals below 10 Hz and down to the mHz region that cannot be measured with conventional multimeters.

System Interfaces

System interfaces for PM 2528 include GPIB/IEEE- busline interface and BCD parallel and an analog output. Full remote control of all front panel functions is possible.

The analog output offers 1 mV/digit over a maximum of any three selected decades and can be connected in parallel with one of the digital interfaces.

Specifications

Technical Specifications

Counts: 240000
Type of Display: LED (11 mm)
Range Selection: Automatic or manual
Range Limits Auto-Ranging: Up at 110% full scale; Down at 10% full scale

Operating Modes

HRM: High Resolution Mode; 1.6 to 2.7 measurements/s
NM: Normal Mode; 3.3 to 5.4 measurements/s
HSM: High Speed Mode; 13 to 18 measurements/s

DC Voltage

Measuring Modes: HRM, NM and HSM
Ranges: 200 mV, 2V, 20V, 200V, 1000V
Polarity: Automatic '+' and '-' sign
Resolution in Lowest Range: In HRM 1 µV, in NM and HSM 10 µV

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Maximum Display: In HRM 239999, in NM and HSM 23999
Accuracy: ±(0.01% rdng + 0.005% rng)
Temp. Coeff.: (0.002% rdng + 0.0005% rng)
Input Impedance: Up to 2V> 1 GΩ//20 pF; over 2V 10 MΩ//20 pF
Offset Current: <10 pA (zero set using front panel switch)

	HRM	NM	HSM
CMRR DC	140 dB	140 dB	140 dB
CMRR AC(50 or 60 Hz ±1%)	140 dB	130 dB	120 dB
SMRR (50 or 60 Hz ±1%)	60 dB	50 dB	40 dB
SMRR (50 or 60 Hz ±0.1%)	80 dB	70 dB	60 dB

Max. CM Signal: 250VRMS or 400V p between guard and ground
Max.: 60V RMS or 85V p between '0' and guard
Max. SM Signal: Peak value 200% of range

Response Time

Mode	Ranging	Asynchr. start	Synchr.start
HSM	Hand	0.15s	0.08s
	Auto	0.45s	0.38s
NM	Hand	0.6s	0.33s
	Auto	1.0s	0.93s
HRM	Hand	1.2s	0.65s
	Auto	1.2s	1.2s

Maximum Input Voltage
Ranges up to 2V: 600V continuous, 1000V for 30s
Ranges over 2V: 1000V continuous (1400V peak for all ranges)

AC Voltages RMS AC- or DC-Coupled

Measuring Modes: NM and HRM
Ranges: 200 mV, 2V, 20V, 200V, 600V
Resolution in Lowest Range: 10 µV in HRM, 100 µV in NM
Max. Display: 23999 in HRM, 2399 in NM
Accuracy: (in % rndg ±% of rng)

	220V and 2V	other ranges
30 Hz- 20 kHz	0.2% + 0.07%	0.01% + 0.05%
20 kHz- 100 kHz	0.4% + 0.07%	0.3% + 0.05%V
100 kHz-300 kHz		1% + 0.05%
300 kHz-500 kHz		5% + 0.05%

Additional Error for DC Component: 0.05% + 0.01%
Limit of Lowest Reading: 1% of range
Temp. Coeff.: (0.01% rdng + 1 digit)/°C
Input Impedance: 1 MΩ//55 pF
CMRR: For DC 120 dB, for AC (50 or 60 Hz ±1%) 80 dB
Max. CM Signal: 250V RMS or 400V p between guard and ground.
Max.: 60V RMS or 85V p between '0' and guard.
Crest Factor: RMS converter >4.5 at full scale, warning in display when exceeded

Response Time
Excluding Ranging: <1s
Including Ranging: <2.6s
Maximum Input Voltage: 600V AC or DC with max. 900V peak.
Maximum V. Hz Product: 2.10^7

Resistance, 2-Wire and 4-Wire

Measuring Modes: HRM, NM and HSM
Ranges: 220Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ and 2 wire only 20 MΩ, 200 MΩ, 2 GΩ
Resolution in Lowest Range: In HRM 0.001Ω, in NM and HSM 0.01Ω
Max. Display: In HRM 239999, in NM and HSM 23999, above 20 MΩ 2399
Accuracy: In % rdng + % rng and temperature coefficient in % rdng/°C

Ranges	Accuracy	Temp. Coeff.
up to 200 kΩ	0.03% + 0.005%	0.005%
2 MΩ-20 MΩ	0.1% + 0.005%	0.01%
200 MΩ	0.2% + 0.05%	0.02%
2000 MΩ	1% + 0.05%	0.1%

Max. Voltage at Open Input: <12V up to 200 kΩ, <4.5V over 200 kΩ
Measuring Current: = 2V divided by range-end value
Response Time at Normal Mode: Up to 2 MΩ 0.6s excl. ranging and 1s including autoranging increasing up to 2.7s at 200 MΩ and 22s at 2000 MΩ
Protected up to 250V RMS or 350V p in the 2-wire resistance mode and 30V RMS or 42V p on the 4-wire input.

DC Current and AC + DC Current

Measuring Modes: NM and HRM and HSM for DC only
Ranges: 2 µA, 20 µA, 200 µA, 2 mA, 20 mA, 200 mA, 2000 mA
Resolution in Lowest Range: 10 pA for DC in HRM mode
Maximum Display: 239999, for DC, HRM mode 23999

Accuracy
For DC: ± (0.1% rdng + 0.02% rng), 30 Hz...5 kHz ± (0.2% rdng + 0.07% rng)
Limit of Lowest Reading for AC: 1% of range

Temperature Coefficient
DC: (0.005% rdng)/°C
AC: (0.01% rdng + 0.005% rng)/°C
Crest Factor of AC: RMS converter 2 at full scale
Voltage Drop at Input:
in 2000 mA range <500 mV;
in 2...200 mA range <250 mV;
in 200 µA range <25 mV;
in 20 µA range <2.5 mV;
in 2 µA range <0.25 mV
SMRR for DC Current Measurements: 40 dB at 50 and 60 Hz ±1%
Max. SM Signal: peak value <180 full scale
Max. CM Signal: 250V RMS or 400V p between guard and ground
Max.: 60V RMS or 85V p between '0' and guard
Response time as for voltage measurements
Protected up to 250V RMS or 350V p by fuse.

Temperature Measurements

Type of Probe: Pt 100 e.g. Philips PM 9249
Range (depending on probe used): Between -250°C and +850°C
Resolution: 0.1°C
Max. Display: 8500
Accuracy: Referred to DIN 43760 and excluding probe ± (0.3% rdng + 0.2°C)
Temperature Coefficient: (0.01% rdng + 0.003% rng)/°C
Measuring Current: 1 mA
Response Time (excluding probe): <1s

HF Voltage

With optional unit PM 9258 and HF probe set PM 9211
Ranges: 200 mV, 2V, 20V and 200V
Resolutions: 10 µV in 200 mV range (HRM)
Limit of Lowest Reading: 5 mV

Accuracy

100 kHz...3 MHz	2% rdng + 0.1% rng
3 MHz...6 MHz	5% rdng + 0.1% rng
6 MHz...25 MHz	10% rdng
25 MHz...700 MHz	3 dB

Input Capacitance: 2 pF

Maximum Input Voltage
AC: 30V, with attenuator 200V
DC: 200V, with attenuator 500V
50Ω T-piece and attenuator included in delivery of PM 9211

Peak Voltage

(With option PM 9259)
Measuring Modes: NM and HRM
Ranges: 2V, 20V, 200V and 900V p
Resolution in Lowest Range: 100 µV (HRM)
Maximum Display: 2399 in NM; 23999 in HRM
Input Impedance: 1 MΩ//15 pF
Maximum VHz Product: 2.10^7
Maximum Input Voltage: 900V p or 600V RMS

Periodical Peak Value
Two or three times per second the peak value over a preceding period of 200 ms is displayed.
Start of measuring cycle is automatic.
Repetitive signals with a rise time not faster than 0.5% of signal period time or a peak value during at least 0.5% of period time are measured with the following accuracy.
+Vpeak and -Vpeak (DC-coupled)
± (0.2% rdng + 0.2% rng) for 5 Hz...100 kHz
Vpeak-to-peak (AC-coupled)
± (0.5% rdng + 0.2% rng) for 10 Hz...10 kHz
± (1% rdng) + 0.2% rng for 10 kHz...100 kHz
Absolute Peak Value
At any time during the measurement the maximum peak value from the start of the measurement is displayed.
Start and stop controlled manually or by external contact.
Repetitive signals:
With a measuring period, equal to 1s or 1 period time (whichever is the largest) and a duty cycle of >0.5%, repetitive signals are measured with the following accuracy.

+Vpeak and -Vpeak (DC-coupled)
± (0.2% rdng + 0.2% rng) for 0 to 100 kHz
Single shots:
Each signal with a rise time not faster than 1 ms or a peak value during at least 1 ms is measured with the following accuracy.
+Vpeak and -Vpeak (DC-coupled)
± (1% rdng + 0.2% rng)

Relative Reference Measurements

In the "Relative reference" mode of the instrument the difference between any value and a previous measured reference value can be displayed.

System Interfaces (optional)

IEC bus interface	PM 9291
BCD parallel output	PM 9292
Analog output	PM 9254

The analog output can be installed in parallel to one of the digital interfaces. All front panel functions can be remotely controlled via the interfaces. The high speed mode can be controlled via the interfaces. For further details see 'Optional accessories'.

IEEE/IEC Interface Data
IEEE interface option PM 9291
Interface connector 25-pole IEC connector
Address settable by switches

Interface Functions

SH1	Source handshake
AH1	Acceptor handshake
T5	Talker with talk only, serial poll and automatic unaddress if MLA Output data Measuring data including polarity data and range Status data generated by serial poll including parameter, range and error conditions overload, crest factor ex ceeded and wrong programming
L4	Listener with automatic unaddress if MTA Input data Programming data for all manual con trollable functions + high-speed setting
SR1	Service Request (can be switched off with local switch) SRQ is generated in case of overload, crest factor exceeded, data available and illegal range pro gramming
RL1	Local-Remote control
DT1	Device trigger by GET and data bytes E1 Time specification (excluding analog functions of voltmeter) Programming time 10 ms/byte Output time 8 ms + 4.5 ms/byte Response to serial poll 5.5 ms
Codes	ISO 7 bit code Input delimiter (all characters of column 0 of ISO 7-bit coding table) Output delimeter: EXT, ECI

General Specifications

Power Supply: 110, 120, 220, 240V (±10%)
Line Frequency: 50 or 60 Hz (±1%)
Power Consumption: 30 VA
Safety Class: IEC-348 class I
Dimensions: 328 x 280 x 90 mm (13 x 11 x 3.5 in)
Weight: 5.3 kg (12 lbs)
MTBF: 10 000 hours

Environmental Conditions

Reference Temperature: +23°C ±1°C
Rated Range of Use: 0...+50°C
Operating Range: 0...+55°C
Storage and Transport: -40...+70°C
Humidity Operating Range: 20...80%

Ordering Information

Model

PM 2528/02x Standard Instrument
(x = power options)

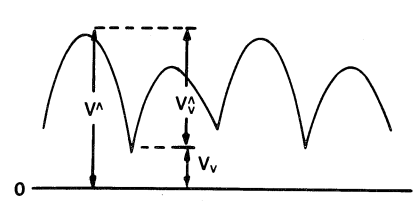
Power Options

Instruments are normally delivered in accordance with local power requirements. If an alternative power options is required, the instrument can be supplied with a different power setting and cord. In such cases, please specify one of the following options:
/..1 Universal European 220V/16A/50 Hz
/..3 Standard North America 110V/16A/60 Hz
/..4 United Kingdom 240V/13A/50 Hz
/..5 Switzerland 220V/10A/50 Hz

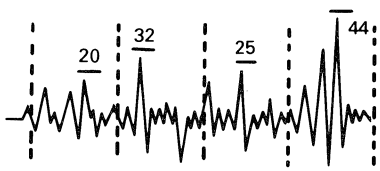
Accessories

Delivered with the instrument:
PM 9260/00 Set of test leads with probes
5322 321 24376 Shielded measuring cable, spare fuses
4822 872 30441 Operating manual for PM 2528
Optional available:
PM 9053 Adapter Banana (m) - BNC (f)
PM 9071 Measuring cable 135Ω Banana (m) - Banana (f)
PM 9072 Measuring cable 135Ω BNC (m) - Banana (m)
PM 9211/01 High frequency 2 mV probe 10 kHz ... 1 GHz
PM 9244/00 AC and DC current shunt up to 31.6A
PM 9245/00 AC current transformer 10A...150A
PM 9246/03 High tension probe
PM 9249/01 Temperature probe
PM 9254/02 Analog output for PM 2528
PM 9258/01 High frequency option for PM 2528
PM 9259/01 Peak voltage option for PM 2528
PM 9263/01 Data hold probe
PM 9264/01 4-Wire test lead for resistor measurement
PM 9266/03 Set of safety test leads with probes (UL-aproved)
PM 9265/01 Shielded 3-Wire test lead
PM 9291/02 IEEE-488 Interface option for PM 2528
PM 9292/02 BCD Parallel output interface option for PM 2528
PM 9669/03 19-in Rackmount adapter (3E/132 mm/5.22-in)
9499 475 01811 Service manual for PM 2528
9499 473 002011 Manual for repair of PM 2528 by Signature Analysis

Peak Voltage Measurements



Measured are:
V^{v} = most positive peak of signal (DC-coupled)
V_v = most negative peak of signal (DC-coupled)
Both V^{v} and V_v can have pos. as well as neg. polarity
V^{v}_{v} = peak to peak value (AC-coupled)



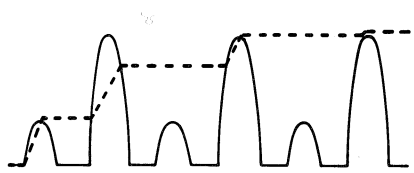
Reading at 'periodical' mode

A	00	20	32	25	44

Reading at 'absolute' mode

B	00	20	32	32	44

Measuring modes:
A. Periodical peak value indicating highest peak in preceding period (see line A)
B. Absolute peak value indicating highest peak value since the start of the measurement (see line B)



Accuracy:
Any signal of which peak value can be reached in one or more cycles by a slew rate of 7 digit/μs in normal mode or 70 digit/μs in high resolution mode can be measured with full accuracy. (Slew rate is indicated by dotted line)

PM 2534 & PM 2535

GPIB IEEE-488



PM 2535

PM 2534 & PM 2535 System Multimeters

- 3-1/2 to 6-1/2 digits
- 100 nV resolution
- 100 measurements/second
- GPIB/IEEE-488 interface standard
- Front or rear input
- Scanner extension
- Advanced data calculation, collection and control (PM 2535)

The Philips PM 2534 and PM 2535 Systems Multimeters cover a broad range of applications. While both are suitable for a wide range of general purpose measurements, the PM 2535 offers additional advanced functions for applications demanding data gathering, and fast measurement collecting and processing.

Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs, and 6-1/2 digit guarded sensitive measurements or up to 3-1/2 digit high speed measurements. The units can operate in scan mode under external control via the standard GPIB/IEEE-488* interface.

Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, advanced control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to 150 measurements/sec. Sequence programming allows repetition of the same measurement cycle; for example, this capability, when combined with a Philips System 21 module, allows the PM 2535 to act as a small data logger with no need for dedicated computer control.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Three Million Counts

Philips own VLSI technology is used in the custom analog-to-digital circuitry that gives the PM 2534 and PM 2535 their outstanding performance. The 100 nV resolution on a 300 mV measurement, plus its exceptional short-term stability (0.002%) and long-term accuracy (0.005%) more than substantiates this performance.

To guarantee this measurement integrity, PM 2534 and PM 2535 are the only instruments in their class with a true, fully-guarded input. This eliminates parasistic lead voltages and noise which can be several orders of magnitude larger than the measurement resolution of the instrument itself and would otherwise invalidate sensitive measurements.

Fast Measurement and Output

At a touch of the 'speed' button, the PM 2534 and PM 2535 step through 6-1/2, 5-1/2, 4-1/2, and 3-1/2 digit modes, enabling the optimum speed/resolution combination to be selected for every application. At a 3-1/2 digit resolution the instrument makes 100 measurements per second and can transmit the measured values through its standard GPIB/IEEE-488 interface at the same rate.

This is achieved by the use of two powerful 8-bit microprocessors in parallel – one controlling measurements while the other controls the GPIB/IEEE-488 interface function. In addition, the measurement and interface functions are galvanically separated, eliminating the possibility of ground loops between different instruments connected to the bus, which can ruin sensitive measurements.

V_{DC} Measurement Speed (including Controller)

Digits	Trigger Mode	Measurements/s
3-1/2	Internal	100
3-1/2	IEEE	50
4-1/2	IEEE	30
5-1/2	IEEE	3
6-1/2	IEEE	0.3

Typical measurement speeds

Measurement Capabilities

The very high performance of these instruments cover more than DC voltages alone. In fact, seven measuring functions, including temperature are standard.

Function	Maximum Resolution	Maximum Range	Accuracy (90-Day)
V_{DC}	100 nV	300V	0.05%
V_{AC}	10 µV	300V	0.2%
I_{DC}	100 nA	3A	0.03%
I_{AC}	10 µA	3A	0.2%
Ω 2-wire	1 mΩ	300 MΩ	0.02%
Ω 4-wire	1 mΩ	3 MΩ	0.02%
°C via Pt-100	0.1°C	-100°C... +850°C	0.3%

Simple English Commands

The PM 2534 and PM 2535 are without doubt two of today's friendliest programmable instruments, because they respond to simple English commands rather than complex codes. For example, to measure an unknown AC voltage, it is necessary only to enter the command 'VAC AUTO', and both the AC voltage and autoranging functions are immediately selected.

To ensure faultless communication with both user and computer, these instruments also accept numeric ranging values in either decimal or exponential notation, and automatically round-off to the correct range. For example, the com-

mands 'VDC-2' or 'VDC 185E-3' both result in selection of the 300 mV DC range. The PM 2534 and PM 2535 also overcome one major drawback of many other programmable instruments — the amount of 'string splitting' that the controller has to perform to extract the required measurement data. Use of the 'OUT' command gives exactly the required data, eliminating this complex and time-consuming task.

Command	Output string to controller
OUT String	'VDC + 123.4567 E-03'
OUT Numeric	'+ 123.4567 E-03'
OUT N, 6	'123.4'

For applications needing operator instructions, messages can be generated on the DMM display with the "TXT" command.

Operator and Application Friendly

Single button selection of function, range and trigger modes make the PM 2534 and PM 2535 very simple to use. Precise measurements are always made very quickly thanks to the 'NULL' key to compensate for small offsets and the 'FILTER' key to eliminate small instabilities on DC signals.

Access to the GPIB/IEEE-488 address and mode of operation is under the 'CHECK' function but to prevent unauthorized use in systems application this can be 'locked-out' resulting in a 100% tamper free front panel.

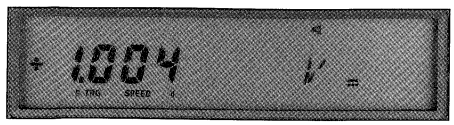
And emphasizing the system-oriented design even further, the standard facility for full electronic calibration allows simple recalibration either via the GPIB/IEEE-488 bus, or manually, without the need to open the case.

PM 2535 for Collection, Calculation and Control

As for the PM 2534, all the PM 2535's normal measuring functions are directly selectable by a single keystroke. When the calculation, collection or control facilities are required, a simple touch of the SHIFT key reveals a logical and extremely simple user prompting technique. Each key has two color-coded sublevels, with the active level clearly indicated on the display.

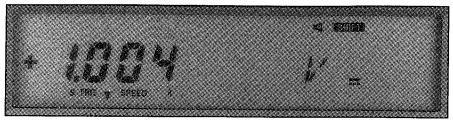
In addition, user prompting messages appear on the display to request the required user input. The example shows how simple this facility is to use.

Once the required measuring set-up has been programmed, it can also be saved in one of ten non-volatile PROG memory locations, so that the next time it is needed it can simply be recalled by number, rather than having to be reprogrammed.



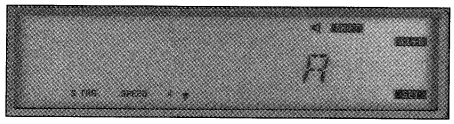
Normal measurement display

Press SHIFT



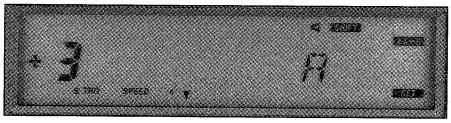
SHIFT appears on display

Press AX x B



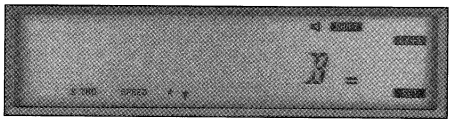
AX x B and SET appear on display
Display requests setting of A

Press 3



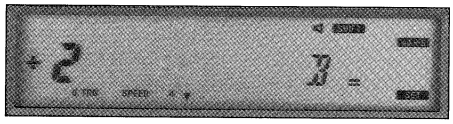
New value of A defined

Press ENTER



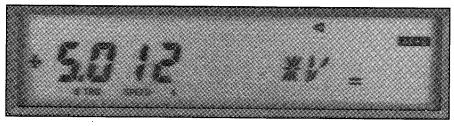
New value of A entered
Display requests setting of B

Press 2



New value of B defined

Press ENTER



New value of B entered
PM 2535 now shows measuring
Results scaled according to 3X + 2 where x is the measured value

Direct Parameter Display

In many applications, the measured voltage or current is just a function of the real measured parameter, for example where pressure transducers are used. Translating the measured value into the parameter actually required would normally tie-up a computer, and require additional software to be written. The PM 2535 has this capability as standard, enabling the following transformations to be achieved:

AX + B	For scaling for example transducer outputs with live zeros.
dBm	For direct amplifier gains and losses. The value of the reference resistance is user programmable.
Δ%	For % tolerance measurements for example when matching components. This uses the formula ((X - C) x 100) ÷ C.
ZERO	For absolute deviation measurements from a specified value which can be measured or programmed.
LIMITS	For fast and accurate GO/NO GO measurements within or outside a predetermined range.

Data Collection

At any time, the Minimum or Maximum measurement made in the selected measuring function can be checked by using the MIN/MAX key. The PM 2535 also has a 999-point buffer which is constantly active. This ensures that the last 999 measurements can be reviewed at any time, and ensures that measurements are not lost — you can always go back to them using the RD.BUF. key.

In applications requiring the collection of data following an event, rather than preceding it, the use of the BURST key relocates the internal buffer relative to the trigger point, so that the buffer then acts as a post-trigger memory. In combination with the DELAY facility, this mode enables a measurement to be made every five minutes, for example, over a three-and-a-half day period; ideal for weekend monitoring of test set-ups.

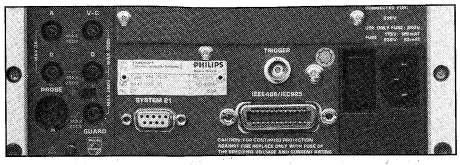
The internal buffer is also valuable when very fast measurements need to be made. One-for-one output of measured values via the GPIB/IEEE-488 bus can take place at up to 100 measurements/sec., depending on the controller's GPIB/IEEE-488 specification.

The PM 2535 can measure at up to 150 measurments/sec., and by storing these directly in the internal buffer, more than 6 seconds of high-speed measurements can be collected regardless of the controller's speed.

After such a measurement cycle, all or any selected part of the buffered information can be transmitted at the normal transfer speed of the computer.

Controlling Philips System 21 Modules

Many system applications demand measurements to be made at a number of different points and require large and expensive scanners. But with the PM 2534 and PM 2535, Philips System 21 can be added to any GPIB/IEEE-488 application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 master unit built-in, enabling them to control the PM 2120 universal switches or the PM 2121 low level switches.



Rear view of PM 2535 showing duplicated front panel input sockets, data bus interface and System 21 connectors.

Specifications

Technical Specifications

Volts DC/Amps DC

Ranges	Maximum Resolution	Accuracy: 5-1/2 or 6-1/2 Digits in %Rdng + %Rng 24 Hrs (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)	Temp. Coeff./°C in %Rdng + %Rng	Input Characteristics
30 mV	100 nV	0.0025 + 0.0014*	0.007 + 0.0017*	0.012 + 0.0017*	0.002 + 0.0005	10 MΩ//30 pF
3V	1 µV	0.0020 + 0.0010	0.005 + 0.0013	0.010 + 0.0013	0.002 + 0.0005	10 MΩ//30 pF
30V	10 µV	0.0025 + 0.0013	0.006 + 0.0017	0.015 + 0.0017	0.002 + 0.0005	10 MΩ//30 pF
300V	100 µV	0.0025 + 0.0010	0.006 + 0.0013	0.010 + 0.0013	0.002 + 0.0005	10 MΩ//30 pF
30 mA	100 nA	0.01 + 0.005	0.03 + 0.005	0.05 + 0.005	0.005 + 0.001	<250 mV drop
3A (<1A) 3A (>1A)	10 µA 10 µA	0.01 + 0.005 0.10 + 0.0	0.03 + 0.005 0.15 + 0.01	0.05 + 0.005 0.20 + 0.01	0.005 + 0.001 0.005 + 0.001	<600 mV drop <600 mV drop

**Valid when using "NULL"*

Operation Modes Scale Length	Speed Measurements/Sec.	Series Mode Rejection 50-60 Hz ±0.1%	50-60 Hz ±1.0%	Common Mode Rejection* DC	50-60 Hz ±0.1%	50-60 Hz ±1%	Common Mode Voltage Influence in %Rng/Volt DC	50/60 Hz + 0.1%	50/60 Hz ±1%
3000000	0.3	>80 dB	>60 dB	>140 dB	>160 dB	>140 dB	0.00002	0.00002	0.0002
300000	3.0	>70 dB	>50 dB	>140 dB	>150 dB	>130 dB	0.00002	0.00002	0.0002
30000	30	>60 dB	>40 dB	>140 dB	>140 dB	>120 dB	0.00002	0.00002	0.0002
3000	100 (150)**	—	—	>140 dB	>80 dB	>80 dB	0.002	0.01	0.01

**Measured with 1 kohm unbalance and guard connected to CM voltage* ***For PM 2535 using internal buffer*

Maximum Input Voltage: 600V peak, 300V continuous
Maximum S.M. Voltage: 140% of selected range
Maximum C.M. Voltage: 350V peak between low and guard; 350V peak between guard and ground
Filters: User-selectable digital
Clip Indication: † is displayed when input circuitry clips during measuring cycle
Null Range: ±100 µV
Protection: 3.15A fuse

Volts AC RMS/AC Amps

Ranges	Maximum Resolution	Input Characteristics	Accuracy: 4-1/2 or 3-1/2 digits in %Rdng + %Rng valid from 1% to 100% of range Frequency Range	24 Hrs (tcal ±5°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)
300 mV 3V	10 µV 100 µV	1.2 MΩ//30 pF	40/400 Hz - 5 kHz	0.10 + 0.10	0.20 + 0.10	0.30 + 0.10
30V 300V	1 mV 10 mV	0.93 MΩ//30 pF	5 kHz-100 kHz per kHz	0.02 + 0.02	0.04 + 0.02	0.06 + 0.02
30 mA	1 µA	<250 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.10
3A	100 µA	<600 mV drop	*40/400 Hz - 1 kHz	0.1 + 0.1	0.2 + 0.10	0.3 + 0.1

**Analog Filter on/off*

Operation Modes Scale Length	Speed Measurements/Sec
30000	2.5
3000	25

Protection: 3.15A fuse
Crest Factor: 3.3 at full scale, increasing down scale. Crest factor overload indicated by 1 on display
Temperature Coefficient: <0.03%/°C
Maximum Volt-Hertz Product: 10^7
CMRR: With 1 kΩ unbalance and guard to '0': >120 db for DC signals; >80 db for 50 /60 Hz AC signals
Maximum Input Voltage: 600V peak, 400V continuous

PM 2534 & PM 2535

Ohms (2-Wire and 4-Wire)

Ranges	Maximum Resolution	Accuracy 6-1/2 or 5-1/2 Digits in % Reading + % Range			Input Characteristics (Non-Linear)
		24 Hr (tcal ±1°C)	90 Days (tcal ±5°C)	1 Year (tcal ±5°C)	
3 kΩ 30 kΩ 300 kΩ	1 mΩ 10 mΩ 100 mΩ	0.010 + 0.0033	0.02 + 0.0033	0.03 + 0.0033	1 mA drive 100 µA drive 10 µA drive
3 MΩ 30 MΩ* 300 MΩ*	1Ω 100Ω 10 kΩ	0.020 + 0.0033 0.060 + 0.0033 0.8 + 0.033	0.04 + 0.0033 0.10 + 0.0033 1.6 + 0.033	0.05 + 0.0033 0.15 + 0.0033 2.0 + 0.033	1 µA drive 100 nA drive 10 nA drive

**Only in 2 wire configuration*

Operation Modes Scale Length	Speed Measurements/Sec
3000000	0.25
300000	2.5
30000	25
3000*	65

**Excluding 3 MΩ, 30 MΩ and 300 MΩ ranges*

Temperature (via Pt 100 R to probe)*

Meter Ranges	Resolution	Accuracy	Measurements/Sec
-100 to 850°C	1.0°	0.3% Reading + 0.2°C	30
-100 to +850°C	0.1°C	0.3% Reading + 0.2°C	3

**For optional accuracy see PM 9249/01 RTD Probe*

Maximum Open Circuit Voltage: 10V
Maximum 4-Wire Lead Resistance: 100Ω
Protection 2-Wire Terminals: 250V ac or dc, 350V peak
Protection 4-Wire Terminals: 30V ac or dc, 42V peak
Maximum CM Voltage: 2-Wire: 250V ac or dc, 350V peak between '0' and guard, or between guard and ground; 4-Wire: 30V ac or dc, 42V peak between '0' and ground; guard must be connected to '0'
Linearization: According to DIN 43760
Max Voltage: Between '0' and guard 30V ac or dc, 42V peak

General Specifications

Power Requirements

Power Supply: 115V or 230V (±10%)
Line Frequency: 50 Hz or 60 Hz (±1%)
Power Consumption: 20 VA
Safety Class: IEC 348 class I
Dimensions: 280 x 210 x 86 mm (11 x 8.3 x 3.4 in.)
Weight: 2.9 kg (6.2 lbs)
MTBF: 32000 hrs
Calibration Interval: 1 year

Environmental Conditions

Reference Temperature: 23°C ±1°C
Rated Range of Use: 0...+50°C
Operating Range: 0...+55°C
Storage and Transport: -25...+70°C
Limits of Humidity for Operation: 20...80%
Max Dew Point: +25°C
Included with the instrument: Set of safety test leads (PM 9266/03) with probes, spare fuses, operating instructions, service manual

Ordering Information

Models

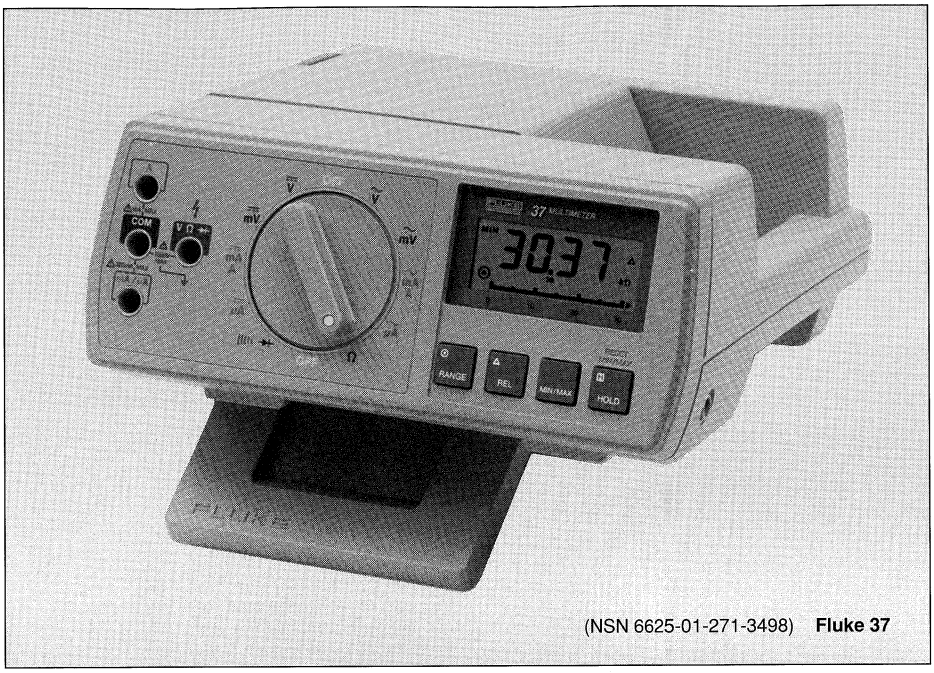
PM 2534/01x Standard Instrument
PM 2535/01x Standard Instrument
x is a power option

Power Options

Instruments are normally delivered in accordance with local power requirements. If an alternative power options is required, the instrument can be supplied with a different power setting and cord. In such cases, please specify one of the following options:
/**..1** Universal European 220V/16A/50 Hz
/**..3** Standard North America 110V/16A/60 Hz
/**..4** United Kingdom 240V/13A/50 Hz
/**..5** Switzerland 220V/10A/50 Hz

Accessories

PM 9053 Adaptor Banana (m) - BNC (f)
PM 9071 Measuring cable 135 ohm Banana (m) - Banana (m)
PM 9072 Measuring cable 135 ohm BNC (m) - Banana (m)
PM 9190/01 RS-2320 / V24 interface
PM 9210/00 High frequency 150 mV probe 10 kHz... 1GHz
PM 9212/00 Accessories for HF probe PM 9210
PM 9213/00 High frequency 10 mV probe 10 kHz... 100 MHz
PM 9244/00 AC and DC current shunt upto 31.6 A
PM 9245/00 AC current transformer 10A... 150A
PM 9246/03 High tension probe
PM 9249/01 Temperature probe
PM 9264/01 4-Wire test lead for resistor measurement
PM 9265/01 Shielded 3-Wire test lead
PM 9267/01 Data hold probe
PM 9280/02 19-in rackmount adaptor



(NSN 6625-01-271-3498) **Fluke 37**

Fluke 37 Bench Portable Digital Multimeter

- Sloped front panel for easy viewing
- 3200-count digital display, combined with fast 31-segment analog bar graph
- "Min-Max" and "Relative" modes
- Fast autoranging and Touch Hold® functions
- 0.1% basic dc accuracy, overload protection to 1000V rms, fused 10A range
- Built-in storage compartment for accessories and a detachable tilt stand
- Superior shielding against electromagnetic interference (EMI)
- Survives 6 kV transients on 660V major ac feeders
- Designed to meet UL 1244 requirements

Unique Case Design

The internal design of the Fluke 37 allows the front panel to slope 15 degrees, permitting easy viewing from a number of operating positions. When used in the flat position the Fluke 37 may be stacked with other instruments.

Storage Compartment/ Carrying Handle

A storage compartment for test leads and small accessories is built into the case. Access to the battery and fuses is through a snap-out door inside this compartment. A built-in carrying handle (molded into the case) offers portability when needed.

High Performance

0.1% basic dc accuracy, low millivolt to 1000V ac and dc voltage measurements, 30 kHz ac response, low microamp to 10A ac and dc current measurements, low milliohms to 32 MΩ resistance, up to 10,000 MΩ with conductance.

3200-Count Digital Display

Better accuracy and resolution than a conventional 3½ digit (2000 count) DMM, high contrast liquid crystal display with a wide viewing angle, updated two times per second.

31-Segment Analog Bar Graph

Makes dynamic indications such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Min-Max & Relative Modes

Min-Max stores the highest and lowest digital reading, allowing a signal to be monitored for seconds, or days. The Relative mode remembers a reading and shows the change (difference) between it and any following readings.

Fast Autoranging

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Selectable manual ranging included.

Touch Hold®

The meter will beep, capture a measurement, and lock it on the digital display until you're ready to view it. Automatically updates with each new stable measurement if preferred for later viewing.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. Easy to hear, mid-frequency beeper (1500 Hz).

EMI Shielding

A unique conductive shield fully encloses all circuitry to provide exceptional protection against electromagnetic interference.

Safety Designed

Extensive overload protection, high energy fuses, fused 10A range, non-metallic case and tilt-stand. All voltage inputs meet the power line surge tests for major feeders as defined in IEEE-587-1980, Category B, which includes simulated lightning and load switching transient pulses up to 6 kV superimposed on 660V power lines.

Power

The Fluke 37 is battery powered for true portability. It is also equipped with an input jack which accepts the optional Fluke A81 battery eliminator accessory for continuous operation from line voltage. Typical battery life 1,000 hours.

Standard Equipment

Every meter is packaged with a pair of safety-designed TL70 right-angle test leads, spare fuse, 9 volt battery, and operator's manual.

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18° C to 28° C for one year after calibration. Accuracy is specified as within ±(% of reading plus number of least significant digits).

DC Voltage

Range	Resolution	Accuracy
320.0 mV	100 µV	
3.200V	1 mV	
32.00V	10 mV	0.1% + 1
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Rejection Ratio: >60 dB at 50 and 60 Hz
Common Mode Rejection Ratio: >120 dB at dc, 50 Hz and 60 Hz; ≤1 KΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz - 30 kHz
320.0 mV	100 µV			
3.200V	1 mV			
32.00V	10 mV	0.5%+3	2%+3	4%+10
320.00V	100 mV			
1000V	1V	1%+3	3%+3	Not Spec

Extended Frequency Response: Typical -3 dB @ 100 kHz
Conversion Type: AC coupled, average sensing, calibrated to read the rms value of a sine-wave
Input Impedance: 10 MΩ nominal, <100 pF
Common Mode Rejection Ratio: >60 dB, dc to 60 Hz, ≤1 kΩ unbalance
Overload Protection: 10^7 Volt-Hertz maximum, 1000V, 500V on 320 mV range
Response Time: ≤2s to rated accuracy

DC & AC Current

Range	Resolution	Nominal Burden Voltage
320.0 µA	0.1 µA	0.5 mV/µA
3200 µA	1 µA	0.5 mV/µA
32.00 mA	10 µA	5.6 mV/mA
320.0 mA	100 µA	5.6 mV/mA
10.00A	10 mA	50 mV/A

DC Accuracy: Within 0.75% + 2
AC Accuracy: Within 1.5% + 2 (40 Hz to 1 kHz)
Overload Protection
10A Range: 15A/600 fuse, 100,000A interrupt rating
mA Range/µA Ranges: 630 mA / 250V fuse, 1500A interrupt rating; in series with a 2A/600V fuse, 10,000A interrupt rating
Response Time: ≤2s to rated accuracy

Ohms

Range	Resolution	Accuracy
320.0	0.1Ω	0.3% + 2
3.200k	1Ω	
32.00k	10Ω	0.2% + 1
320.0k	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Test Voltage: <420 mV dc full scale up to 3.2 MΩ; >1.3V up to 32 MΩ. <2.8V open circuit
Test Current: <1 mA
Response Time: ≤6s to rated accuracy in highest and lowest range; ≤2s for other ranges

Diode Test & Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.0V full scale. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold).
Continuity Indication: Continuous audible tone for test resistance below approximately 150Ω
Open Circuit Test Voltage: <3.3V
Overload Protection: 500V rms

General Specifications

Storage Temperature: -55°C to 85°C
Operating Temperature: -15°C to 55°C Operate to -40°C for 20 minutes when taken from a 20°C environment 0°C to 50°C
Temperature Coefficient: 0.1 x the applicable accuracy specification per °C (<18°C or >28°C)
Relative Humidity: ≤90% (≤80% in 32 MΩ range) to 35°C, ≤70% to 50°C
Shock & Vibration: Per MIL-T-28800, Class 3
Electro-Magnetic Interference (EMI): MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and RE02 (radiated emissions)
MIN/MAX Mode: Records digital display readings (updated twice per sec.)
Digital Display: 3200 counts plus polarity indication updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Maximum Voltage to be Applied to any Terminal: 1000V with respect to earth ground
Battery: 9V NEDA 1604. Symbol when 60 hours remain. 1000 hour typical
Safety: Protection Class II per IEC 348 and ANSI C39.5
Size: 97 mm H x 216 mm W x 231 mm L (3.8 in H x 8.5 in W x 9.1 in L)
Weight: 1.31 kg (2.9 lb)

Included with Instrument: TL70 test leads, spare fuse, battery and instruction manual

Ordering Information

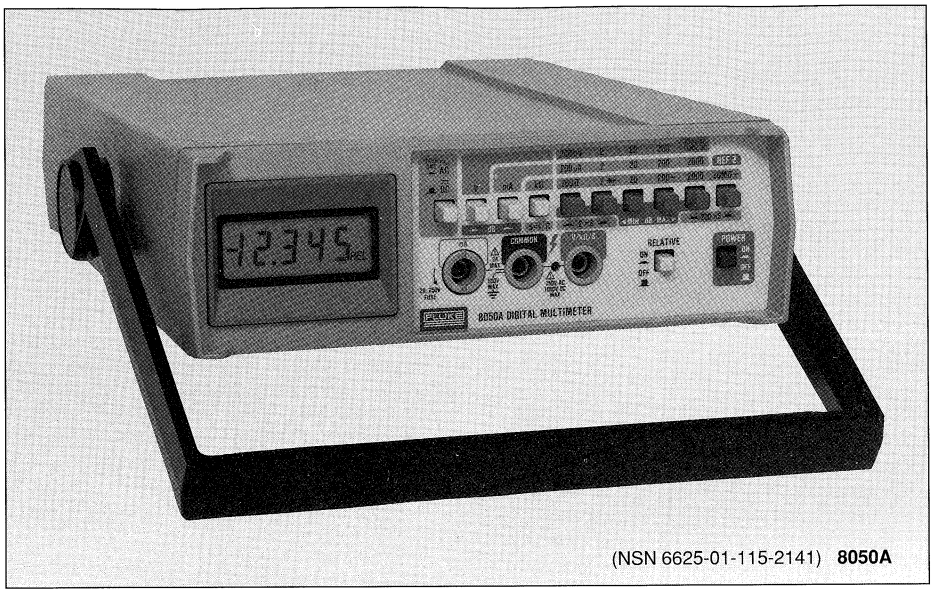
Model

Fluke 37 Multimeter

Accessories (Also see Section 5)

TL 20 Test Lead Set
Y8134 Deluxe Test Lead Set
Y8140 Test Lead Set
A81 Battery Eliminator
83RF High Frequency Probe
85RF High Frequency Probe
80TK Thermocouple Module
80T-150U Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Current Probe
80i-1010 DC/AC Current Probe
80i-kW Current/Power Probe
LCA-10 Line Current Test Adapter

8050A



(NSN 6625-01-115-2141) **8050A**

8050A, Bench/Portable Digital Multimeter

- 4 1/2 digits (20,000 counts)
- Nine functions including-Relative reference, dB, Conductance, Diode test
- 0.03% basic dc accuracy
- True-rms from 20 Hz to 50 kHz
- Microcomputer-based
- Extensive overload protection
- Rechargeable battery version available (-01)
- Touch-hold probe available (80T-H)
- Probes for rf, high voltage, high current available
- Factory Mutual approved

The 8050A provides superior performance and measurement capabilities in a low-cost, bench-top instrument. This 4 1/2-digit DMM has the following measurement functions: dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, dBm (with selectable reference impedances) conductance, and diode test. It also has a relative-reference feature that works with all measurement functions.

Relative Reference

When the RELATIVE switch is on, the displayed value is equal to the difference between the present input value and a previously stored reference value.

One application is to null out test lead resistance. The resistance of the test leads is first measured and stored in the 8050A. Subsequently, all displayed values of resistance will be actual values since the stored value of lead resistance will be automatically subtracted. Measurement errors are greatly reduced for low values of resistance (about 1Ω or less).

Another application is measuring the dB gain of the various stages of an audio amplifier. First, the input voltage to the amplifier is measured and stored as the zero dB reference value. Subsequent measurements will show the gain of each stage of amplification. Calculations are not needed; the 8050's microcomputer does it for you.

The relative-reference feature can be used to determine the drift of power supplies, the bandwidth or bandpass of audio devices, and lowpass filter response. This feature makes the 8050A an excellent pass-fail tester for the production line or incoming inspection.

dB Function

While many analog meters will indicate dBm referenced to 600 ohms, the 8050A provides digital read-out of decibels referenced to any one of sixteen impedances from 8 ohms to 1200 ohms. Now there is no need to use manual conversion tables – the internal microprocessor does the calculations for you. A front panel pushbutton and scrolling memory lets you select the reference impedance needed.

A resolution of 0.01 dB (above 1 mV) and high accuracy from 20 Hz to 50 kHz make the 8050A an extremely valuable tool for audio measurements. It can be used to determine the bandwidth of audio amplifiers, filters, audio consoles, etc. With the addition of an optional rf probe, the 8050A can be used on rf communications equipment.

Conductance

Two ranges of conductance extend the resistance-measuring capabilities of the 8050A to 100,000 MΩ, far beyond the capacity of ordinary multimeters. This lets you measure leakage of diodes, pcbs, cables, insulators, even measure transistor beta using a simple test adapter.

True-RMS AC

The 8050A uses a true-rms conversion technique to assure accurate measurement of non-sinusoidal waveforms as well as pure sinewaves. Examples: distorted or modulated sinewaves, squarewaves, sawtooths, noise, and pulse trains with a duty cycle of 10% or higher. Specified accuracy extends from 20 Hz to 50 kHz. Useful measurements go to 200 kHz, the typical -3 dB bandwidth.

Optional Touch-Hold Probe

The 80T-H Probe allows you to "hold" any displayed reading of voltage, resistance, or conductance as long as the control switch on the probe body is depressed. (Not for current or dB measurements.)

Overload Protection

The 8050A has extensive protection against overloads and operator errors. The instrument will accept up to 750V ac or 1000V dc continuously, regardless of the voltage range, or 500V dc when measuring resistance. It will also withstand short-duration transients to 6 kV.

The current input is protected against overloads by a 2A/250V fuse. For accidental connection of high voltage to the current input terminals (such as 480V ac line power) a heavy duty 3A/600V fuse backs up the first fuse.

Optional Accessories

Fluke offers a complete line of optional accessories that enable you to measure rf voltages to 500 MHz, temperature to 1000°C, current to 1000A, or high voltage to 40 kV.

8050A

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of 90% or less.

DC Voltage*

Ranges: ±200 mV, ±2V, ±20V, ±200V & ±1000V
Resolution: 10 µV on lowest range, 0.1V on 1000V range
Accuracy: ±(0.03% of reading + 2 digits) all ranges
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz or 60 Hz
Common Mode Noise Rejection: ≥90 dB at dc, 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, continuous, except 10 seconds maximum on the 200 mV and 2V ranges
Response Time: 1 second maximum, to rated accuracy within a range

** DC voltage can also be measured using the dB mode with 0.01 dB resolution between 5% of range and full range*

AC Voltage (True-RMS, AC Coupled)

Voltage Readout: From 5% to 100% of range

Range	Resolution	Accuracy: ±(% of Rdg+Digits) 20 Hz*	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV	10 µV	1% +10		0.5% +10	1% +10		5% +30
2V	100 µV						
20V	1 mV						
200V	10 mV						
750V	100 mV			Not specified			

**Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full scale*

dB Readout: From 5% to 100% of range

Input Voltage	dBm 600Ω Ref	Range	Accuracy 20 Hz	45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
0.77mV -2mV	-60 to -52	200 mV*	±0.5 dBm					N/S
2mV -2V	-52 to +8							
0.1V -2V	-18 to +8	2V*	±0.25 dBm		±0.15 dBm	±0.25 dBm		±0.75 dBm
1V-20V	+2 to +28	20V						
10V-200V	+22 to +48	200V						
100V-750V	+42 to +60	750V			Not specified (N/S)			

** When 200 mV range is selected, 8050A autoranges for best accuracy for inputs up to 2V*

dB Resolution: ±0.01 dB from 5% to 100% of range; 0.1 dB from 1% to 5% of range; 1.0 dB below 1% of range
Decibel Reference Impedances: Fifteen user-selectable impedance reference levels are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 125Ω, 135Ω, 150Ω, 250Ω, 300Ω, 500Ω, 600Ω, 800Ω, 900Ω, 1000Ω, 1200Ω. An 8Ω impedance reference level is provided to reference 0 dBW. (dBV = 1000Ω)
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Extended dB Response: Typically -72 dBm (600Ω ref) ±1 dB to 10 kHz
Useful Frequency Range: Typically -3 dB at 200 kHz
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Common Mode Noise Rejection: 90 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 750V rms or 1000V peak continuous, except 10 seconds maximum on the 200 mV and 2V ranges, not to exceed a volt-hertz product of 10^7 (e.g., 200V at 50 kHz)
Response Time: 2 seconds max to rated accuracy within a range

DC Current

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Burden Voltage
200 µA	10 nA	±(0.3% of rdg + 2 digits)	0.3V max
2 mA	100 nA		
20 mA	1 µA		
200 mA	10 µA		
2000 mA	100 µA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuses in series

AC Current (True-RMS, AC Coupled)

Range	Resolution	Accuracy: (5% to 100% of Range)* 20 Hz**	45 Hz	2 kHz	10 kHz	20 kHz
200 µA	10 nA	2% + 10		1% + 10		2% + 10
2 mA	100 nA					
20 mA	1 µA					
200 mA	10 µA					
2000 mA	100 µA			Not spec'd		

**Accuracy applies from 5% to 100% of range*
***Typically 3 t o 5 digits of "rattle" will be observed at 20 Hz at full range*

Burden Voltage: 0.3V rms max, 200 µA through 200 mA range; 0.9V max on 2000 mA range
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: 2A/250V and 3A/600V fuse in series

Resistance

Range	Resolution	Accuracy	Full Scale* Voltage
200Ω	0.01Ω	±(0.1% reading +2 digits+0.02Ω)	0.19V
2 kΩ*	0.1Ω		1.2V
20 kΩ	1Ω	±(0.05% reading +2 digits)	0.2V
200 kΩ*	10Ω		2V
2000 kΩ	199Ω	±(0.25% reading +3 digits)	0.2V
20 MΩ*	1 kΩ		2V

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The three non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements
Open Circuit Voltage: Less than 3.5V on all ranges
Input Protection: 500V dc or rms ac on all ranges
Response Time: (To rated accuracy) 10 seconds maximum on 20 MΩ range, 2 seconds maximum on all other ranges

Conductance

Range	Resolution	Accuracy
2 mS	0.1 µS	±(0.1% of reading + 5 digits)
200 nS	0.01 nS	±(0.5% of reading + 20 digits)

Equivalent Resistance
2 mS Range: 500Ω to 10 MΩ
200 nS Range: 5 MΩ to 100,000 MΩ
Open Circuit Voltage: Less than 3.5V on both ranges
Input Protection: 500V dc or rms ac on all ranges

Relative Reference

An input applied when the RELATIVE button is depressed is held as "0" reference point. Subsequent readings indicate deviations ± from this point.
Accuracy: Error will not exceed the sum of the errors for the two measurements.

General Specifications

Common Mode Voltage: 500V dc or peak ac max
Temperature: 0°C to 50°C, operating; -40°C to +70°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C and from 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C, except 2000 kΩ, 20 MΩ, and 200 nS ranges where it is <80% to 35°C
Safety: IEC 348, Protection Çlass I when operated from supply mains or Protection Class II when operated from internal batteries. Factory Mutual 3820 Approved. CSA 556A Certified.
Power: 90 to 110V ac, 105 or 132V ac, or 200 to 264V ac, 47 to 440 Hz, factory-configured for customer-specified voltage. With rechargeable battery version (-01), the line voltage range is field-changeable. 4W max, 6W with -01 version.
Batteries: NiCd batteries are installed in version -01. They provide 10 hours of typical operation on a full charge. Recharge takes 14 hours. Can run on ac line while charging
Size: 22 cm W x 6 cm H x 25 cm L (8.5 in W x 2.5 in H x 10 in L)
Weight: 1.08 kg (2.38 lb) for standard model
Included with Instrument: Manual, line cord, test leads (TL70) and statement of calibration practice

Ordering Information

Models

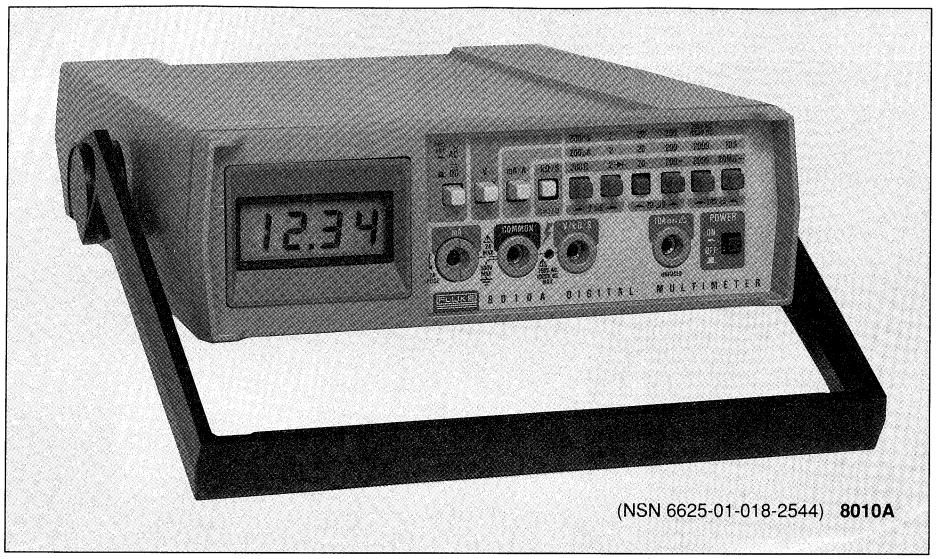
8050A DMM
8050-01 DMM w/rechargeable batteries

Accessories (Also see Section 5)

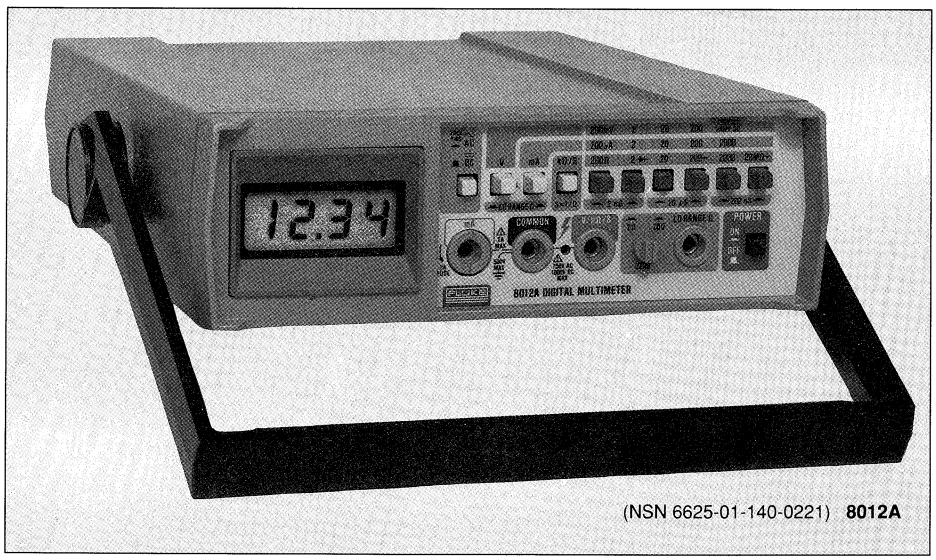
TL20 Test Lead Set
TL70 Test Lead Set
Y8132 Replacement Test Leads
Y8134 Deluxe Test Lead Set
Y8140 Slim Test Leads, w/needle points
C86 Ruggedized Carrying Case
Y8205 Carrying Case w/shoulder strap
80T-H Touch Hold Probe
83RF RF Probe, 100 MHz
85RF RF Probe, 500 MHz
80TK Thermocouple Module
80T-150U Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
80J-10 Current Shunt
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Current Probe
80i-1010 DC/AC Current Probe
80i-kW Current/Power Probe
M00-200-611 3½" Rack Mount Kit, Offset
M00-200-612 3½" Rack Mount Kit, Center
M00-200-613 3½" Rack Mount Kit, Dual

8010A & 8012A

T&M EXPRESS LINE



(NSN 6625-01-018-2544) **8010A**



(NSN 6625-01-140-0221) **8012A**

8010A & 8012A, Bench/Portable Digital Multimeters

- 3½ digits (2000 counts)
- Seven functions, including – Conductance, Diode Test
- 0.1% basic dc accuracy
- True-rms ac, from 45 Hz to 50 kHz
- 10A range (8010A only); 2Ω and 20Ω range (8012A only)
- Optional touch-hold probe (80T-H)
- Extensive overload protection
- Rechargeable-battery model (-01)
- Extended measurements with optional accessories
- Factory Mutual approved

The 8010A and 8012A are 3-1/2 digit portable/bench DMMs, that offer exceptional performance and features at a low cost. Measurement functions include: dc Volts, true-rms ac Volts, dc amps, true-rms ac amps, ohms, conductance, and diode test. The difference is that only the 8012A features two low-resistance ranges (2 ohms and 20 ohms) and only the 8010A features a 10A current range. Rechargeable battery versions are available as Models 8010A-01 and 8012A-01. The 8010A and 8012A operate on ac line power only.

True-RMS

A Fluke-manufactured true-rms converter assures accurate measurements of non-sinusoidal voltage or current waveforms such as squarewaves (crest factor of 1 to 1). This custom hybrid provides low noise and a wide bandwidth. Accuracy is specified to 50 kHz, but the typical -3 dB bandwidth is 200 kHz.

Conductance

This unique and highly useful function makes resistance measurements as high as 10,000 megohm possible. Since conductance, which is expressed in Siemens (S), is the inverse of ohms (1/Ω), a simple conversion of the DMMs conductance reading yields resistance. The conductance function is useful for checking high value resistors, leakage in connectors, cables, printed circuit boards, diodes, photodiodes, etc. Even the beta of a transistor may be measured using a simple adapter.

10A Range (8010A Only)

The 8010A has a 10 ampere ac or dc current range for applications that require measuring more than 2 amperes.

Low Ohms (8012A Only)

The 8012A has two additional ranges of low resistance - 2 ohms and 20 ohms. Along with the conductance function, that gives you a resistance range of 0.001Ω to 10,000 MΩ! There are not many resistance measurements that the 8012A can't handle.

The two low-resistance ranges are suited for measuring transformer windings, cables, heating elements, coils, small-value resistors, and many other devices. Lead resistance is nulled out using a front panel control so that only the unknown resistance is measured.

Optional Touch-Hold Probe

The 80T-H probe lets an operator "hold" the displayed reading by simply depressing a button on the probe's body. The reading will not change until the button is released. The 80T-H can be used as a normal probe at other times. It works for voltage, resistance, and conductance measurements.

Overload Protection

When measuring resistance or conductance, up to 500 volts may be applied with no instrument damage. Voltage inputs can handle 1000V dc or peak ac and transients up to 6 kV. The 2A current input is protected with two in-series fuses—2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V back-up fuse protects the DMM should the 2A/250V fuse ionize when accidentally attached to a source of more than 250 volts—like a 480-volt power line.

Extended Measurements

Optional accessories enable you to extend the measurement capabilities of the 8010A and 8012A. For example, measure current to 600A, rf voltage to 500 MHz, voltage to 40 kV, and temperature to 1000°C (1832°F).

Specifications

Technical Specifications

All accuracy specifications are for one year after purchase or recalibration when operated in a temperature range of 18°C to 28°C.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 µV on lowest range 1V on 1000V range
Accuracy: (±0.1% of reading + 1 digit) on all ranges
Input Impedance: 10 MΩ on all ranges
Normal Mode Noise Rejection: ≥60 dB at 60 Hz or 50 Hz
Commom Mode Noise Rejection: ≥90 dB at dc, 50 Hz, and 60 Hz, with 1 kΩ unbalance
Overload Protection: To 1000V dc or peak ac on any range
Response Time: 1 second maximum

AC Voltage (True RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)*				
		45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV 2V 20V 200V	100 µV 1 mV 10 mV 100 mV	0.5% + 2		1.0% + 2	5% + 3	
750V	1V	0.5% + 2	Not specified			

**Accuracy applies from 5% to 100% of range*

Useful Frequency Range: Typically ±3 dB at 200 kHz
Input Impedance: 10 MΩ in parallel with <100 pF
Commom Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: To 750V rms, 1000V peak, not to exceed 10^7 volt hertz product (10 seconds maximum on 200 mV and 2V ranges)
Response Time: 2 seconds maximum

Resistance

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2Ω	1 mΩ	1.0% + 2	0.02V	10 mA
20Ω	10 mΩ	0.5% + 2	0.2V	10 mA
Note...above ranges in 8012A only				
200Ω	0.1Ω	0.2% + 1	<0.25V	1.30 mA
2 KΩ*	1Ω		>1.0V	1.30 mA
20 kΩ	10Ω		<0.25V	10.0 µA
200 kΩ*	100Ω		<1.0V	35.0 µA
2000 kΩ	1 kΩ	0.5% + 1	<0.25V	0.10 µA
20 MΩ*	10 kΩ		>1.5V	0.35 µA

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: <3.5V on all ranges except <16V on 2Ω and 20Ω ranges
Input Protection: To 300V dc or rms on 2Ω and 20Ω ranges. 500V dc on all other ranges
Response Time: 1 second on all ranges except 2000 kΩ and 20 MΩ where time is 4 seconds, maximum

Conductance

Conductance is the inverse of ohms (1/Ω) and is expressed in Siemans (S), formerly mhos

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Full Scale Voltage	Max Test Current
2 mS	1 µS	0.2% + 1	<3.5V	1.3 mA
20 µS	10 nS	0.2% + 1	<1.0V	10 µA
200 nS	0.1 nS	1.0% + 10	<1.0V	0.1 µA

Equivalent resistance
2 mS Range: 500Ω to 1 MΩ
20 µS Range: 50 kΩ to 100 MΩ
200 nS Range: 5 MΩ to 10,000 MΩ
Input Protection: To 500V dc or rms on all ranges

DC Current

Range	Resolution	Accuracy: ±(% of Reading + Digits)	Burden Voltage
200 µA	0.1 µA	0.3% + 1	0.3V max
2 mA	1 µA		
20 mA	10 µA		
200 mA	100 µA		
2000 mA	1 mA		0.9V max
10A*	10 mA	0.5% + 1	0.5V max

**This range in 8010A only*

Overload Protection: 2A, 250V front panel fuse in series with 3A/600V front panel fuse. 10 ampere range in 8010A not fused, 12A maximum
Response Time: 1 second maximum

AC Current (True-RMS, AC Coupled)

Range	Accuracy: ±(% of Reading + Digits)*				Burden Voltage
	45 Hz	2 kHz	10 kHz	20 kHz	
200 µA 2 mA 20 mA 200 mA	1% + 2			2% + 2	0.3V max
2000 mA 10A**	1% + 2	Not specified			0.9V max 0.5V max

**Applies from 5% to 100% of range*
***This range in 8010A only*

Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Response Time: 2 seconds maximum
Other Specifictions: Same as for dc current

General Specifications

Display: 3-1/2 digit (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or peak ac, maximum
Touch and Hold: Holds a voltage or resistance reading when the mA jack is monentarily shorted to COMMON. Accessory probe 80T-H is recommended.
Temperature: 0°C to +50°C, operating; -40°C to +60°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: <0.1 times the applicable accuracy specification per °C, from 18°C to 0°C and 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C except for 2000 kΩ, 20 MΩ, and 200 nS ranges where it is ≤80% to 35°C
Power: 90 to 132 ac or 200 to 264V ac, 50 or 60 Hz, 2W for standard models. With battery version (-01), voltage and frequency range is selectable with internal switches, 3.5W.
Batteries: Rechargeable NiCd batteries and recharge circuits installed in version -01. Recharge time approximately 14 hours. "BT" on display appears when approximately 1/2 hour of operation remains. Fifteen to thirty hours of operation typical of full charge, depending on functions used
Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W x 10 in D)
Weight: 1.08 kg (2.38 lb) for standard models. 1.42 kg (3.13 lb) for version -01 with batteries
Included with Instrument: Manual, line cord, test leads (Y8131), statement of calibration practice

8010A & 8012A

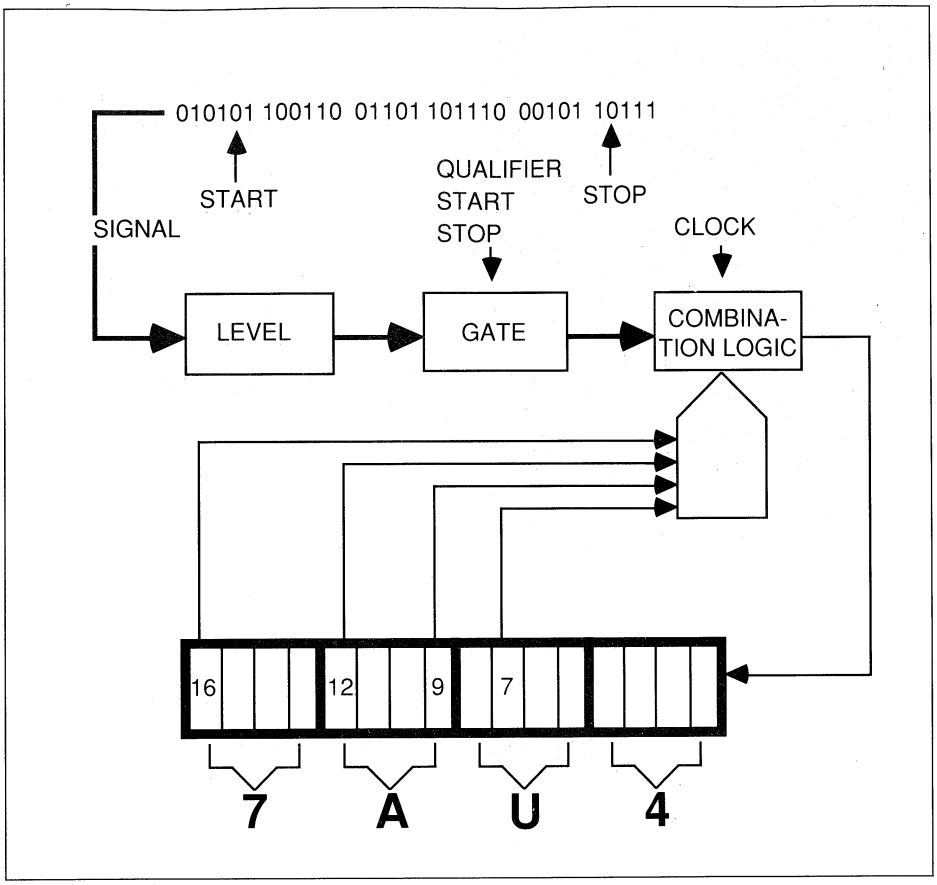
Ordering Information

Models

8010A DMM w/10A Range
8010A-01 DMM w/Batteries
8012A DMM w/2Ω and 20Ω Range
8012A-01 DMM w/Batteries

Accessories (Also see Section 5)

Y8131 Replacement Test Leads
Y8133 Deluxe Test Lead Set
Y8140 Slim Test Leads w/needle points
C86 Ruggedized Carrying Case
Y8205 Soft Carrying Case
80T-H Touch-Hold Probe
83RF RF Probe, 100 MHz
85RF RF Probe, 500 MHz
80TK Thermocouple Module
80T-150U Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
80J-10 Current Shunt
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-600 Ac Current Probe
M00-200-611 3 1/2" Rack Mount Kit, Offset
M00-200-612 3 1/2" Rack Mount Kit, Center
M00-200-613 3 1/2" Rack Mount Kit, Dual



Signature Analysis Introduction

The Solution to a Problem

During the past few years the effect of the microprocessor on almost all types of equipment has become apparent. This has not only lead to products becoming more sophisticated in their capabilities but also more complex in their testing and repair.

Analog circuitry can be checked using a voltmeter and oscilloscope by simply tracing the signal flow through a system. Microprocessor based equipment with its complex bus structures, bi-directional lines and combinatorial logic requires more dedicated tools.

Whilst the Logic analyzer and A.T.E. systems solved these testing problems in the development and large-scale production areas, service still had to rely on its multimeters and oscilloscopes. As these tools were unable to test microprocessor-based equipment the only repair method available was that of board-swapping and returning the faulty board to a central service department where suitable test equipment and detailed board knowledge were available. The effect of the board-swapping service was an ever increasing service stock of both good and bad boards which tied up company capital and lead to increased service costs.

This situation demanded the development of a new sort of testing technique that could be used in low-scale production and depot and on-site service. Above all, this technique had to be inexpensive, and required a minimum training time to be used effectively. These needs were answered by the Signature Analysis technique first introduced seven years ago.

Stimulate and Compress

The Signature Analysis method consists of controlled repetitive circuit node stimulation and the measurement of that stimulus signal by means of a data-compression technique. The stimulation is best achieved in the product itself by forcing the system into a known program loop which repetitively exercises a specific section of the total system. Measurements can then be made using the data compression technique from the Signature Analyzer. Such measurements on a good board will give a reproducible characteristic signature for each node which consists of a 4 digit pseudo hexadecimal code. By collecting signatures from the same nodes on a suspected faulty board and comparing these against the known good values a simple "GO - NO-GO" fault location technique is realized.

The Signature Analyzer

The signature analyzer consists of a 16-bit shift register with four feedback paths. The data from a stimulated node is sampled into this shift register under the control of a clock edge (either rising or falling) derived from the system under test.

This system clock must be chosen so the data present at the active edge is stable and meets the set-up and hold-time requirements of the signature analyzer.

The period over which data is sampled is determined by the start and stop signals. These are also edge-active signals derived from the system under test and must be so chosen to ensure that the number of sampling clock edges which they enclose is perfectly repeatable for each test. The same signal can often be used for both start and stop as this reduces the number of connections to be made. In some applications (e.g. ROM testing) the use of a qualifier is also needed. This is a level-active signal derived from the system under test which — when active — inhibits the sampling clock, so masking unwanted data from the data stream.

When the stop edge is detected the sampling clock stops and the 16-bit data value present in the shift register is displayed as four pseudo hexadecimal digits called the signature. This method of data compression is extremely reliable, the likelihood of identifying a bad data stream as correct being 1 in 50000 whilst a 100% guarantee is given for identifying good data streams as correct.

Designing Requirements and Test Procedure

As signature analysis relies on the stimulation of each circuit node under controlled and repeatable conditions, this capability must be designed into the product. The most important design requirement is that the functional division which breaks the total system down into smaller minimally interdependent modules. This ensures easier understanding and repair and should be considered as a standard design practice rather than a specific requirement for signature analysis.

Working from the basis of a total system failure the S.A. technique starts testing from the center of the system and works its way outwards using only one functional module for stimulation of another after it has been verified as correct itself. The first functional module to be checked is the Kernel (processor, RAM, ROM).

To ensure repeatable testing of the Kernel certain hardware modifications are needed. The possibility of "free running" of the microprocessor enables all addressing and decoding circuitry to be checked. This is simply achieved by the addition of switches across the data bus

Signature Analysis

which then force a no-operation code onto the bus at each processor address. In addition all interrupts need to be disabled as these will erroneously affect both S.A. stimulation programs and free running.

Once the addressing and decoding circuits are verified each PROM location can be tested whilst the processor is still in the free-run mode. Should this prove error-free then the data bus may be reconnected and a test PROM containing stimulation programs may be inserted. These programs are unique to the system under test and should exercise specific functional areas of the system.

If these functional areas contain feed-back (interactive) loops, they may need to be set in a fixed condition by switches to ensure repeatable testing.

At each stage of the testing the correct signatures need to be known. This involves the generation of signature lists, or, what is often simpler, is the addition of the signatures to the circuit diagrams.

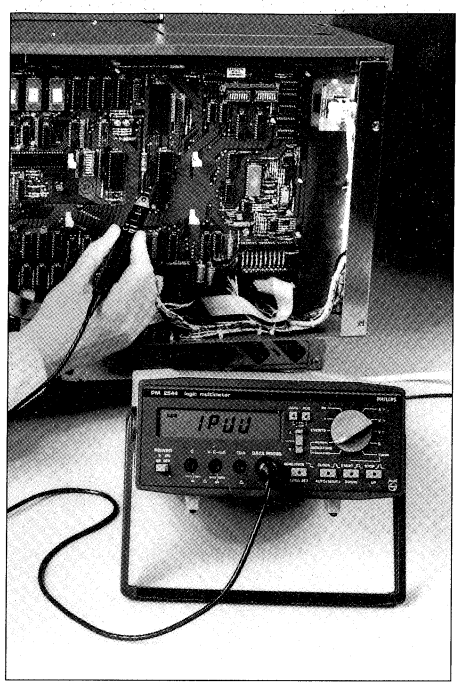
Return on Investment

The cost of implementing signature analysis in a product is approximately 1% of its total development time. This involves:

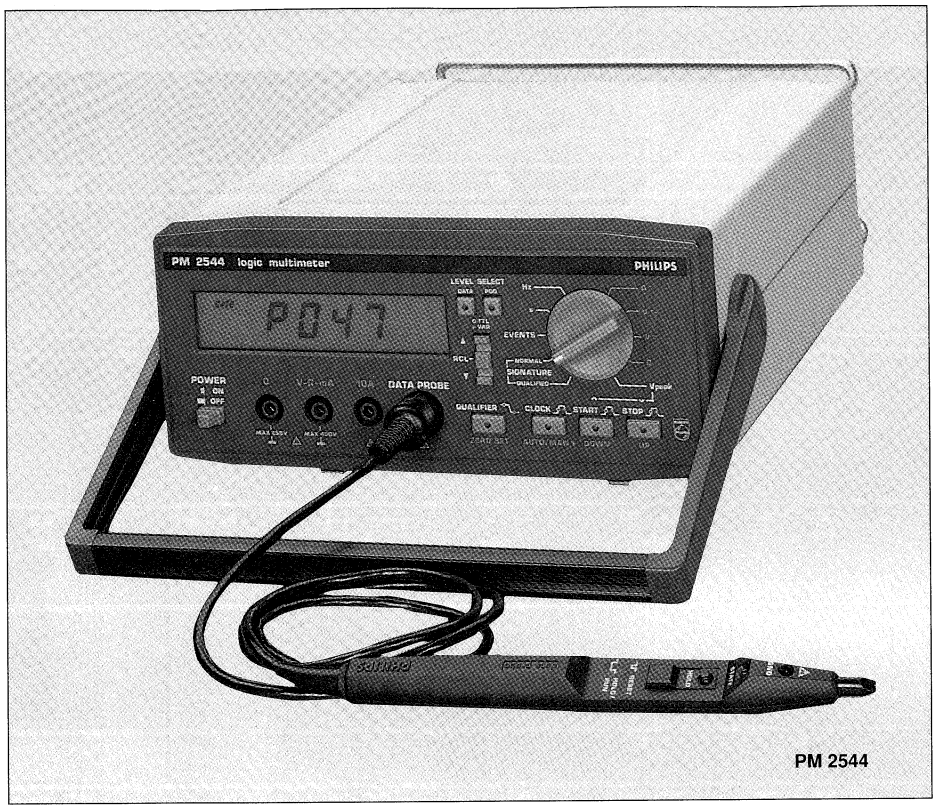
- Hardware modifications for S.A. (free running switches etc)
- Software stimulation programs
- Documentation (Signature lists)

The return on this investment comes in the following forms:

- Lower "spare board" stocks
- Reduced board transport and administration costs
- Reduced central service or factory loading in repairing faulty boards
- On-site servicing possible



A typical application using the data hold probe which allows a measurement to be "frozen".



PM 2544

PM 2544 Logic Multimeter with Signature Analysis

- Industry standard signature analysis
- Memory modules store 125 signatures
- Full V.I.R. capabilities
- 20 MHz frequency counter
- Event counting and time measurement
- Peak detection and relative reference measurements
- 4-1/2 digit display

The PM 2544 Logic Multimeter combines measurement of all standard electrical parameters, including time, event counting and peak voltage with a signature analysis facility. This permits data flow comparison making it the ideal tool for those difficult servicing problems posed by modern LSI circuit boards.

In addition to these valuable features there are the facilities for relative reference measurements, and excellent overload protection.

Signature Analysis

The PM 2544 compresses the data flow at a point to produce an industry-standard four digit signature. All inputs to the signature analyzer are threshold-selectable and the inbuilt logic data probe enables rapid identification of stuck nodes. The multimeter also offers an optional plug-in memory module capable of storing the user's own signatures for future use. Signatures can be loaded into the memory module while testing a known good circuit.

This fast, easy to use catch and compare system is invaluable for speeding up fault-finding in the repair of digital equipment.

Standard Multimeter Functions

Both DC volts and ACRMS voltage measurements offer a resolution of 100 µV with full scale readings of 450V.

DC current measurements between 10 µA and 20A (short-term) are possible, while resistances between 0.18 and 10 MΩ can be measured. In all these modes, relative reference measurements can be made either by using an already measured value, or 'dialling-up' the required reference setting.

Peak Voltage Measurements

Push-button selection allows positive or negative peaks with pulse widths as short as 20 ns and repetition rates down to 20 Hz to be measured to a 0.1V resolution in the range +12.6 to -12.6 volts.

Frequency Measurements

After selecting the data probe trigger level to match the circuit under test, frequency measurements from 1 Hz to 20 MHz are fully automatic, requiring both the high and low thresholds to be crossed. The data probe indicates this by means of a LED which blinks with each transition below 3 Hz, or at 3 Hz for higher frequencies.

Time Measurement

Time measurements between 100 ns and 100000s are automatically made between user-defined start and stop edges. Signal connection is made via the timing pod while edge selection is made via the front panel.

Event Counting

Low to high transitions up to a maximum of 10-in are counted from the data probe during a gate time defined by the start and stop edges applied to the timing pod.

Data Hold

The logic data probe supplied also doubles as a data hold probe. It is only necessary to press the button on the probe to freeze the measured current value for easy reading.

PM 9140 Memory Module Adapter

The PM 9140 Memory Module Adapter enables the storage and recall of signatures from the PM 9141 memory modules by the PM 2544. This allows direct comparison of measured signatures previously stored in a memory module. Any incorrect signature detected during measurement gives an error indication in the display and an audible alarm signal.

The use of these options considerably shortens the troubleshooting time at individual service depot level within large service organizations.

Other Options

In addition to the memory module and adapter a wide range of HF, high current, and high voltage probes can be used to extend the measuring range of the PM 2544. These are detailed in the instrument specification.

Logic Multimeter/Signal Analyzer

PM 2544

Specifications

Technical Specifications

PM 2544

Measuring Quantity	VDC	VAC	IDC	R	Hz	Time	Events	Vpeak
Ranges (All Auto Ranging)	1V 10V 100V 1000V*	1V 10V 100V 1000V*	100 mA 10A	1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	100 kHz 1 MHz 10 MHz 20 MHz	10 ms to 10^5s in eight ranges	10^5 to 10^{11} events in 7 ranges	-12.6 volts to +12.6 volts
Max Resolution	100 µV	100 µV	10 µA	100 mΩ	1 Hz	100 ns	1 event	100 mV
Accuracy (% Reading + % Range)	0.2 + 0.05	0.5 + 0.1 (40 Hz to 1 kHz) 1.0 + 0.1 (1 kHz to 10 kHz) 5.0 + 0.1 (10 kHz to 20 kHz)	0.5 + 0.1	0.5 + 0.1 for kΩ ranges 1.0 + 0.1 for MΩ ranges	0.01 + 0.02	0.01 + 0.02	0.01 at <10 MHz 0.02 at <10 MHz	2.0 ±0.2V
Input Characteristics	9.8 MΩ ≤10V Range 8.85 MΩ >10V Range	2 MΩ/50 pt ≤10V Range 1.8 MΩ/50 pt >10V Range	Voltage Drop <200 mV	Open Input Voltage <3V	As Data Probe	As Data Pod	As Data Probe and Pod	As Data Probe
CMRR DC AC 50 Hz SMRR 50 Hz ±0.1% Maximum CM Voltage	>100 dB >100 dB 80 dB 250V	>100 dB >80 dB 250V						
Response Time Including Ranging	<0.Ωs <1s	<1s <2s	<0.8s <2s	<0.8s	<1s <1s	<1s <1s	<1s <1s	<1s
Overload Protection	630 Vp	630 Vp	100 mA Range Fused	250V rms	250V for 10s	250V for 10s	250V for 10s	250V for 10s
Relative Reference	Yes	Yes	Yes	Yes				
Additional Information			20A for Max 10s	Beeper at <100 counts in Man Ranging	Min Pulse Width 20 ns	Min Pulse Width 100 ns		Min Pulse Width 20 ns Max Repeat Time 50 ms
Number of counts	11 000	11 000	11 000	11 000	99 999	99 999	99 999	

**Max input voltage 450V*

General Specifications

PM 2544

Performance Characteristics: This specification is valid after the instrument has warmed up for 15 minutes (reference temperature 23°C ±2°C).

Signatures

Measuring Modes: With or without qualifier, repetitive or single measurement with data-hold and 'latch unstable signature' mode
Display: 4 characters (0 to 9, ACFHPU)
Unstable Indication: With '~' sign
Display Refreshment: Each 300 ms except for unstable signatures, which are shown immediately

Inputs

Data Input: Via data probe provided with 'hold' switch and indicators for hold mode and logic state
Clock, Start, Stop and Qualifier: Via Pod
Input Impedance: Data probe; 142 kΩ to logic 0/ /25 pF, 77 kΩ to 0.78 (dL + dH)V
Pod: 100 kΩ to logic 0//25 pF
V Open Data Probe: Mean value of dL and dH, between +9.2 and -7.2V
Protection: 150V continuously; 250V for 10s (max. peak 350V)

Trigger Levels and Edges

Selection: TTL or Variable

	TTL	VAR	
		Default CMOS	Setting Range
Data Low	<0.8V	<1.5V	Independently Adjustable
Data High	<2.0V	<3.5V	Between + and -
Pod	1.4V	2.5V	12.7V in 0.1V Steps

The default value for Variable setting is for CMOS 5V and is automatically set at switching on. All levels can be shown in the display. The trigger edges for clock start and stop and the low/high level of the qualifier can be selected and are indicated by LEDs.

Timing Data

Clock: Maximum frequency 20 MHz; minimum pulse width 20 ns
Gate Length: Min. 1 clock cycle, max. no limit
Time Between Gates: Min. 1 clock cycle

	Data Probe	Start, Stop Qualifier
Set-up Time	10 ns	20 ns
Hold Time	0	0

Logic State Indicator

Indicator: LED on data probe bright for >dH; off for <dH; dim for <dL, <dH
Minimum Detectable Pulse Width: 20 ns shown on LED for at least 100 ms
Trigger Levels: As for signatures

PM 9140

Storage Capacity: Trigger levels for probe and pod separate trigger edges for normal and qualified mode maximum of 125 signatures
Read Time: 1 ms/signature
Loading: Via PM 2544, using 'store' mode
Supply: Li battery (lifetime 5 years)

General Specifications

Power Supply: 110V, 120V, 220V or 240V (±10%)
Line Frequency: 50 Hz or 60 Hz (±1%)
Power Consumption: 20 VA
Safety Class: IEC 348 class I
Dimensions: 305 x 225 x 107 mm (12 x 8.8 x 4.2 in.)
Weight: 2.8 kg (6.2 lbs)
Calibration Interval: 180 days

Environmental Conditions

Reference Temperature: 23°C ±1°C
Rated Range of Use: 0...+45°C
Operating Range: 0...+50°C
Storage and Transport: -40...+70°C
Limits of Humidity for Operation: 20...80%
Max Dew Point: +25°C

Ordering Information

Models

PM 2544/01x Standard Instrument
x is a power option

Power Options

Instruments are normally delivered in accordance with local power requirements. If an alternative power options is required, the instrument can be supplied with a different power setting and cord. In such cases, please specify one of the following options:
/..1 Universal European 220V/16A/50 Hz
/..3 Standard North America 110V/16A/60 Hz
/..4 United Kingdom 240V/13A/50 Hz
/..5 Switzerland 220V/10A/50 Hz

Accessories

Delivered with the instrument

PM 9266/03	Set of safety test leads with probes (UL-aproved)
5322 210 70082	Data probe
5322 218 61036	POD
8499 470 18401	Operating manual for PM 2544

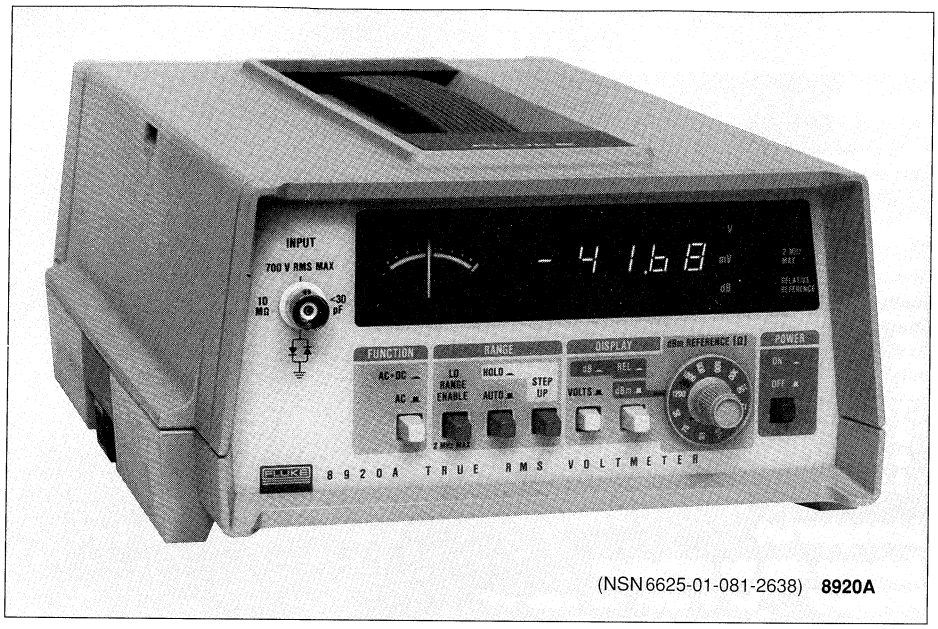
Optional available

PM 9053	Adaptor Banana (m) - BNC (f)
PM 9071	Measuring cable 135 ohm Banana (m) - Banana (m)
PM 9072	Measuring cable 135 ohm BNC (m) - Banana (m)
PM 9140/01	Memory adaptor for PM 2544
PM 9141/02	3 memory modules for PM 9140/01
PM 9142/01	Data copier for PM 9141
PM 9210/00	High frequency 150 mV probe 10 kHz... 1 GHz
PM 9212/00	Accessories for HF probe PM 9210
PM 9213/00	High frequency 10 mV probe 10 kHz... 100 MHz
PM 9244/00	AC and DC current shunt upto 31.6A
PM 9245/00	Ac current transformer 10A... 150A
PM 9246/03	High tension probe
PM 9279/01	Ever-ready case
9499 475 02011	Service manual for PM 2544

Digital Voltmeters

8920A, 8921A & 8922A

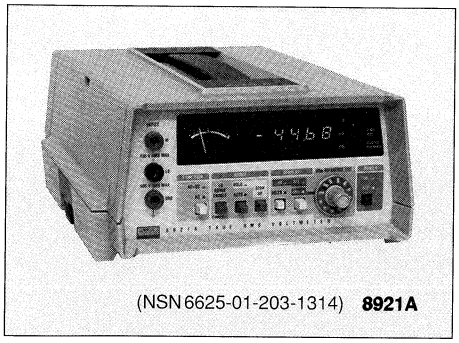
GPIB IEEE-488



(NSN 6625-01-081-2638) **8920A**

8920A, 8921A & 8922A Wideband Digital Voltmeters

- True-rms ac with readout in volts or dB
- AC or ac + dc measurements
- Autoranging
- Selectable dBm reference impedance
- Analog display for peak/null adjustments
- Rear panel linear analog output (Models 8920A & 8922A)
- Relative dB measurements
- 10 Hz to 20 MHz or 2 Hz to 11 MHz (Model 8922A)
- 180 μV to 700V



(NSN 6625-01-203-1314) **8921A**



(NSN 6625-01-126-3884) **8922A**

Choice of Bandwidth

Bandwidth capabilities of the 8920 Series Voltmeters encompass many applications, from testing high-frequency oscillators, attenuator flatness and amplifier frequency response to microphone levels, phono-pickup devices, vibration tests and wideband noise levels to list only a few. Models 8920A and 8921A cover a bandwidth of 10 Hz to 20 MHz. The 8922A offers low-frequency capabilities in the 2 Hz to 11 MHz bandwidth and a switchable 200 kHz low pass filter which eliminates unwanted high-frequency noise from the measured signal.

True-RMS Converter

The heart of all 8920 Series Voltmeters is Fluke's monolithic thermal converter which can measure rms values of an ac signal. This patented semiconductor circuit balances the heating power of a dc feedback signal against the heating power of the ac input voltage, producing a true rms equivalent dc output. This unique converter enables Fluke voltmeters to provide wideband, low-noise, accurate measurements at a low cost.

Selectable dBm Reference Impedance

Fluke's 8920 Series Voltmeters permit an operator to select any one of 12 reference impedances from 50Ω to 1200Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 MΩ for all settings of the dB reference control. This minimizes circuit loading and allows the operator to add the appropriate termination externally. Zero dB corresponds to 1 mW for each of the selectable levels.

AC or AC + DC Functions

The input coupling capabilities of the 8920 Series Voltmeters help solve difficult measurement problems. Without these features, whenever an operator is required to measure a signal which (1) is not symmetrical, (2) has unequal excursions above and below zero, or (3) has a dc component, it is necessary to go through a series of computations to determine the actual rms voltage value. First, the signal has to be measured with a dc voltmeter (providing its ac rejection is sufficient) and then with an ac voltmeter. Finally, the sum of the squares of the two readings must be calculated and the square-root extracted from the result. Failure to consider the dc component by using only an ac-coupled meter can result in substantial error.

Relative dB Measurements

The relative reference feature of the 8920 Series Voltmeters allows direct readings of gain or attenuation. Depressing the REL switch sets the existing dB reading to zero, establishing the input voltage level as the relative dB reference. Subsequent readings of higher voltages will be displayed as +dB, lower voltages as –dB.

Autoranging

Fluke's autoranging feature allows you to carry out your testing without having to change ranges manually. A range can be placed on HOLD or manually stepped up to a higher range. On HOLD, the meter will remain in a given range regardless of changes in input levels. On STEP UP, the meter will increase ranges step-by-step until the switch is released.

Peaking/Dipping Meter

In addition to an accurate digital display, all Fluke Voltmeters in the 8920 Series feature an analog meter for peak and null voltage adjustments. The meter indicates 0 to 100 percent full scale in each range.

Linear Analog Output

Models 8920A and 8922A are equipped with a rear panel output for driving X-Y or strip chart recorders, delivering voltages proportional to the display count. A 2-volt level equals 2000 counts, a 1-volt level equals 1000 counts, etc. This feature is not available on Model 8921A.

Accuracy

Fluke Digital Voltmeters avoid the possibilities for error so common in analog meters. The digital displays eliminate the likelihood of misreading the meter due to viewing angle problems of parallax common with analog meters. Also, the accuracy of 8920 Series Voltmeters is specified as a percent of reading rather than as percent of full scale.

Percent of reading accuracy does not degrade for measurements at the low end of a scale. Front panel switching offers a choice of readings in dB or volts.

Specifications

Technical Specifications

The accuracy specifications below apply from 9% to 100% of full scale and from 18°C to 28°C for 90 days. For six-month specifications multiply figures by 1.5.

AC Accuracy: ± % of voltage reading or ± dB (8922A)

Range	2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	11 MHz
	FILTER IN				FILTER OUT				
700V 200V	3% or* 0.35 dB	1% or* 0.15 dB	1% or 0.15 dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified		
20V 2V 200 mV		5% or 0.5 dB					3% or 0.35 dB	5% or 0.5 dB	
20 mV	5% or 0.5 dB	2% or* 0.25 dB	2% or 0.25 dB	1% or 0.15 dB		2% or 0.25 dB			
2 mV	5% or* 0.5 dB**	5% or 0.5 dB	3% or 0.35 dB	2% or 0.25 dB	4% or 0.4 dB				

**Valid when AC + DC DAMPING is selected and input has no dc components.*
***Below 2 mV add number of digits (N) to ±5% voltage readings, where N = 5 ÷ mV input. Or, for dB readings, add N to ±0.5 dB, where N = 0.5 ÷ (mV input)²*

AC+DC Accuracy: Add to ac accuracy specifications (above) ±10 digits or ±0.5 dB above 2 mV, or ±100 digits or ±5.0 dB below 2 mV. For dc only, add above digits to 50 Hz to 10 kHz specifications

Functions: True rms measurements only. AC or ac + dc (8920A and 8921A); ac or ac + dc with damping (8922A)

Maximum Input: 700V rms or 1000V peak, not to exceed a volt-hertz product of 1 x 10^8 on any range

Maximum Common Mode Voltage: 400 mV rms or 600 mV peak (8920A & 8922A); 500V rms or 700V peak (8921A)

AC Common Mode Rejection: ≥60 dB at 50 and 60 Hz with 100Ω unbalance

DC Common Mode Rejection: ≥100 dB, 100Ω unbalance

Crest Factor: 7 at full scale, increasing down scale by 7 times the voltage range divided by the voltage input. Degrades below 10 Hz, annunciated when capability exceeded (8922A only)

Input Impedance: 10 MΩ shunted by <30 pF

Voltage Ranges: 2 mV, 20 mV, 200 mV, 2V, 20V, 200V, 700V

Ranging: Autoranging with HOLD to defeat auto ranging and STEP UP for manual ranging. Ranges up at 2000 counts and ranges down at 180 counts

Decibel Ranges: In the autorange mode, the instrument appears as though it has a single range spanning 131 dB

dBm Reference: Twelve user-selectable impedances are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) (dBV = 1000Ω)

Relative dB Reference: A voltage input present when this button is pushed is held as "0 dB" reference point. Subsequent readings indicate ± deviations from this point

Voltage Resolution: 0.05% of ranges (3½ digits)

Decibel Resolution: 0.01 dB (4 digits)

Typical-3 dB Points: 40 MHz on 20 mV thru 20V ranges and 4 MHz on 2 mV range (8920A/8921A); 22 MHz on 2 mV to 20V ranges (8922A)

Low Pass Filter: Approximately 200 kHz -3 dB point (8922A)

Reading Rate: 2.5/s or 1/s with ac + dc with damping (8922A)

Autorange Rate: <950 ms or <3.5s with ac + dc with damping (8922A)

Response Time: (To rated accuracy) <1.6s or <7s with ac + dc with damping (8922A)

Readout: Panel-selectable for volts or dB, automatic decimal point location: analog peaking/dipping meter

LED Annunciators: Indicate "mV," "V," "dB," "REL REF," and "2 MHz MAX" for 2 mV range (8920A and 8921A) and "UNCAL" when crest factor limitation exceeded (8922A)

Overrange: Flashes maximum reading for that range

Underrange: Flashes decimal

Linear Analog Output: (8920A and 8922A only) Linear output of 2000 mV dc for a 2000-count readout; ±1.0% relative to display; essentially 0Ω output into a ≥10 kΩ load; non-isolated, with output common same as input common

AC Accuracy: ± % of voltage reading or ± dB (8920A & 8921A)

Range	2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	10 MHz	20 MHz
700V 200V	Not Specified	5% or 0.5 dB	1% or 0.15 dB	0.5% or 0.1 dB		0.7% or 0.15 dB	Not Specified			
20V 2V 200 mV							3% or 0.35 dB	5% or 0.5 dB		
20 mV			2% or 0.245 dB	1% or 0.15 dB		2% or 0.25 dB	4% or 0.4 dB			
2 mV			3% or 0.35 dB	2% or 0.25 dB		3% or 0.35 dB				

Option Specifications

Counter Output Option (-03)

Drives frequency counters. Converts input signal into a 100 mV peak square wave. Greater dynamic range extends the sensitivity of counters to 180 μV at the low end and 700V at the high end. Impedance is 50Ω. Used with the 8921A, counter can measure signals elevated to 500V rms.

Logarithmic Analog Output Option (-04)

For 8920A and 8922A only. Provides an analog output voltage proportioned to the logarithm of the input voltage. Plots logarithmically-scaled graphs, dB variations. Zero volts and zero dB on the output correspond with 200 μV on input. A 13.1V output corresponds to 700V or 131 dB on the input. Therefore, 2V on the output equals 20 dB, 6V equals 60 dB, etc., making it easy to relate voltage to dB. The option provides a low-cost way of using an X-Y recorder to plot graphs as one continuous curve over any part of the 131 dB range.

PTI Interface Option (-521)

To use the 8920 Series DVMs with Fluke's own addressable Portable Test Instrument (PTI) byte-serial data bus. Output to Fluke printers, typically. Supplied with 2-foot ribbon cable Y7203.

1120A Interface Option (-522)

A "personality card" that fits in the Fluke 1120A GPIB/IEEE-488* Translator.

IEEE-488 Interface Option (-529)

The 8920 Series Voltmeters can be made compatible with IEEE Std 488-1978 by using Option -529 in combination with the Fluke Model 1120A Translator. A single 1120A will interface three Fluke instruments to the bus. Option -529 is electrically equivalent to Option -521 plus Option -522. Supports subsets SH1, AH1, T3, TE3

** The terms GPIB/IEEE-488 may be used interchangeably throughout this catalog.*

General Specifications

Temperature: -40°C to +75°C, non-operating
Relative Humidity: <80%
Shock: MIL-T-28800 all classes
Vibration: MIL-T-28800, classes 2, 3 & 4
MTBF: >10,000 hours
Power: 100V, 120V, 220V ac ±10% or 240V ac +4%, -10%, selected by internal switches, 50 to 400 Hz, 10W max
Size: 32.6 cm L x 20.3 cm W x 10.5 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 2.47 kg (5.44 lb)

Included with Instrument: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

8920A DVM w/BNC Input
8921A DVM w/Banana Jack Input
8922A DVM w/BNC Input

Options

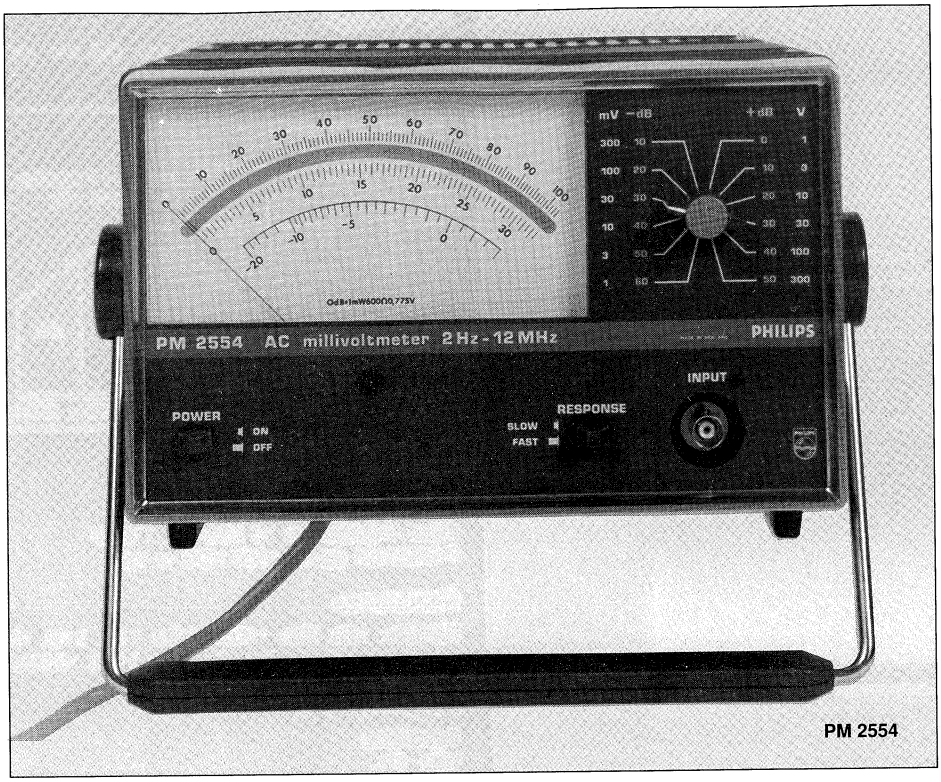
-03 Counter Output
-04* Logarithmic Output (not for 8921A)
-521 Interface Opt w/PTI Cable
-521K Interface Opt w/PTI Cable, field-installable
-522K 1120A Interface field-installable
-529** IEEE-488 Interface Opt w/PTI Cable

**Not compatible with -521, -521K, -529*
***The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have -529 Option installed, an IEEE Interface can be added by ordering -521K and -522K (1120A required).*

Accessories (Also see Section 20)

1120A IEEE-488 Translator
Y7203 Ribbon Cable, PTI 2 ft
Y7204 Ribbon Cable, PTI 5 ft
Y2014 5¼" Rack Mount Kit, Single
Y2015 5¼" Rack Mount Kit, Dual
Y2020 Panel Mount Kit
Y2024 3-Module Power Cord
A90 Current Shunt, 6-Range
80J-10 Current Shunt, 10 Amp
Y9100 BNC 50Ω Attenuator (6 dB)
Y9101 BNC 50Ω Attenuator (14 dB)
Y9102 BNC 50Ω Attenuator (20 dB)
Y9103 50Ω Feedthrough Terminator
Y9107 BNC "T"
Y9109 Banana to BNC Adapter
Y9111 BNC to BNC Cable, 3 ft
Y9112 BNC to BNC Cable, 6 ft

PM 2554

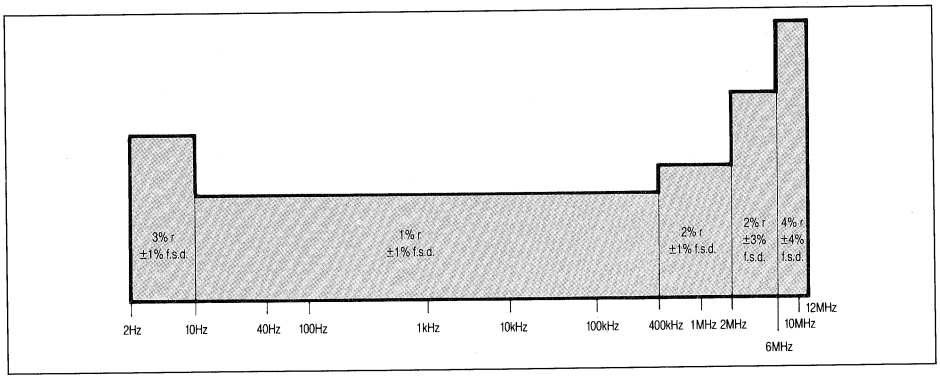


PM 2554

PM 2554 Wide Bandwidth AC Millivoltmeter

- Sensitivity 1 mV (fsd) to 300V
- Bandwidth 2 Hz...12 MHz
- High accuracy up to 1% fsd ±1% of reading
- 140 dB CMRR at 50 Hz (1 mV range)
- DC recorder output or AC output

The PM 2554 combines good accuracy with an extremely wide bandwidth (12 MHz) and voltage range (100 µV-300V). It is therefore ideal for all measurements from audio frequencies to HF and beyond. All ranges are protected from overloads of up to 300V rms (400V dc). Power Line voltage variations of ±10% give no more than 0.1% change in accuracy.



Accuracy

Specifications

Measuring Ranges: 0-300V rms in 12 ranges from 0-1 mV to 0-300V. dB scale ranging from -80 dB to +52 dB (0 dB - 1 mV into 600Ω)
Frequency Range: 2 Hz-12 MHz
Input: Floating
Input Impedance: 1 MΩ//33 pF
Max. Voltage Low-Ground: 500V peak
Impedence low-ground: 1 GΩ/1.4 nF
For reduction of capacitive loading, the PM 2554 can be used with the PM 8926 oscilloscope probe, input impedance 10 MΩ//11 pF
Common Mode Rejection: 140 dB at 1 kHz in 1 mV range; 120 dB at 100 kHz in 1 mV range
Accuracy: 1% fsd. + 1% of reading
Additional error for frequencies outside flat part of bandwidth - see graph
Stability: A line voltage variation of ±10% will give an additional error of 0.1% max.
Long-Term Stability: ±0.1% over 90 days
Noise At Short-Circuited Input: <30 µV
Influence of noise on measuring accuracy less than 0.5% at 10% of full scale deflection
Overload: Protected against overloads up to 300V rms or 400V dc

Recorder Output
DC Voltage: 1V at full scale
Output Impedance: 1 kΩ
Accuracy: As specified for voltmeter

AC Output
Output Impedance: 600Ω in series with 47 µF
Output Voltage: 50 mV; Short-circuit proof
Line Voltages: 90V...132V or 180V...265V
Frequency: 50/60 Hz

Temperature Range
Reference Temp.: 23°C ±5°C
Operating Temperature: 0°C...45°C
Temperature Coefficient: 0.1%/°C
Size: 236 mm W x 145 mm H x 298 mm L (9.3 in. W x 5.7 in. H x 11.7 in. L)
Weight: 3.5 kg (7.7 lb)
Included: Line cable, measuring cable, instruction manual

Ordering Information

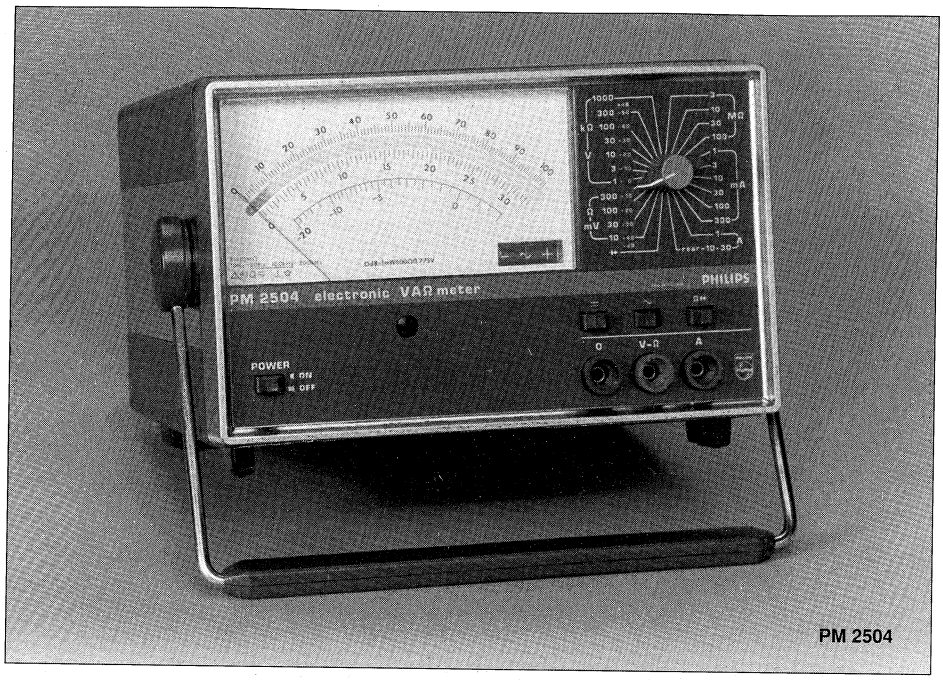
Model

PM 2554 Wideband AC Millivoltmeter

Accessories

PM 8924/00 Passive Probe 1:1
PM 8926 Passive Probe 10:1
PM 9051 Adapter BNC-Banana
PM 9067 T-piece BNC-BNC
PM 9074 Measuring Cable Banana-BNC, 135Ω

PM 2504



PM 2504 Portable Multimeter

- 1...2% accuracy on all ranges
- Overload protection
- 1 000h battery life; line supply option
- 200 kHz bandwidth
- Automatic polarity indication

The PM 2504 combines a high accuracy with extensive overload protection and ease of operation. This latter feature includes the unique linear resistance scale as well as an attractive and ergonomically laid out front panel. Moreover this high accuracy is available for each and every application due to the instrument's portable performance. When battery power is low, and replacement inconvenient, the PM 2504 can be quickly recalibrated using the internal calibration facility.

It also provides a meter system with the same accuracy in both horizontal and vertical positions.

The meter has only three scales which makes for easy, unambiguous reading. They are 0-30, 0-100 and dB. Extensive overload protection is provided.

Specifications

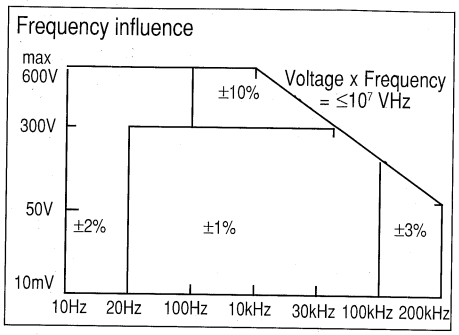
Technical Specifications

DC-Voltage

Ranges: 10 mV, 30 mV, 100 mV, 300 mV, 1V, 3V, 10V, 30V, 100V, 300V, 1000V
Polarity automatic by extra meter
Sensitivity: 100 µV
Accuracy: 1%
Input Resistance: 10 MΩ//70...115 pF
SMRR: 60 dB
CMRR: 100 dB
Protection up to: 1700V DC or Vpk

AC-Voltage

Ranges: 10 mV, 30 mV, 100 mV, 300 mV, 1V, 3V, 10V, 30V, 100V, 300V, 1000V



Sensitivity: 100 µV
Frequency Range: 20 Hz...200 kHz
Accuracy: 1.5% f.s.d. at 50...60 Hz.
Input Impedance: 10 MΩ//70...115 pF
Protection up to: 1500 VDC or Vpk

Resistance

Ranges: 10Ω, 30Ω, 100Ω, 300Ω, 1 kΩ, 3 kΩ, 10 kΩ, 30 kΩ, 100 kΩ, 300 kΩ, 1 MΩ, 3 MΩ, 10 MΩ, 30 MΩ, 100 MΩ
Sensitivity: 0.1Ω

Accuracy:
10Ω: 5%
20Ω...300Ω: 2.5%
1000Ω...300 kΩ: 1.5%
1 MΩ...10 MΩ: 2.5%
30 MΩ...100 MΩ: 5%
Max. Open Input Voltage: 1V
Measuring Current: 1 mA for 10Ω...300Ω; 31.6 µA for 1 kΩ...10 kΩ; 1 µA for 30 kΩ...300 kΩ; 100 nA for 1 MΩ...10 MΩ; 31.6 nA for 30 MΩ...100 MΩ
Testing Semiconductors: Current 1 mA; test volt. 1V
Protected up to: 250V

dB Measurements

Ranges: 10 mV/-40 dB...1000V/+60 dB

DC-Current

Ranges: 1 mA, 3 mA, 10 mA, 30 mA, 100 mA, 300 mA, 1A, 10A, 30A
Sensitivity: 10 µA
Accuracy: 1.5%
Voltage Drop: 100 mV...300 mV
Protected up to: 250V by fuse (10A and 30A unprotected)

AC-Current

Ranges: 1 mA, 3 mA, 10 mA, 30 mA, 100 mA, 300 mA, 1A, 10A, 30A,
Sensitivity: 10 µA
Accuracy: ±1.5% for AC 50/60 Hz
±2.5% for 10 Hz...1 kHz
Voltage Drop: 100 mV...300 mV
Frequency Range: 10 Hz...1 kHz
Protected up to: 250V by fuse
(10A and 30A unprotected)

General Specifications

Meter System Tautband Suspension: 50 µA
Power Supply: 9V dc 6 batteries (R14DD)
Battery Operating Life: 1000h
Dimensions: 236 mm W x 145 mm H x 298 mm L (9.3 in W x 5.7 in H x 11.7 in L)
Weight: 2.7 kg (5 lb)
Included: Set of 2 test leads and probes (PM 9260), operating and service manual (9499 470 11502)

Environmental Conditions

Reference Temperature: 23° ±2°C
Temperature Coefficient: <0.1%.../°C
Range of Operation: -10°C...+55°C
Storage and Transport: -40°C...+70°C
Limits of Humidity for Operation: 20...80%

Ordering Information

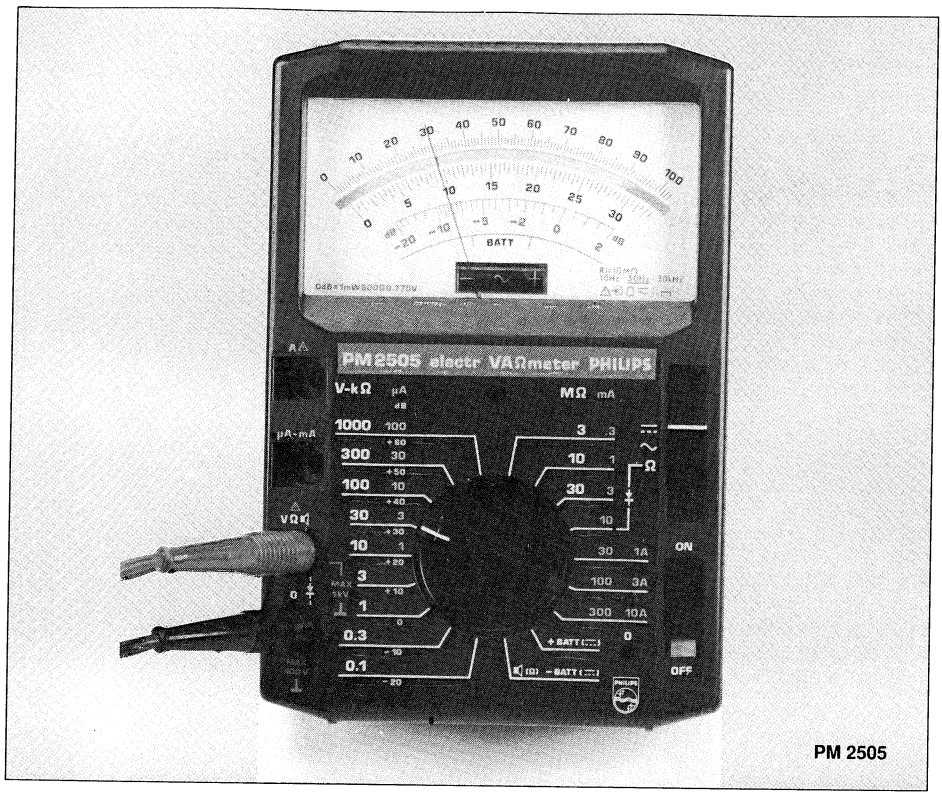
Model

PM 2504 High Accuracy Portable Multimeter

Accessories

PM 9260 Set of two Test Leads and two Probes
PM 9053 Adapter Banana (f) - BNC (m)
PM 9071 Measuring Cable 135Ω Banana (m) - Banana (m)
PM 9072 Measuring Cable 135Ω BNC (m) - Banana (m)
PM 9210 High Frequency Probe 10 kHz ... 1 GHz
PM 9213 High Frequency Probe 10 kHz ... 100 MHz
PM 9244/00 AC and DC Current Shunt up to 31.6A
PM 9245/00 AC Current Transformer 10A...150A
PM 9246/03 High Tension Probe
PM 9218A/010 Mains Adapter 220V/50 Hz to 9V DC
PM 9218A/013 Mains Adapter for 115V/50... 60 Hz to 9V DC (USA)
PM 9218A/014 Mains Adapter for 240V/50... 60 Hz to 9V DC (UK)
9499 470 11502 Operating and Service Manual

PM 2505



PM 2505

PM 2505 Electronic Multimeter

- 62 measuring ranges, high V and A sensitivity
- 10 MΩ input impedance
- Continuity check by sound signal
- Linear resistance ranges
- Automatic polarity indication

The PM 2505 is an extremely versatile, yet remarkably compact multimeter. Built-in features include very high accuracy and repeatability, high sensitivity and a constant input impedance of 10 MΩ. Unlike conventional multimeters, which tend to use non-linear reversed scales for resistance measurement, PM 2505 has an easy-to-read linear scale giving accuracies well in advance of the usual 7 to 10% levels. Moreover, continuity checks (having less than 10Ω approx point-to-point resistance) are simplified by means of a built-in sound signal. A diode measuring facility is provided.

The PM 2505 has a built-in polarity indicator, making it unnecessary to reverse the test leads when making different polarity checks and helping the user when making zero adjustments. The instrument is robust, immune to external magnetic interference and does not radiate magnetic fields. The advanced electronic circuitry ensure minimal power consumption, delivering an estimated life for the two 9V batteries of 1000 hr (equivalent to 6 months of continuous everyday use). Additionally, full overload protection is provided on all ranges.

Specifications

Technical Specifications

DC Voltage

Ranges: 100 mV...1000V
Sensitivity: 1 mV
Accuracy: 1.5% (f.s.d.)
Input Impedance: 10 MΩ // 75 pF
SMMR: >60 dB (50...60 Hz)
Maximum Input Voltage: 1000V RMS

AC Voltage

Ranges: 100 mV...1000V
Sensitivity: 1 mV
Accuracy: 2.5% (f.s.d.) at 50...60 Hz
Input Impedance: 10 MΩ//75 pF
Maximum Input Voltage: 600V RMS

DC Current

Ranges: 1 µA...10A
Sensitivity: 10 nA
Accuracy: 1.5% f.s.d.
Voltage Over Shunt: <100 mV + I x 3.1Ω
Protection (fuse): Ranges 1 µA...300 mA

AC Current

Ranges: 1 µA...10A
Sensitivity: 10 nA
Accuracy: 3%
Voltage Over Shunt: <100 mV + I x 3.1Ω
Protection (fuse): Ranges 1 µA...300 mA

Resistance

Ranges: 100Ω...30 MΩ
Sensitivity: 1Ω
Accuracy: 3% f.s.d. up to 10 MΩ
Max. Measuring Voltage: 100 mV up to 100 kΩ, 1V at 1 MΩ up to 30 MΩ
Max. Measuring Current: 316 µA

Continuity Check

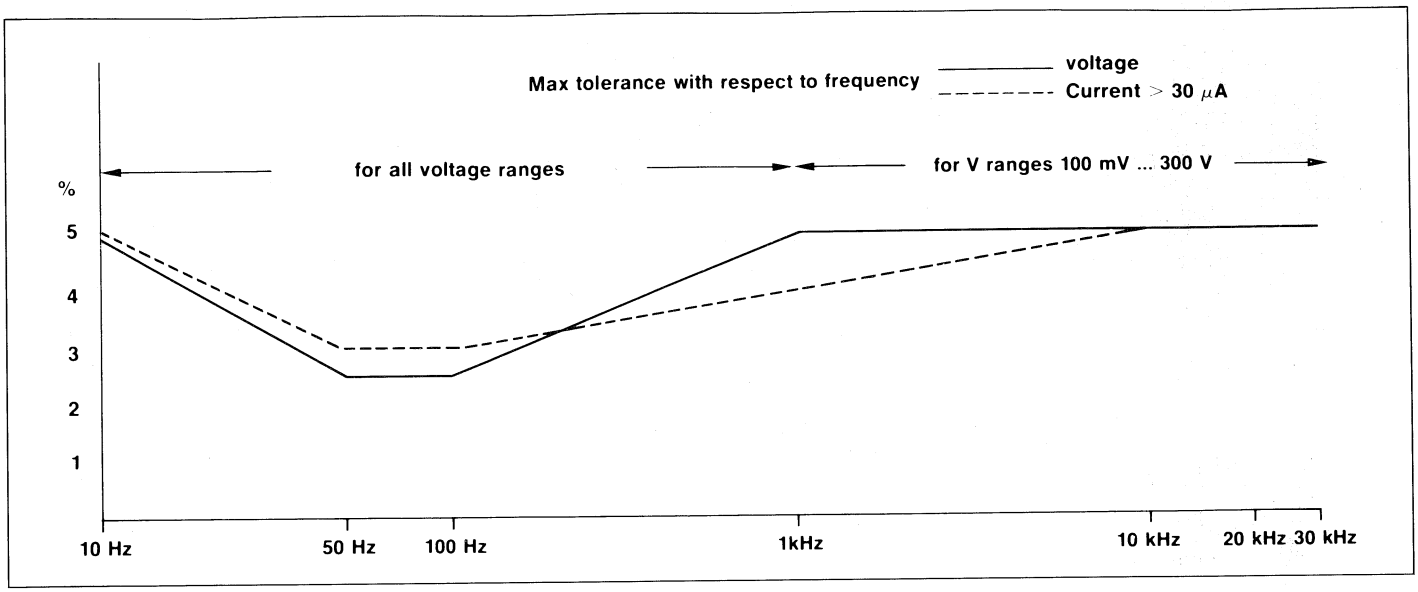
Audio Signal At: <20Ω

Diode Check

Measuring Current: 316 µA
Measuring Voltage: 1V

General Specifications

Power Supply: 2 batteries (6F22 HD)
Battery Operating Life: approx.1000h
Dimensions: 118 mm W x 172 mm H x 60 mmL
Weight: 0.7kg (1.5 lb)
Included: Set of 2 test leads and two probes (PM 9260), operating and service manual (9499 470 18614), spare fuses (5322 253 30016)



Environmental Conditions

Reference Temperature: 23°C ±2°C
Range of Operation: 0°C...±55°C
Storage and Transport: -40°C...+70°C
Humidity Operating Limits: 10....90% at <35°C

Ordering Information

Model

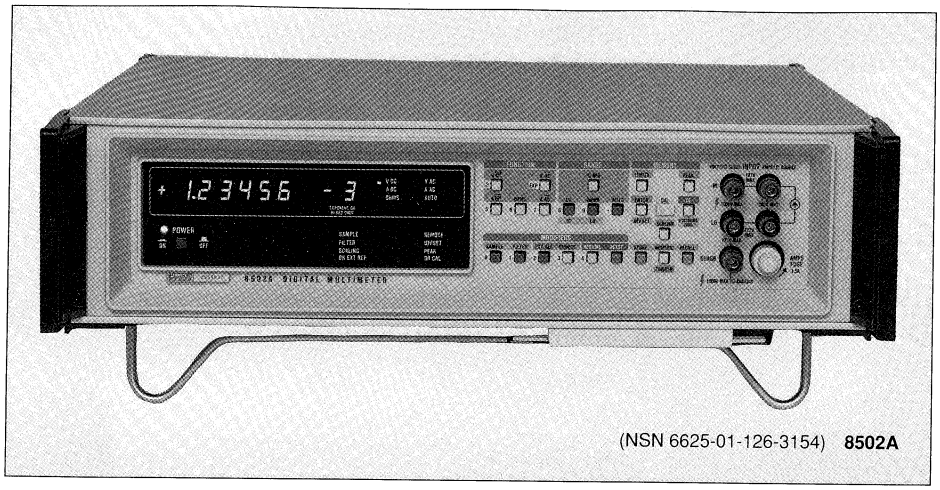
PM 2505/04 Electronic Multimeter

Accessories

Delivered with the instrument:
PM 9260 Set of test leads with probes
9499 470 18614 Operating and Service Manual
5322 253 30016 Spare fuse 400 mA (2)

Optional available:
PM 9071 Measuring cable 135Ω Banana (m) - Banana (m)
PM 9072 Measuring cable 135Ω BNC (m) - Banana (m)
PM 9111/01 Power Supply 9V DC
PM 9210/00 High Frequency 150 mV Probe 10 kHz...1 GHz
PM 9212/00 Accessories for HF Probe 9210
PM 9213/00 High Frequency 10 mV Probe 10 kHz...100 MHz
PM 9244/00 AC and DC Current shunt up to 31.6A
PM 9245/00 AC Current Transformer 10A...150A
PM 9246/03 High Tension Probe
PM 9278/02 Ever-ready Case

Limited Availability



(NSN 6625-01-126-3154) **8502A**

8502A Digital Multimeter

- 6 ppm dc accuracy • 6½ digit resolution
- 500 readings per second system speed
- Modular construction for configurability
- Interface options: GPIB/IEEE-488, RS-232-C, or Parallel
- Measurement options: AC volts, true-rms or averaging; Resistance; Current
- Up to 212% overrange

Note: In most applications, the 8505A or 8506A DMMs should be substituted.

The basic 8502A measures dc voltage or the ratio of two dc voltages. With optional plug-in circuit card modules it will also measure resistance, ac or dc current, ac voltage, or the ratio of such a quantity to an external dc voltage.

One option is for resistance, one is for current, and two are for ac voltage – either true-rms for sinusoidal or non-sinusoidal waveforms, or average-sensing for sinewaves. The current-measuring option is good for both dc and ac current but one of the ac voltage measurements options must also be installed. All the measurement capabilities may be included in one instrument if you wish, except that only the true-rms or the average-sensing measurement module can be included at one time.

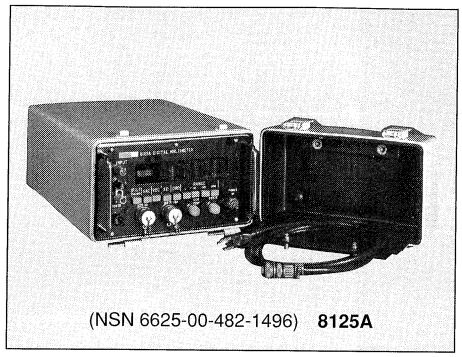
8502A Digital Multimeter

Options

-**01** Average Responding AC Converter
-**02** Ohms Converter
-**03** Current Converter
-**04** Cal Memory
-**05** IEEE-488 Interface
-**06** RS-232-C Interface
-**07A** True Parallel Interface (for DEC PDP11, DR11C, DRV11)
-**09A** RMS AC Converter
-**16** Switchable Front/Rear Inputs

All options except -16 are customer installable.

Digital Multimeter 8125A & 8425A



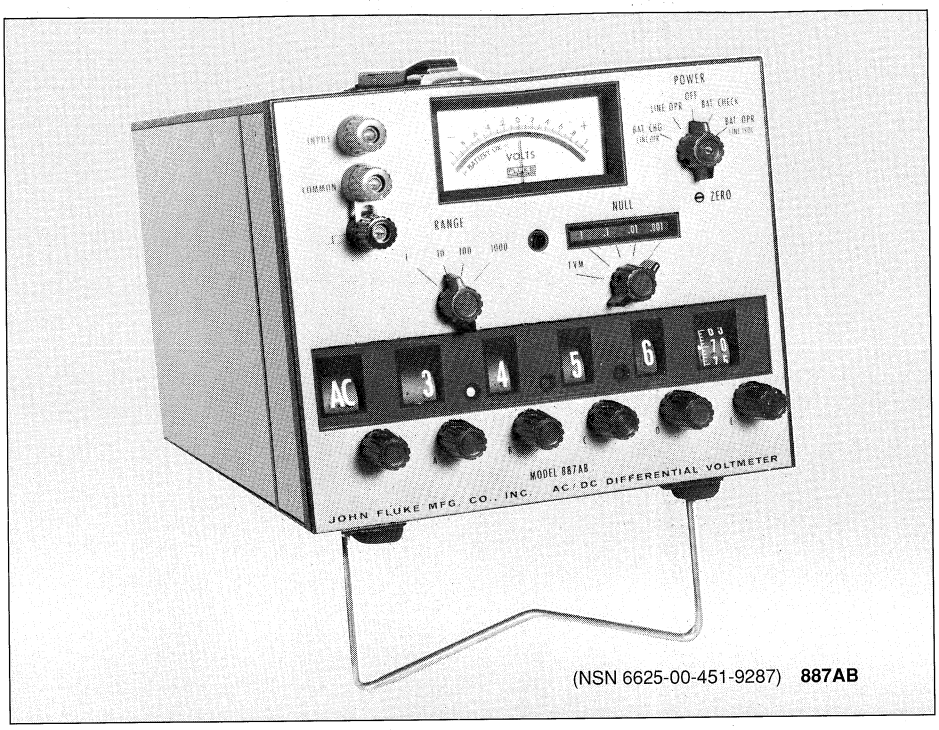
(NSN 6625-00-482-1496) **8125A**

Model 8125A is a compact, militarized 5½ digit digital multimeter designed to meet MIL-T-28800B, Type II, Class 2, Style A requirements for rugged field applications. Prices on request.

Model 8425A is a ruggedized 5½ digit rack mounted digital multimeter, designed for system applications, that meets the requirements of MIL-T-28800B, Type II Class 4, Style B.

The functions, ranges, and performance of the 8425A are identical to those of the discontinued 8400A. Prices on request.

Limited Availability



(NSN 6625-00-451-9287) **887AB**

Digital Voltmeters

Fluke Differential Voltmeters, at one time, were the most accurate kind of voltmeters available. They are still exceptionally accurate but their principal remaining advantage is their extremely high input impedance for dc "at null," a setting where input voltage is most accurately measured. When measuring voltage from relatively high impedance sources, the input impedance of any voltmeter acts as a load and has a very significant effect on the accuracy of the measurement. Differential voltmeters reduce the measurement error in such cases.

Differential Voltmeter Selection Guide

Model	DC Resolution	AC Sensing	Infinite Impedance
893A	10 µV	Average	To 1100V
895A	1 µV	N/A	To 1100V
887AB	1 µV	Average	To 11V
931B-01	N/A	True RMS	N/A

893A Differential Voltmeter
895A Differential Voltmeter
887AB Differential Voltmeter
931B-01 Differential Voltmeter

A-90 Current Shunt

The model A-90 Current Shunt may be used for both ac and dc current measurements over six current ranges from 0.1 mA range to 10A range. A voltage of 100 mV, measurable with virtually any voltmeter, is developed at full scale on each range. Basic accuracy is ±0.15% for dc, ±0.3% for ac.

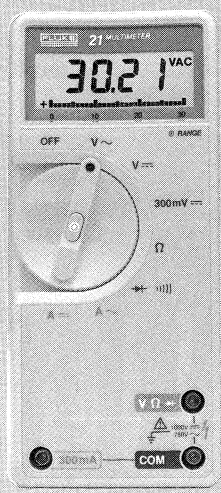
A-90 Current Shunt

80E-10 High Voltage Divider

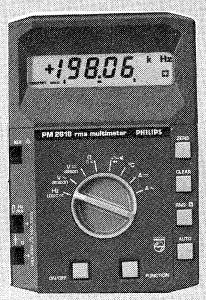
The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

80E-10 High Voltage Divider

Handheld Multimeters



Fluke 21 Page 116



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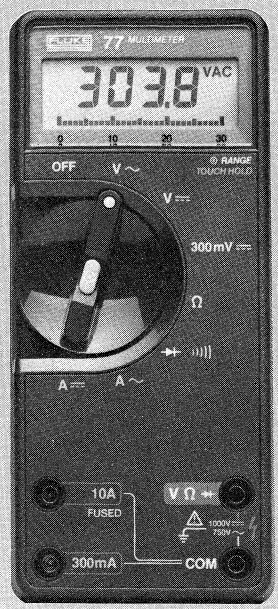
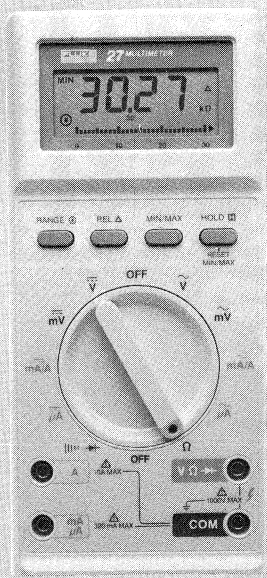
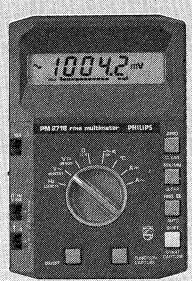
Fluke 87 Page 120



Fluke 77 Page 113



Fluke 27 Page 118



PM 2718 Page 132

Fluke and Philips handheld digital mutimeters (DMMs) all operate from small, self-contained batteries. Some can also be operated from ac power using a battery eliminator.

Many Fluke and Philips handheld DMMs rival the performance of more expensive bench models. Others have features that make them uniquely suited for particular applications for industries. For example, the Fluke Model 25 and 27 are sealed against rain and moisture and can be used at temperatures well below freezing. The Fluke Model 87 can capture the value of high momentary motor-starting currents. The Philips PM 2618/323 mAs meter is ideally suited for medical x-ray applications. The Fluke 8060A and Fluke 87 can read the frequency of telephone touchtone signals.

Fluke and Philips handheld multimeters are designed to take electrical and physical abuse with little or no damage.

Selection Guide Page 112
Handheld Multimeters Page 113

Handheld Multimeters Selection Guide

Models	Basic Features		Special Features												DC Volts**		AC Volts*					AC/DC Amps		Ohms, etc.				Page Number
	Max Display Counts*	Autoranging	Analog Bar Graph	Frequency Measurement	dB, dBm Readout	Offset/Relative Ref	Continuity & Beeper	Peak-Hold, AC/DC	Touch-Hold	Sealed Case Water/Chemical Resistant	Min/Max Hold	Milliamp Seconds (mAs)	Capacitance 5.00 nF to 5.00 µF	Duty Cycle 0.0 to 99.9%	Basic Accuracy, %	Max Resolution, µV	Max AC Voltage, w/o Probe (RMS)	True-RMS	Basic Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, µA	Max Amps, w/o Probe	Max Resolution, mΩ	Max Resistance, MΩ	Diode Test	Conductance (Low) >20 MΩ	
Fluke 73	3200	•	•	—	—	—	—	—	—	—	—	—	—	—	0.7	100	750	—	3.0	1k	1k	10k	10	100	32	•	—	113
Fluke 75	3200	(1)	•	—	—	—	•	—	—	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	113
Fluke 77	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	113
Fluke 21	3200	(1)	•	—	—	—	•	—	—	—	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	0.32	100	32	•	—	116
Fluke 23	3200	(1)	•	—	—	—	•	—	•	—	—	—	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	•	—	116
Fluke 25	3200	(1)	•	—	—	—	•	—	•	•	—	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	118
Fluke 27	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.1	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	118
Fluke 83	4000	(1)	•	•	—	•	•	—	•	(6)	(7)	—	•	•	0.3	100	1000	—	1.0	100	5k	0.1	10	100	40	•	•	120
Fluke 85	4000	(1)	•	•	—	•	•	—	•	(6)	(7)	—	•	•	0.1	100	1000	—	0.5	100	20k	0.1	10	100	40	•	•	120
Fluke 87	4000	(1)	(5)	•	—	•	•	•	•	(6)	(7)	—	•	•	0.1	100	1000	•	0.7	100	20k	0.1	10	100	40	•	•	120
8025B	3200	(1)	•	—	—	•	•	—	•	•	•	—	—	—	0.2	100	1000	—	0.5	100	30k	0.1	10	100	32	•	•	123
8060A	20,000	—	—	•	•	•	•	—	—	—	—	—	—	—	0.04	10	750	•	0.2	10	100k	0.01	2	10	300	•	•	125
8062A	20,000	—	—	—	—	•	•	—	—	—	—	—	—	—	0.05	10	750	•	0.5	10	30k	0.01	2	10	300	•	—	125
8024B	2000	—	—	—	—	—	•	•	(2)	—	—	—	—	—	0.1	100	750	—	0.75	100	5k	1	2	100	20	•	•	128
8026B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	•	0.5	100	10k	1	2	100	20	•	•	128
8020B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	—	0.75	100	5k	1	2	100	20	•	•	128
8021B	2000	—	—	—	—	—	•	—	—	—	—	—	—	—	0.1	100	750	—	1.0	100	450	1	2	100	20	•	—	128
PM 2518	2K/11K	(1)	•	—	•	•	•	—	—	—	—	—	—	—	0.1	100	750	(3)	0.5	100	40k	10	10	100	100	•	—	132
PM 2618	2K/11K	(1)	•	•	•	•	•	—	—	—	—	(4)	—	—	0.07	100	750	(3)	0.4	100	70k	10	10	100	100	•	—	132
PM 2718	2K/11K	(1)	•	•	•	•	•	—	•	—	(7)	—	—	—	0.04	100	750	(3)	0.3	100	100k	10	10	100	100	•	—	132

• *Standard*
—*Not applicable*
* *All displays LCD*
** *Max DC Voltage w/o Probe 1000V*

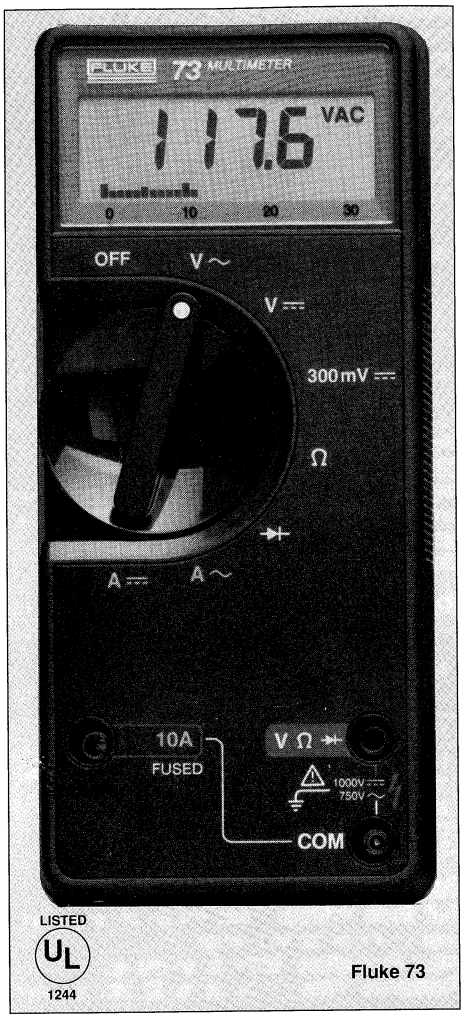
(1) Or manual ranging
(2) Use Peak-Hold Mode
(3) AC Coupled
(4) For PM 2618/323

(5) Analog Pointer
(6) Splash and dust proof
(7) MINMAX Average

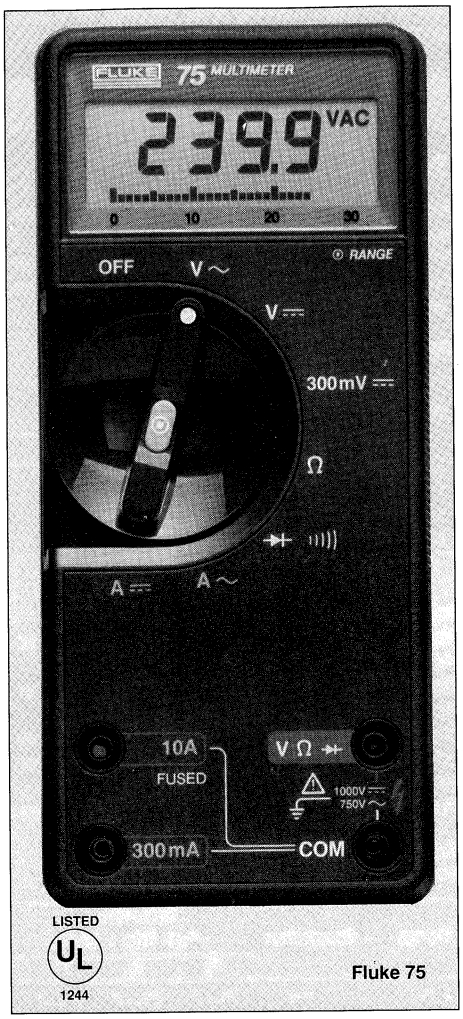
For Bench/System Multimeters see Section 3.
For Multimeter Accessories see Section 5.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg Co, Inc.

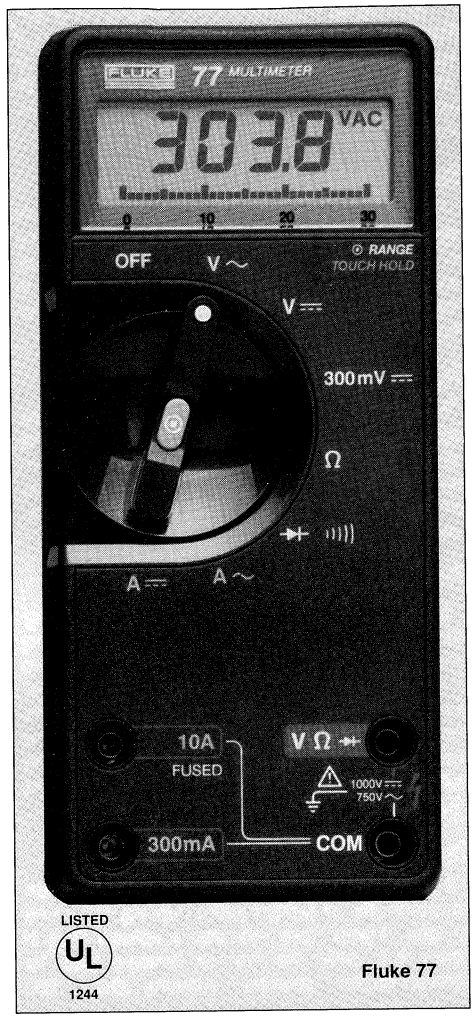
T&M EXPRESS LINE



Fluke 73



Fluke 75



Fluke 77

Fluke 73 Multimeter

- 3 1/2 digit, 3200 count display
- 31 segment analog bar graph
- 0.7% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hour battery life
- "Sleep Mode" extends battery life
- One current range: 10A
- 3 year warranty, 1-year calibration cycle
- Inputs overload protected & 10A fused

Fluke 75 Multimeter

- 3 1/2 digit, 3200 count display
- 31 segment analog bar graph
- 0.5% basic dc accuracy
- Single rotary switch control
- Autoranging & manual selection
- 2000 hour battery life
- "Sleep Mode" extends battery life
- 3 current ranges: 10A, 320 mA & 32 mA
- 3 year warranty, 1-year calibration cycle
- Inputs overload protected & 10A fused
- Continuity beeper

Fluke 77 Multimeter

- 3 1/2 digit, 3200 count display
- 31 segment analog bar graph
- 0.3% basic dc accuracy
- Single rotary switch control
- Autoranging and manual selection
- 2000 hour battery life
- "Sleep Mode" extends battery life
- 3 current ranges: 10A, 320 mA & 32 mA
- 3 year warranty, 1-year calibration cycle
- Inputs overload protected & 10A fused
- Continuity beeper
- Touch Hold® to capture readings
- Multipurpose protective holster

73, 75 & 77

These digital multimeters with analog bar graph display utilize the latest advances in microcircuit technology without compromising quality or capability. The result is a series of meters with features never before found, not even on expensive instruments.

Digital/Analog

The Model 73, 75, and 77 provide a 3200 count digital display that gives extended resolution and a 31 segment bar graph that reacts 10 times faster than the numerical display, allowing you to make peaking and dipping adjustments easier than with digital-only DMMs.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Range Hold (75, 77)

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones (75, 77)

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less. A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices passing about 500 microamps.

Touch Hold® (77)

Touch Hold captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and automatically holds the reading. Touch Hold reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Multipurpose Holster (77)

Our multipurpose holster is made of a tough resilient plastic that snaps over the instrument, protecting it from even the most severe shock. Both test leads may be snapped into the holster in a position so only one hand is needed to hold both the meter and probe tip in contact with the test point. You can also hang the meter on your belt or for easy viewing while probing, tilt it back on its bail for bench use.

Specifications

Technical Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32Ω resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
320 mV 3.2V 32V 320V	0.1 mV 1 mV 10 mV 100mV	0.7%+1	0.5%+1	0.3%+1
1000V	1V	0.8%+1	0.6%+1	0.4%+1

Input Resistance: 10 MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB for dc, 50 Hz, and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
3.2V	1 mV	3%+2*	2%+2*	2%+2*
32V 320V 750V	10 mV 100 mV 1V	3%+2**	2%+2**	2%+2**

** 45 Hz to 500 Hz*
***45 Hz to 1 kHz*
Typical frequency response is -0.5 dB at 10 kHz on the 32V and 320V ranges and ±3 dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤ 2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	_	1.5%+2	1.5%+2
320 mA	0.1 mA	_	2%+2	2%+2
10A	10 mA	2%+2	1.5%+2	1.5%+2

Voltage Burden: 0.6V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: 630 mA/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 15A/600V fuse on 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	_		
320 mA	0.1 mA	_	3%+2*	3%+2*
10A	10 mA	3%+2*		

** 45 Hz to 1 kHz*

Voltage Burden: 0.6V on 32 mA range, 2.0V on 320 mA range, 0.5V on 10A range
Input Protection: 0.63A/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 15A/600V fuse on 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(%of Rdg + Digits)		
		73	75	77
320Ω	0.1Ω	1%+2	0.7%+2	0.5%+2
3200Ω 320 kΩ 320 kΩ	1Ω 10Ω 100Ω	1%+1	0.7%+1	0.5%+2
3.2 MΩ	10 kΩ	3%+1	2.5%+1	2.0%+1

Open Circuit Voltage: ≤3V
Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity. Fluke 75 and 77 only.
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction. Fluke 75 and 77 only.
Display: An indication of approximately .600V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100 ms

Analog Display

Measurement Rate: 23 measurements per second

Touch-Hold (77)

Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinitely even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60° C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35° C except ≤80% using 32 MΩ range
Safety: Protecton Class II per IEC 348, UL 1244 listed and VDE 0411 licensed
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off (15 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in L x 2.95 in W x 1.12 in H)
Warranty: Three years; calibration guaranteed for one year
Weight: 0.28 kg (0.63 lb)

Included with Instrument: TL70 Test Leads, manual, plus battery and spare fuse (installed). Also C70 Holster included with Fluke 77.

Ordering Information

Models

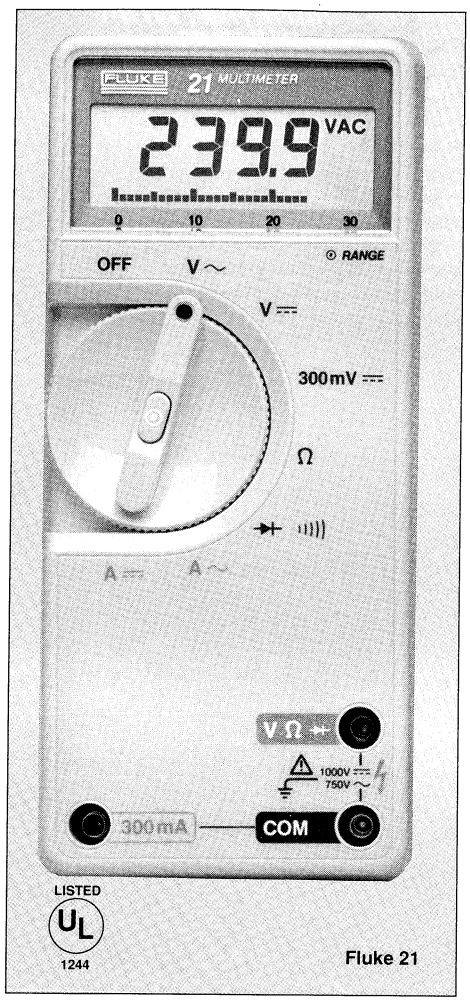
Fluke 73 Multimeter
Fluke 75 Multimeter w/beeper
Fluke 77* Multimeter w/Touch Hold & beeper
**Includes C70 Multipurpose Holster*

Accessories (Also see Section 5)

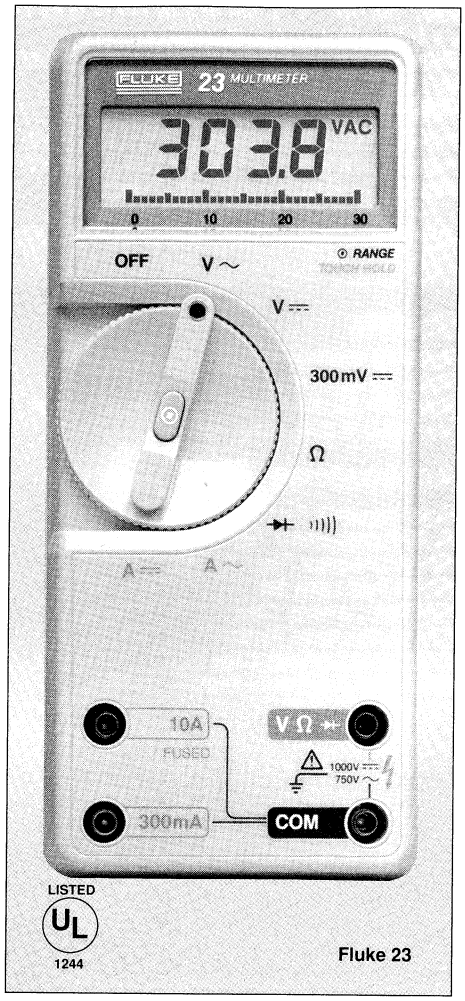
TL20 Industrial Test Lead Set
TL70 Replacement Test Leads
Y8134 Universal Test Lead Kit
Y8140 Test Lead Set
C50 Soft Carrying Case
C70 Multipurpose Holster
C100 Hard Carrying Case
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Thermocouple Converter
80T-150U Universal Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
Y8100 DC/AC Current Probe
Y8101* AC Current Probe
80i-400* AC Current Probe
80i-410* DC/AC Current Probe
80i-600* AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
LCA-10 Line Current Test Adapter
**Not applicable to Fluke 73*

21 & 23

T&M EXPRESS LINE



Fluke 21



Fluke 23

Fluke 21 & 23 Low-Cost, High-Accuracy Multimeters

- Analog and digital display - tests changing or stable signals
- Easy to use - single rotary switch and automatic ranging
- Volts, ohms, diode test, milliamps, 10 amps (Fluke 23)
- All inputs overload protected, including 10 amps
- 3-year warranty
- High visibility yellow, high impact ABS case
- Touch-Hold® (Fluke 23)
- 2000 hour battery life on a single 9V battery

Safety Designed

All inputs on the Fluke 21 and 23 are protected from high energy overloads, including the Fluke 23's fused 10 amp range. Resistance, continuity and mV functions are overload protected to 500V dc or ac rms, voltage functions to 1000V dc and 750V ac rms. Recessed input jacks accept Fluke safety designed test leads or standard banana plugs.

3200 Count Digital Display

Offers better accuracy and resolution than a conventional 3½ digit (1999 count) DMM. High contrast liquid crystal display, with wide viewing angle, updates two times per second.

31-Segment Analog Bar Graph

Makes dynamic measurements such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Fast Autoranging and Automatic Polarity

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Optional manual ranging included. Reverse polarity is indicated by a "-" sign next to the reading.

Touch-Hold® (Fluke 23)

Allows automatic measurements while watching probes and circuit. The meter captures the measurement, beeps, and locks it in the display until you're ready to view it. Automatically updates with each new stable measurement value.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. A continuous tone signals continuity, a beep signals a forward biased diode or transistor.

Standard Equipment

Every meter is packaged with a pair of safety designed Fluke TL70 right angle test leads, two insulated alligator clips, 9V battery installed, spare fuse and operator's manual. Fluke 23 comes with C70 protective holster that includes tilt bail, belt hook and lead storage. C70 is available as an accessory for Fluke 21.

Specifications

Technical Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32 MΩ resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320 mV 3.2V 32V 320V	0.1 mV 1 mV 10 mV 100 mV	0.5% + 1	0.3% + 1
1000V	1V	0.6% + 1	0.4% + 1

Input Resistance: 10 MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB for dc 50 Hz and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges

Response Time: ≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
3.2V	1 mV	2% + 2*	2% + 2*
32V 320V 750V	10 mV 100 mV 1V	2% + 2**	2% + 2**

** 45 Hz to 500 Hz*
***45 Hz to 1 kHz*
Typical frequency response is -0.5 dB at 10 kHz on the 32V and 320V ranges and ±3 dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA 320 mA	0.01 mA 0.1 mA	1.5% + 2 2% + 2	1.5% + 2 2% + 2
10A	10 mA	—	1.5% + 2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 15A/600V fuse for 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA 320 mA	0.01 mA	3% + 2*	3% + 2*
10A	10 mA	-	1.5% + 2*

**45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V max on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 15A/600V fuse for 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320Ω	0.1Ω	0.7% + 2	0.5% + 2
3200Ω 32 kΩ 320 kΩ 3.2 MΩ	1Ω 10Ω 100Ω 1 kΩ	0.7% + 1	0.5% + 1
32 MΩ	10 kΩ	2.5% + 1	2.0% + 1

Open Circuit Voltage: ≤3V
Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤1s up to 320 kΩ, ≤2s up to 3.2 MΩ, ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction
Display: An indication of approximately .600V for a normal forward biased silicon diode or semiconductor junction and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100 ms

Analog Display

Measurement Rate: 23 measurements per second

Touch-Hold

Fluke 23 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinitely even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60°C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35°C except ≤80% using 32 MΩ range
Safety: Protection Class II per IEC 348, UL 1244 listed
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off. Sleep mode activates after approximately 1 hour (5 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in L x 2.95 in W x 1.12 in H)
Weight: 0.28 kg (0.63 lb)
Warranty: Three years

Included with Instrument: TL70 Test Leads, manual, battery, spare fuse (installed), and alligator clips

Ordering Information

Models

Fluke 21 Multimeter w/ beeper
Fluke 23* Multimeter w/ Touch-Hold
** Includes C70 Multipurpose Holster*

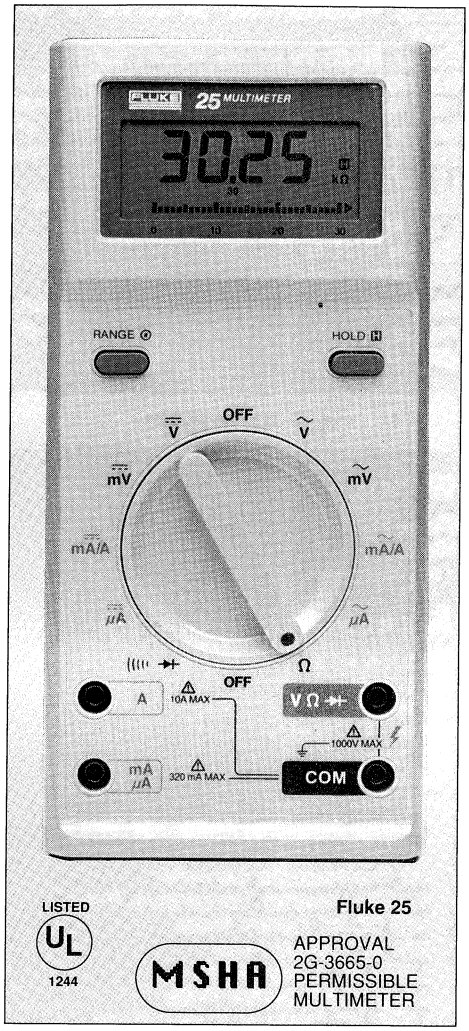
Accessories (Also see Section 5)

TL20 Industrial Test Lead Set
TL70 Replacement Test Leads
Y8134 Universal Test Lead Kit
Y8140 Test Lead Set
C50 Soft Carrying Case
C70 Multipurpose Holster
C100 Hard Carrying Case
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Thermocouple Converter
80T-150U Universal Temperature Probe
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400* AC Current Probe
80i-410 DC/AC Current Probe
80i-600* AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
LCA-10** Line Current Test Adapter
** Limited to ≤320A with Fluke 21*
***Fluke 23 only*

4

25 & 27

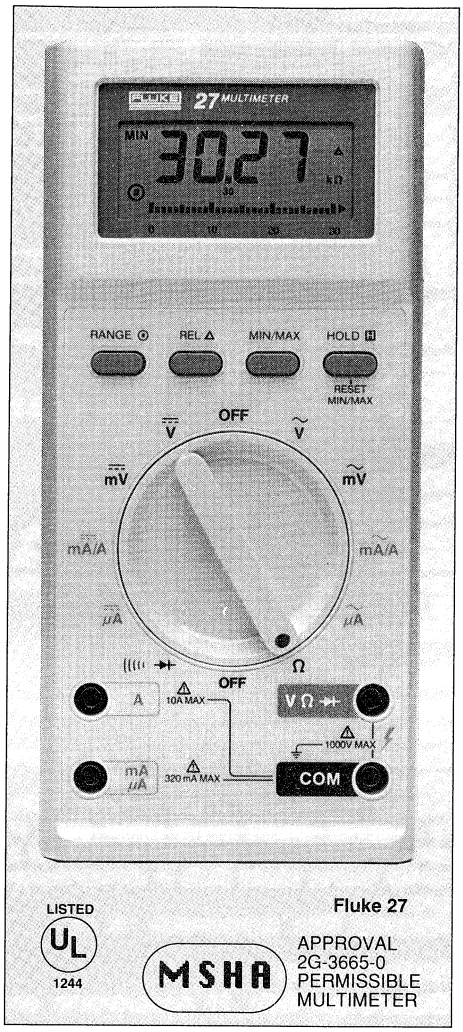
T&M EXPRESS LINE



LISTED UL 1244

Fluke 25

MSHA APPROVAL 2G-3665-0 PERMISSIBLE MULTIMETER



LISTED UL 1244

Fluke 27

MSHA APPROVAL 2G-3665-0 PERMISSIBLE MULTIMETER

Fluke 25 & 27 Analog/Digital & Rugged Multimeters

- Analog and digital display - tests changing or stable signals
- Easy to use, auto or manual range selection
- 3 year warranty, 1-year calibration cycle
- Rugged "O" ring sealed case withstands harsh environments
- Superior EMI shielding
- -15° to 55°C operating range
- "Min-Max" Mode stores highest & lowest readings (27 only)
- "Relative Mode" displays only changes in readings (27 only)

Rugged

Plant maintenance electricians, field service technicians, electrical equipment installers, and outside equipment installers will find these instruments rugged, reliable, and easy to use while providing all the accuracy and features needed for almost any application.

Designed to meet military specification of MIL-STD-28800 for Style A, Class 2 Instruments, the Fluke 25 and 27 Analog/Digital Multimeters perform under the extremes of heat, cold, humidity, shock, electromagnetic interference, vibration, and downright abuse.

The Fluke 25 and 27 are built with cases twice as thick as any other DMM we build. The cases are waterproof to 3 feet of water for one hour, resist many industrial chemicals, and won't sustain a flame when put to the blow torch test.

Safety Protection

Electrical and safety protection exceeds the world's toughest safety standards.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Manual Range

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less.

A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices.

Touch Hold®

Touch Hold® captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and holds the reading. Touch Hold® reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. Touch Hold® reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Min/Max Mode

The 27 can be connected to store minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

Specifications

Technical Specifications

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc 50 Hz or 60 Hz; ≤1 kΩ unbalance
Overload Protection V: 1000V rms
Overload Protection mV: 500V rms
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10kHz-30 kHz
320.0 mV	100µV	0.5% + 3	2% + 3	4%+10
3.200V	1 mV			
32.00 mA	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not spec

Input Impedance: 10 MΩ in parallel with <100 pF
Common Mode Noise Rejection: ≥60 dB from dc to 60 Hz; ≤1 kΩ unbalance
Overload Protection V ac: 1000V rms (10^7 volthertz max)
Overload Protection mV ac: 500V rms (10^7 volthertz max)
Response Time: ≤2s to rated accuracy

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	0.75% + 2	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

Input Protection: µA/mA ranges, 630 mA/250V fuse in series with 3A/600V fuse; 10 amp range, 20A/600V fuse
Response Time: ≤2s to rated accuracy

AC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 µA	0.1 µA	1.5% + 2*	0.5 mV/µA
3200 µA	1 µA		0.5 mV/µA
32.00 mA	0.01 mA		5.6 mV/mA
320.0 mA	0.1 mA		5.6 mV/mA
10.00A	0.01A		50 mV/A

**40 to 1000 Hz*

Overload Protection: Same as DC current
Response Time: ≤4s to rated accuracy

Resistance

Range	Resolution	Response Time	Accuracy ±(% of Rdg + Digits)
320.0Ω	0.1Ω	6s	0.3% + 2
3.200 kΩ	1Ω	2s	0.2% + 2
32.00 kΩ	10Ω		
320.0 kΩ	100Ω		
3.200 MΩ	1 kΩ		
32.00 MΩ	10 kΩ	6s	1% + 1

Overload Protection: 500V rms
Open Circuit Test Voltage: <2.8V dc
Full Scale Voltage: Up to 3.2 MΩ <420 mV dc; 32 MΩ <1.3V dc

Conductance

Measures up to 32.00 nS (to 100,000 MΩ) with 0.01 nS resolution accurate to ±1% + 10; full scale voltage <1.3V dc
Response Time: ≤6s to rated accuracy

Diode Test/Continuity Test

Overload Protection	Open Circuit Test Voltage	Typical Test Current	Display Voltage
500V rms	<3.3V dc	0.7 mA	0.0V
		0.5 mA	0.6V
		0.3 mA	1.2V
		0.1 mA	2.0V

General Specifications

MIN/MAX Mode (27 only): Records the digital display readings (updated twice per second)
Display: 3½ digits 3200 counts autopolarity, autozero
Common Mode Voltage: 1000V between any terminal and earth ground
Shock, Vibration and Water Resistance: Per MIL-T-28800 Class 2 Style A
Temperature: Storage -55°C to 85°C; Operation -15°C to 55°C
Temperature Coefficient: 0.1 x (specified accuracy) per °C for temperatures <18°C or >28°C
Electro-Magnetic Interference (EMI): The 25 & 27 meet MIL-STD-461 for RS03 (radiated susceptibility to 1V/meter from 14 kHz to 1 GHz) and REO2 (radiated emissions).
Relative Humidity: 0% to 95% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Power: Single 9V NEDA 1604 or 6F22 or 006P
Battery Life: >1000 hours typical
Battery Indicator: Symbol first displayed when 60 hours of life remain
Safety: Protection Class II per IEC 348, ANSI C39.5, UL 1244 listed. Meets MIL-STD-810C, Method 511.1, Procedure/Explosive Atmosphere Test
Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in L)
Weight: 0.75 kg (1.6 lb)
C20 Case Size: 102 mm H x 152 mm W x 262 mm L (4 in H x 6 in W x 10.3 in L)
Note: Case is 330 mm L (13 in L) including handle
Warranty: 3 years; calibration guaranteed for one year
Included with Instrument: Battery installed, TL70 Test Leads, two insulated alligator clips, spare fuse, and operator's manual. Available in dark umber (STD model) or yellow (YEL model).

4

Ordering Information

Models

Fluke 25 STD Multimeter
Fluke 25 YEL Multimeter
Fluke 27* STD Multimeter
Fluke 27* YEL Multimeter
**With MIN/MAX storage and Relative Modes*

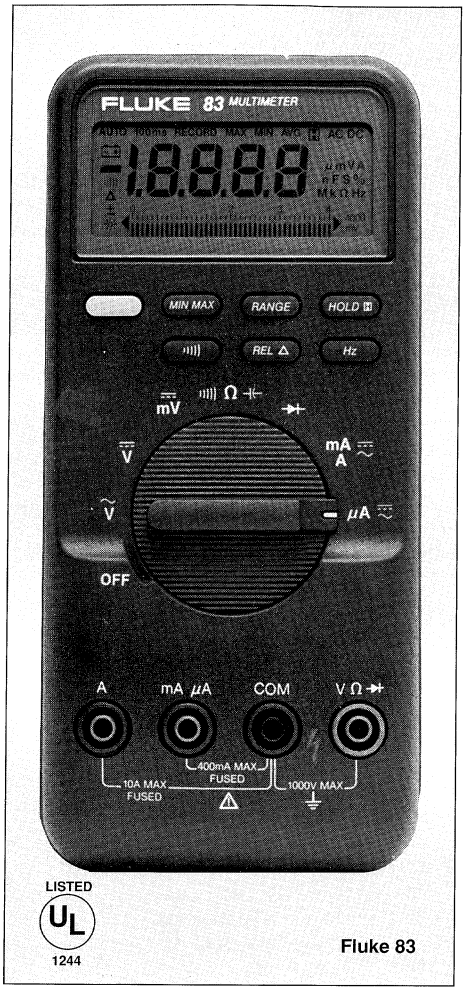
Accessories (Also see Section 5)

TL20 Industrial Test Lead Set
TL70 Replacement Test Leads
Y8134 Universal Test Lead Kit
Y8140 Test Lead Set
C20 Hard Carrying Case
C25 Soft Carrying Case
C100 Hard Carrying Case
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Thermocouple Converter
80T-150U Universal Temperature Probe
80J-10 Current Shunt
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
LCA-10 Line Current Test Adapter

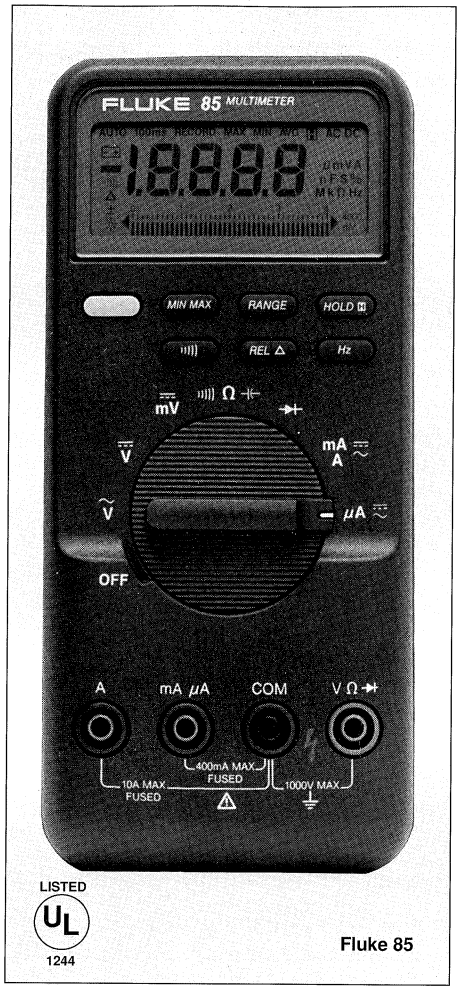
Handheld Multimeters

80 Series

T&M EXPRESS LINE



Fluke 83



Fluke 85



Fluke 87

Fluke 83 Analog/Digital
$3^{3}/_{4}$ digit, 4000 counts
0.3% basic dc accuracy
43 segment analog bargraph
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty

Fluke 85 Analog/Digital
$3^{3}/_{4}$ digit, 4000 counts
0.1% basic dc accuracy
43 segment analog bargraph
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty

Fluke 87 Analog/Digital
$3^{3}/_{4}$ digit, 4000 counts
0.1% basic dc accuracy
Analog pointer
Frequency & duty cycle
Capacitance
Touch Hold® & Relative
3 year warranty
True-rms ac voltage & current
1 ms peak MIN MAX
$4^{1}/_{2}$ digit mode
Back lit display

The Fluke 80 Series (83, 85, and 87) is a family of versatile analog/digital multimeters with an impressive range of capabilities, including frequency, duty cycle and capacitance measurement.

Designed for electronic as well as industrial applications, the 80 Series' durable construction and unique safety features ensure reliability and optimal performance in a variety of environmental settings.

MIN/MAX AVERAGE Recording Mode with Min Max Alert™

Stores the highest, lowest, and average of all readings, allowing you to monitor a signal for seconds or days. Selectable response times allow you to specify the time required to sense changes. Min Max Alert gives an audible tone for readings above or below previous minimums or maximums.

Frequency, Duty Cycle and Capacitance Measurements

Fluke 80 Series meters have a counter for frequency measurements from 0.5 Hz to 200 kHz, and duty cycle measurements from 0.1% to 99.9% of cycle. All three meters measure capacitance from 10 pF to 5 µF. Larger value capacitors may be measured using the analog display in the resistance mode.

Input Alert™ and Overload Protection

Input Alert provides an audible warning when current jacks are used and a non-current function is selected. This reduces the risk of damage to the equipment being tested and to the meter. Fluke 80 Series meters also provide 1000 volt input protection in both ohms and diode test.

Fast 3 3/4 Digit, 4000 Count Digital, High Resolution Analog Display

Ensures greater accuracy and resolution. Digital display updates 4 times/second.

For changing or unstable signals, the 87 features a high-resolution analog pointer; the 83 and 85 use an analog bargraph. The 83 and 85 also feature Zoom Mode for higher resolution analog readings. Analog displays update 40 times per second.

4 1/2 Digit Dode, 1 ms Peak Hold, True-rms, Backlit Display (87 only)

The Fluke 87 is a true-rms meter, and offers a 4 1/2 digit, 19,999 count high resolution mode, plus 1 ms peak hold. The backlit display assures readability in poorly lit settings. Light shuts itself off 68 seconds after the button is pressed, prolonging battery life.

Touch Hold® and Relative Modes

Touch Hold captures the measurement, beeps and locks it on the digital display until you're ready to view it. It automatically updates with each new measurement.

The Relative Mode remembers a reading and shows the change (difference) between it and any readings that follow.

Rugged, Sealed Construction

Splash and dust proof case and a specially designed protective holster protects the meter even under harsh operating conditions. All units are sealed and EMI shielded.

Standard Equipment

Every meter comes packaged with a yellow protective holster complete with a Flex-Stand,™ safety-designed test leads, 9V battery (installed), manual and operator guide.

Specifications

Technical Specifications

Basic electrical specifications are given as ± ([% of reading] + [number of least significant digits]) for the temperature range of 18°C to 28°C and relative humidity less than 90%, for one year after calibration.

DC Voltage

Range	83	85/87
	Accuracy: ±(% of Rdg+Digits)	
400.0 mV, 4.000V, 40.00V, 400.0V 1000V	0.3% + 1	0.1% + 1

Maximum Resolution: 0.1 mV in 400.0 mV range
Input Impedance: 10 MΩ (nominal), <100 pF
Normal Mode Rejection Ratio: >60 dB @ 50 Hz or 60 Hz
Common Mode Rejection Ratio: >120 dB @ dc, 50 Hz or 60 Hz
Overload Protection: 1000V rms

AC Voltage

Range	83	85	87
50 Hz-60 Hz			
400.0 mV	±(1%+4)	±(0.5%+4)	±(0.7%+4)
4.000V, 40.00V, 400.0V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
1000V	±(1%+3)	±(0.5%+2)	±(0.7%+2)
45 Hz-5 kHz			
400.0 mV	±(1.5%+4)	±(1%+4)	±(1%+4)
4.000V, 40.00V, 400.0V	±(1.5%+3)	±(1%+2)	±(1%+4)
1000V	±(2.5%+3)	±(2%+2)	±(1%+4)*
5 kHz-20 kHz			
400.0 mV	—	±(2%+4)	±(2%+4)*
4.000V, 40.00V, 400.0V	—	±(4%+4)	±(2%+4)*
1000V	—	Unspec'd	Unspec'd

** Add 16 counts below 10% of range*

Current: (45 Hz to 2000 Hz)

Range	83	85	87
DC	±(0.4% + 2)	±(0.2% + 2)	±(0.2% + 2)
AC	±1.2% + 2)	±(0.6% + 2)	±(1.0% + 2)

Maximum Resolution: 0.1 mV in the 400.00 mV range
Conversion Type: 83/85 average, 87 true-rms
Input Impedance: 10 MΩ (nominal), 100 pF
Common Mode Rejection Ratio: >60 dB @ dc to 60 Hz
Overload Protection: 1000V rms
AC V Common Mode Rejection Ratio: >60 dB, dc to 60 Hz

DC and AC Current: (45 Hz to 2 kHz)

Range	83	85	87	Burden Voltage
AC	Accuracy: ±(% of Rdg+Digits)			
400.0 µA, 4000 µA	1.2%+2	0.6%+2	1.0%+2	100 µV/µA
40.00 mA, 400.0 mA	1.2%+2	0.6%+2	1.0%+2	1.5 mV/mA
4000 mA, 10.00A*	1.2%+2	0.6%+2	1.0%+2	0.03 V/A
DC	Accuracy: ±(% of Rdg+Digits)			
400.0 µA, 4000 µA	0.4%+2	0.2%+2	0.2%+2	100 µV/µA
40.00 mA, 400.0 mA	0.4%+2	0.2%+2	0.2%+2	1.5 mV/mA
4000 mA, 10.00A*	0.4%+2	0.2%+2	0.2%+2	0.03 V/A

**10A continuous, 20A for 30 seconds maximum*

Maximum Resolution: 0.1 µA in the 400 µA range
Overload Protection: µA/mA Ranges: 1A 600V FAST fuse; Amp Range: 15A 600V FAST fuse

4

Handheld Multimeters

80 Series

Ohms

Range	83	85/87
	Accuracy: ±(% of Rdg+Digits)	
400.0Ω, 4.000 kΩ, 40.00 kΩ 400.0 kΩ, 4.000 MΩ	0.4% + 1	0.2% + 1
40.00 MΩ	1.0% + 3	1.0% + 3
40.00 nS	1.0% + 10	1.0% + 10

Maximum Resolution: 0.1Ω in the 400.0Ω range
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits
Full Scale Voltage: <450 mV dc up to 4.0 MΩ <1.3V dc for 40 MΩ or nS
Open Circuit Voltage: <1.3V

Frequency

0.5 Hz to 200 kHz, pulse width >2 µS

Range	Accuracy: ±(% of Rdg+Digits)
199.99 Hz, 1999.9 Hz 19.999 kHz, 199.99 kHz	0.005% + 1
>200 kHz	Unspecified

Maximum Resolution: 0.01 Hz on the 199.99 Hz range
Duty Cycle: 0.1% to 99.9%
Accuracy: Within ±(0.05% per Hz + 0.1%) of full scale for a 5V logic family input on the 4V dc range; within ±((0.06 x voltage range/input range) x 100%) of full scale for sinewave inputs on ac voltage ranges

Capacitance

Range	Accuracy: ±(% of Rdg+Digits)*
5.00 nF	1.0% + 35**
0.0500 µF, 0.500 µF 5.00 µF	1.0% + 2

** Accuracy with film capacitors or better*
*** ±(1.0% + 2) if Relative mode is used for zero residual*

Maximum Resolution: 0.01 nF on the 5.00 nF range

Diode Test and Continuity

Diode Test Indication: Display voltage drop; 0.8 mA nominal test current at 0.6V; 3.0V full scale, accuracy: ±(2.0% + 1)
Continuity Indication: Continuous audible tone for test resistance below 20Ω
Open Circuit Voltage: <3.9V dc
Overload Protection: 1000V rms for circuits <0.3A short circuit, 660V for high energy circuits.

Display

Digital: 4000 counts, updates 4 times per second
Analog: 43 segments, updates 40 times per second (for 83 and 85); 4 x 32 segments (equivalent to 128), updates 40/sec. (for 87)
Frequency: 19,999 counts, updates 3 times per second @ >10 Hz
Annunciators: u, m, n, k, M, V, A, F, S (siemens), Ω (ohms), Hz, AC, DC, MIN, MAX, RECORD, (AUTO autorange), (duty cycle), (hold), (low battery), (audible continuity), (relative)

General Specifications

Maximum voltage applied to any earth terminal: 1000V rms
Storage Temperature: - 40°C to 60°C
Operating Temperature: -20°C to 55°C
Temperature Coefficient: 0.05 x (specified accuracy) per °C (for temperatures <18°C or >28°C)
Relative Humidity: 0% to 90% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Shock & Vibration: Per MIL-T-28800 for a Class 2 Instrument
Safety: Designed to Class II per IEC 348, ISA-DS82, and UL 1244
Power Requirements: Single 9V battery (NEDA 1604 or 6F22 or 006P)
Battery Life: 500 hours typical (alkaline). Battery symbol first displayed when at least 60 hours of battery life remain.
Size: 32 mm H x 87 mm W x 187 mm L (1.25 in H x 3.41 in W x 7.35 in L); with holster and Flex-Stand, 52 mm H x 98 mm W x 201 mm L (2.06 in H x 3.86 in W x 7.93 in L)
Weight: 0.36 kg (12.5 oz); with holster and Flex-Stand 0.62 kg (22.0 oz)
Warranty: Three years parts and labor. One year calibration cycle.

Included with Instrument: Yellow protective holster complete with a Flex-Stand, safety-designed test leads, 9V battery (installed), manual and operator guide.

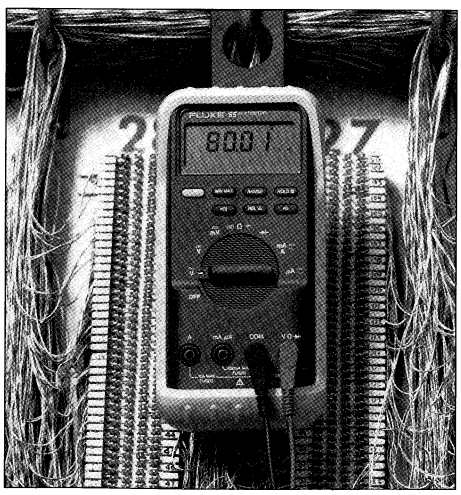
Ordering Information

Models

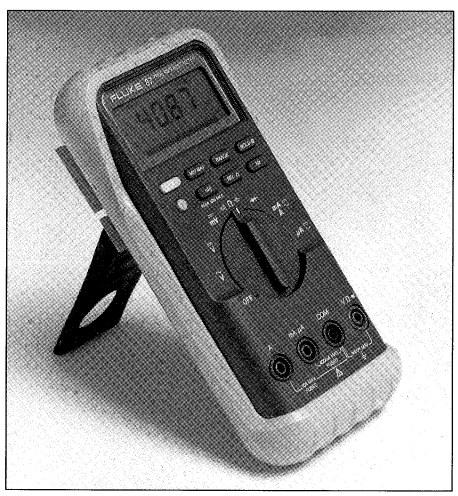
Fluke 83 Multimeter
Fluke 85 Multimeter
Fluke 87 Multimeter

Accessories (Also Section 5)

C25 Ruggedized Soft Case
C81G Optional Grey Holster
C81Y Replacement Yellow Holster
C100 Ruggedized Hard Case
TL20 Test Lead Se
TL70 Test Lead Set (1 set incl. w/meter)
Y8132 Test Lead Set
Y8134 Test Lead Kit
Y8140 Test Lead Set
80TK Thermocouple Module
80T-150U Temperature Probe
LCA-10 Line Current Adapter
Y8100 Current Probe
Y8101 Current Probe
80i-400 Current Probe
80i-410 Current Probe
80i-600 Current Probe
80i-1010 Current Probe
80i-kW Current/Power Probe
80J-10 Current Shunt
80K-6 High Voltage Probe
80K-40 High Voltage Probe
83RF High Frequency Probe
85RF High Frequency Probe

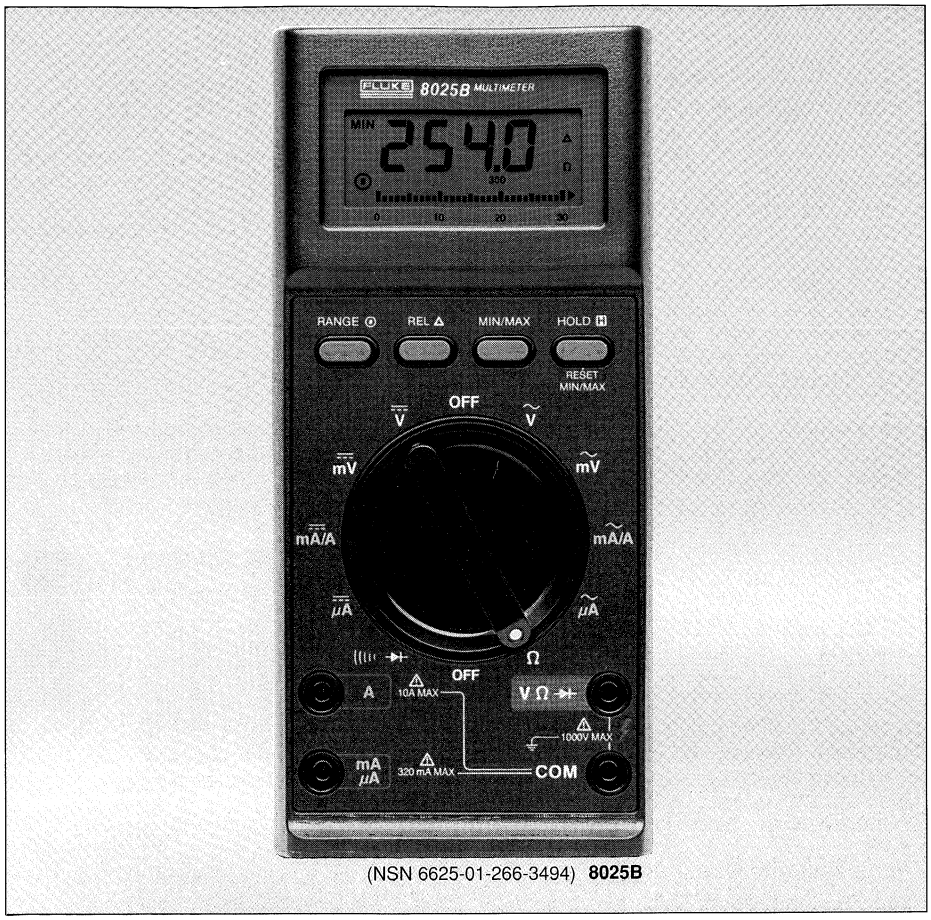


Protective Holster



Flex-Stand

8025B



(NSN 6625-01-266-3494) **8025B**

8025B Multimeter

Designed for MIL-T-28800 Type II, Class 2, Style A requirements
3 1/2 digit, 3200 count display
31 segment bar graph for peaking, nulling and capacitor checking
0.2% basic dc accuracy
Touch Hold® to capture and display readings
LCD symbols annunciate range and modes
Safety designed with extensive overload protection, non-metallic case, and bail
Rugged sealed construction keeps out dirt, water, and contaminants
Comes with C100 ruggedized hard case and low temperature test leads
-40 to 55°C operating range
Two year warranty
Fast autoranging or manual ranging
Range hold
Continuity/diode test beeper
1 kΩ shunted stray-voltage test leads

Designed for use in harsh military environments, the 8025B offers the performance and accuracy of a digital multimeter with the speed and dynamic measurement capability of an analog meter. The 8025B offers bench instrument performance in a convenient hand-held package.

3200-Count Digital Display

The 8025B 3 1/2 digit (3200 count) display equals the resolution of a 4 1/2 digit meter for reading between 2 and 3.2, 20 and 32, or 2000 and 3200.

The analog bar graph allows quicker, easier testing for erratic or unstable signals. It updates ten times faster than the digital display.

Autoranging

Simplifies and speeds up the use of the meter. No need to decide what range to use or to wait for long range-changing delays. Manual ranging is also included.

Audible Continuity/Diode Test

Wiring, diode, and transistor checks can be done quickly without looking at the display.

Touch Hold®

You can take readings of critical circuitry while keeping your eyes on the probes and circuit. Using standard test leads, the 8025B captures your measurement, beeps, locks the reading in the display for viewing, and then automatically updates when a new measurement is taken.

Safety

Safety is designed in with extensive overload protection, high energy fuses, fused 10A range, non-metallic case and bail, recessed input jacks, safety-designed test leads, and no fuses to replace for voltage and resistance overloads.

Low Power Resistance

In-circuit resistance measurements can be made without turning on diodes or transistors.

Min/Max Mode

The 8025B can be connected to record minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

8025B

Display

Liquid Crystal
Digital Display: 3200 counts plus polarity indication, updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Annunciators: k, M, Ω (Ohms); (Hold); (low battery); (manual range); 3,30,300 (range indicators); nS (nanosiemens)

Specifications

Technical Specifications

Basic electrical specifications are defined for the temperature range of 18°C to 28°C and relative humidity up to 95%, for one year after calibration.
Low Temperature Operation: at -40°C LCD updates may take more than 6 seconds

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 µV	0.2% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, 50 Hz or 60 Hz; ≤1 kΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
Response Time: ≤2s to rated accuracy

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV	100 µV	0.5%+3	2% + 3	4%+10
3.200V	1 mV			
32.00V	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not Spec'd

Conversion Type: AC coupled, average sensing, calibrated to read rms value of sinewave
Input Impedance: 10 MΩ nominal in parallel with ≤100 pF
Common Mode Rejection Ratio: ≥60 dB, dc to 50 Hz; ≤1 kΩ unbalance
Overload Protection: 1000V rms, 500V rms on 320 mV range; 10^7 volt-hertz maximum
Response Time: ≤2s to rated accuracy

DC and AC Current

Range	Resolution	Typical Burden Voltage	Accuracy: ±(% of Rdg + Digits)	
			DC Accuracy	AC 40 Hz to 1 kHz
320.0 µA	0.1 µA	160 mV	0.75% + 2	1.5% + 2
3200 µA	1 µA	1.6V		
32.00 mA	10 µV	180 mV		
320.0 mA	100 µA	1.8V		
10.00A	10 mA	0.5V		

Overload Protection: µA/mA ranges: 630 mA/250V fuse in series with 3A/600A fuse
Amp Range: 20A/600V fuse

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0Ω	0.1Ω	0.3% + 2
3.200 kΩ	1Ω	0.2% + 1
32.00 kΩ	10Ω	
320.0 kΩ	100Ω	
3.200 MΩ	1 kΩ	
32.00 MΩ	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Full Scale Voltage: <420 mV up to 3.2 MΩ; <1.3V up to 32 MΩ
Open Circuit Voltage: <2.8V (-15°C to 55°C)
Response Time: ≤6s to rated accuracy

Diode Test and Continuity

Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.08V full scale
Continuity Indication: Continuous audible tone for test resistance below 150 ohms. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold)
Open Circuit Voltage: <3.3V (-15°C to 55°C)
Overload Protection: 500V rms

General Specifications

MIN/MAX Mode: Records the digital display readings (updated twice per second)
Maximum Voltage to be applied to any terminal: 1000V with respect to earth ground
Power Requirements: Single 9V battery NEDA 1604. Lithium battery recommended for low temperature operation
Battery Life: 1000 hours typical. Battery symbol first displayed when at least 60 hours of battery life remain. Battery life shortens significantly at low temperature. Lithium battery recommended for low temperature operation.
Storage Temperature: -55°C to 85°C
Operating Temperature: -40°C to 55°C
Temperature Coefficient: 0.1 x applicable accuracy specification per °C (for temperatures <18°C or >28°C)
Electro-Magnetic Interference (EMI): The 8025B meet MIL-STD-461 for RS03 (to 1V/meter from 14 kHz to 1 GHz) and RE02
Shock, Vibration, Humidity and Water Resistance: Per MIL-T-28800 for a Style A, Class 2 instrument
Instrument Size: 56 mm H x 95 mm W x 203 mm L (2.2 in H x 3.75 in W x 8 in L)
C100 Case Size: 121 mm H x 337 mm W x 394 mm L (4.75 in H x 13.25 in W x 15.5 L)
Weight: DMM alone is 0.75 kg (1.6 lb) with case and accessories 1.5 kg (3.2 lb)
Warranty: Two years

Included with Instrument: Battery, low temperature test leads, two insulated alligator clips, instruction manual, TL25B stray voltage test lead set, with a 1 kΩ thermistor load for DMM input, and C100 ruggedized hard case

Ordering Information

Model

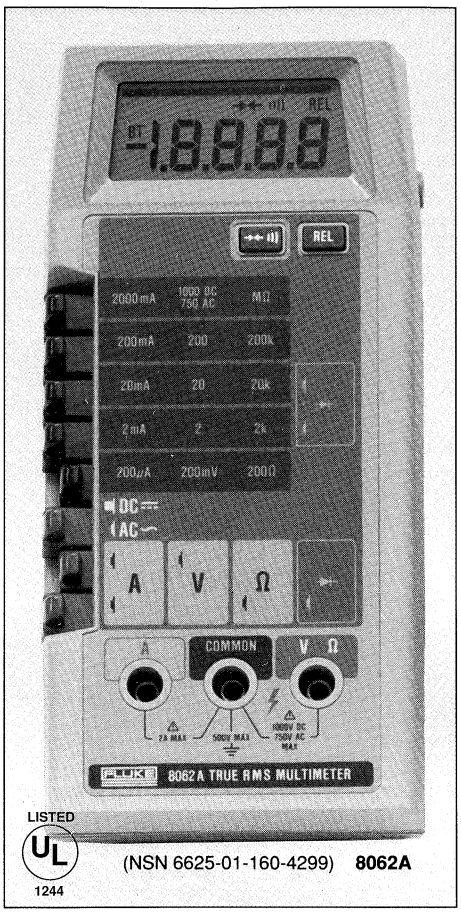
8025B Multimeter

Accessories (Also see Section 5)

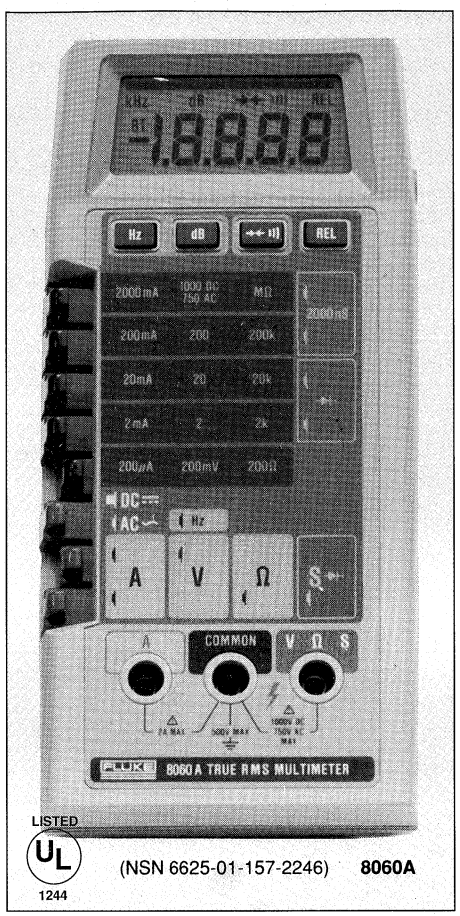
TL25B Stray Voltage Test Leads
Y8134 Universal Test Lead Kit
C25 Soft Carrying Case
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Thermocouple Converter
80T-150U Universal Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
80J-10 Current Shunt5
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
LCA-10 Line Current Test Adapter

8060A & 8062A

T&M EXPRESS LINE



LISTED UL 1244 (NSN 6625-01-160-4299) **8062A**



LISTED UL 1244 (NSN 6625-01-157-2246) **8060A**

The 8060A and 8062A 4½ digit handheld DMMs offer more measurement capabilities than found in most bench/portable models. They are Fluke's finest microcomputer-based handheld DMMs offering unique features never before found in a small low-cost DMM. The 8060A even measures *frequency*—from 12 Hz to more than 200 kHz—autoranging over four ranges from 200 Hz to 200 kHz.

At the touch of a single button you can select V, Hz, and dB.

Relative Reference

When measuring ohms, the microcomputer lets you automatically subtract lead resistance, displaying only the difference between a stored reference value and a measured value. The relative mode is great for measuring changes, especially in dB and frequency measurements.

Overload Protected & Rugged

The 8060A and 8062A are well-suited to the needs of engineers and technicians skilled in audio, video, telecommunication, or computer technology. They have rugged cases, safety engineered jacks and test leads, double-fused current inputs, and extensive overload protection for all other functions and ranges.

Automatic MΩ Range Selection

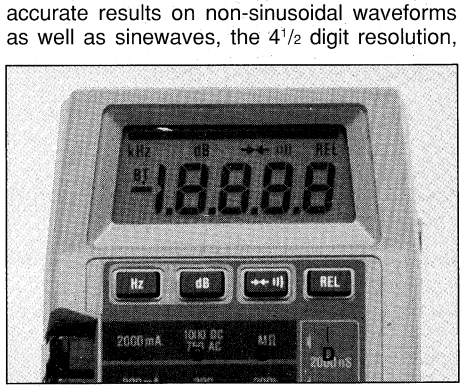
To keep the front panel simple, there is only one manually-selectable position above 200 kΩ. When that position is used, the appropriate 2 MΩ, 20 MΩ, or 300 MΩ range is automatically selected.

Frequency Counter

It is easy to accurately measure the dB gain or loss of amplifiers, filters, attenuators, etc. with a DMM that has dB readout. To combine that feature in a handheld DMM that also measures *frequency* provides a nearly ideal test instrument for many applications. When you need the best in a handheld DMM, you should buy the 8060A. It has features you won't find even in most bench/portable DMMs.

True-rms AC

Because true-rms measurements of ac yield accurate results on non-sinusoidal waveforms as well as sinewaves, the 4½ digit resolution,



8062A 4½ Digit DMM
4½ digit (20,000 count) resolution
True-rms ac measurements
Fast audible/visual continuity tests
Relative reference (offset)
Low-power ohms all resistance ranges
Constant-current diode test mode
Measure resistances to 300 MΩ
True-rms ac voltages to 30 kHz
0.05% basic dc accuracy
Self diagnostics
UL 1244 listed
1 year warranty

8060A 4½ Digit DMM
4½ digit (20,000 count) resolution
True-rms ac measurements
Fast audible/visual continuity tests
Relative reference (offset)
Low-power ohms all resistance ranges
Constant-current diode test mode
Measure resistances to 300 MΩ
True-rms ac voltages to 100 kHz
0.04% basic dc accuracy
Self diagnostics
UL 1244 listed
1 year warranty
Plus
Frequency Counter...12 Hz to 200 kHz
functional to 700 kHz
dBm or relative dB measurements
Conductance measurements

wide bandwidth, and exceptional accuracy of the 8060A and 8062A make them a superior tool for exacting technical people.

Special Functions

Several special annunciator symbols appear in the display as a reminder of what mode or modes have been selected when pushbuttons **A,B,C,** and **D** are used. Only pushbuttons **C** and **D** and corresponding functions appear on the 8062A.

(A) Pushing the Hz button when in the ac voltage mode selects the frequency function. The best of four ranges (200 Hz, 2 kHz, 20 kHz, and 200 kHz) is then automatically selected for frequencies between 12 Hz and 200 kHz. Readings are updated every 1.3 seconds or less even for low-frequency ranges.

(B) Pushing the dB button converts voltage readings to the equivalent in decibels. The reading may be relative to 1 milliwatt (dBm) and a 600 ohm load, or they may be relative to any level previously stored as a "relative reference."

(C) This pushbutton converts resistance measurements to fast indications of continuity, either audibly with a beep tone or quietly by the appearance of the solid black bar across the top of the display. Continuity as brief as 50 microseconds is enough to be recognized, stored, and indicated.

(D) When you first push the REL button it stores the displayed reading and subsequently subtracts that value from all subsequent readings for that measurement function. REL appears in the display as a reminder until the 8060A or 8062A is turned off or the pushbutton is pressed a second time.

Specifications

Technical Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 80%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 10 µV on the 200 mV range
Input Impedance: 10 MΩ on all ranges, >1000 MΩ selectable for 200 mV and 2V ranges
Accuracy: ±(% of Rdg + Digits)

Range	8060A	8062A
200 mV, 2V	0.04% + 2*	-0.05% + 2
20V, 200V, 1000V	0.05% + 2	0.07% + 2

**Accuracy ± (0.05 of reading + 2 digits) for >1000 MΩ input impedance*

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, ≥90 dB at 50 Hz and 60 Hz, with 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous except limited to 20 seconds on 200 mV and 2V ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (True-RMS, AC Coupled)

Ranges: 200 mV, 2V, 20V, 200V, 750V
Resolution: 10 µV on the 200 mV range
Inmput Impedance: 10 MΩ, ≤100 pF (dBm mode also)
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Voltage Readout, 8060A: From 5% to 100% of Range

Range	Accuracy: ±(% of Rdg + Digits)					
	20 Hz	45 Hz	1 kHz	10 kHz	30 kHz	50 kHz 100 kHz
200 mV	1% +10	0.2% +10	0.2% +20	0.5% +40	1% +100	3% +200
2V 20V 200V		0.5% +10	0.5% +20	1% +40	2% +100	
750V	Not Spec'd	1% +10	Not Specified			

Voltage Readout, 8062A: From 5% to 100% of Range

Range	Accuracy : ±(% of Rdg + Digits)				
	20 Hz	45 Hz	500 Hz	1 kHz	10 kHz 30 kHz
200 mV 2V	1% +10	0.5% +10	0.5% +20		1% +40
20V 200V			5% +20		5% +40
750V	Not Spec	2% + 10			Not Spec'd

dBm, 600Ω Reference, 8060A: From 5% to 100% of Range (-50 to +60 dBm)

Range	Accuracy in dB						
	20 Hz	45 Hz	1 kHz	10 kHz	30 kHz	50 kHz	100 kHz
2.45 mV-10.23 mV	±0.5		±1.0		±3.0	Not Spec'd	
10.24 mV-19.99 mV	±0.2				±0.5	±1.0	±2.2
20 mV-199.99V	±0.15				±0.3	±0.65	±1.2
200V-750V	±0.5		Not specified				

Useful Frequency Range: -3 dB at 420 kHz at 100% of range, 220 kHz at 5% of range, typical
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous, except 300V dc or rms ac on the 200 mV and 2V ranges for 20 seconds maximum
Response Time: ≤5 seconds to rated accuracy, any range

DC Current

Range	Resolution	Accuracy: ±(% Rdg + Digits) 8060A	Accuracy: ±(% Rdg + Digits) 8062A	Burden Voltage
200 µA	0.01 µA	0.2% + 2	0.3% + 2	≤0.3V
2 mA	0.1 µA			
20 mA	1 µA	0.3% + 2		
200 mA	10 µA		0.7% + 2	
2000 mA	100 µA			≤0.9V

Input Protection: 2A/250V fuse in series with 3A/600V fuse
Response Time: ≤1 second to rated accuracy

AC Current (True-RMS)

Has dc-coupled current path, ac-coupled voltage-sensing circuits
Ranges, Resolution, Burden Voltage: Same as for dc current
Accuracy, 8060A: ±(% of Rdg + Digits) from 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 kHz-10 kHz	10 kHz-30 kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA				
2000 mA			Not Specified	

Accuracy, 8062A: ±(% of Rdg + Digits) from 5% to 100% of range

Range	20 Hz-45 Hz	45 Hz-3 kHz	3 kHz-10 kHz	10 kHz-30 kHz
200 µA 2 mA 20 mA	1% +10	0.75% +10	2% +20	2% +40
200 mA	1.5% +10	1% +10		
2000 mA			Not Specified	

Crest Factor: 1:1 to 3:1
Response Time: ≤5 seconds to rated accuracy

Resistance

Ranges: 200Ω, 2Ω, 20 kΩ, and 200 kΩ manually selected plus 2 MΩ, 20 MΩ, 100 MΩ, and 300 MΩ automatically selected in the MΩ range

Resolution and Accuracy

Range	Resolution	Accuracy: ±(% of Rdg + Digits) 8060A	Accuracy: ±(% of Rdg + Digits) 8062A
200Ω	0.01Ω	0.07% + 2 + 0.02Ω	0.1% + 2 + 0.02Ω
2 kΩ 20 kΩ 200 kΩ	0.1Ω 1Ω 10Ω	0.07% + 2	0.1% + 2
2 MΩ*	100Ω	0.15% + 2	0.2% + 2
20 MΩ*	10 kΩ	0.2% + 3	0.25% + 3
100 MΩ*	100 kΩ	1% + 3	1% + 3
300 MΩ*	1 MΩ	2% + 3	2% + 3

**These four autoranging MΩ ranges have a high enough source voltage to turn on a silicon junction.*

Open Circuit Voltage: ≤2.5V all ranges, except ≤4.8V on 200Ω range
Overload Protection: 500V dc or rms ac on all ranges
Response Time: ≤2 seconds to rated accuracy except ≤8 seconds on MΩ ranges

Continuity

Ranges: All resistance ranges
Threshold: For 8060A, ≤10% of any range used through 200 kΩ range and ≤20 kΩ above 200 kΩ range. For 8062A ≤50% of range and nominally <100 kΩ above 200 kΩ range
Indication: Horizontal bar in display, plus audible tone when desired
Response Time: ≤50 µs continuity, ≥200 ms indication

Diode Test

The diode test function displays the voltage-drop across a semiconductor junction using a 1 mA (±10%) constant current supply and a 2V range. All resistance ranges up to and including the 200 kΩ range have less than enough source voltage to forward-bias a semiconductor junction, so that they can be used for in-circuit measurements
Reading Accuracy: ±(0.05% + 2 digits) for 8060A, ±(0.06% + 2 digits) for 8062A
Overload Protection: 500V dc or rms ac
Response Time: ≤2 seconds to rated accuracy

Conductance (8060A only)

Range: 200 nS (equivalent to 500 kΩ)
Resolution: 0.1 nS
Accuracy: (0.5% of reading + 20 digits)
Overload Protection: 500V dc or rms ac

Relative Reference

When the REL button is pushed the displayed reading is stored as a reference and subtracted from subsequent readings to indicate the amount of deviation.
Accuracy: Error will not exceed the sum of the errors of the reference reading and subsequent readings

Frequency (8060A only)

Ranges: 200 Hz, 2000 Hz, 20 kHz, and 200 kHz, automatically selected in the Hz mode, ac voltage function. Measures down to 12 Hz. Will measure to 700 kHz in Extended Frequency Mode
Resolution: 0.005% of range, e.g., 0.01 Hz in 200 Hz range
Accuracy: ±(0.05% of reading + 1 digit)
Input Inpedance: AC coupled into 10 MΩ, 100 pF
Sensitivity: For sinewaves, ≥10% of voltage range to 20 kHz, ≥25% of voltage range to 100 kHz, ≥75% of voltage range to 200 kHz
Response Time: ≤1 second above 16 Hz, ≤1.3 seconds from 12.2 Hz to 16 Hz, to rated accuracy

General Specifications

Calibration Cycle: One-year for specified accuracy
Display: 4½ digits (20,000 counts), LCD, autozero, autopolarity, low battery (BT) indicator
Max.Common Mode Voltage: 500V dc or rms ac
Temperature: 0°C to 50°C operating; -35°C to 60°C non-operating
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤80% to 35°C but ≤70% when measuring reisistance above 20 MΩ
Shock and Vibration: Per MIL-T-28800, Class 5
Safety: UL 1244 listed
Power: Single 9V battery, NEDA 1604, typically 170 hours of operation with alkaline type
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in L x 3.4 in W x 1.8 in H)
Weight: 0.41 kg (0.90 lb)
Warranty: One year

Included with Instrument: Manual, TL70 test leads, 9V battery, operator's card, spare fuse

Ordering Information

Models

8060A Digital Multimeter
8062A Digital Multimeter

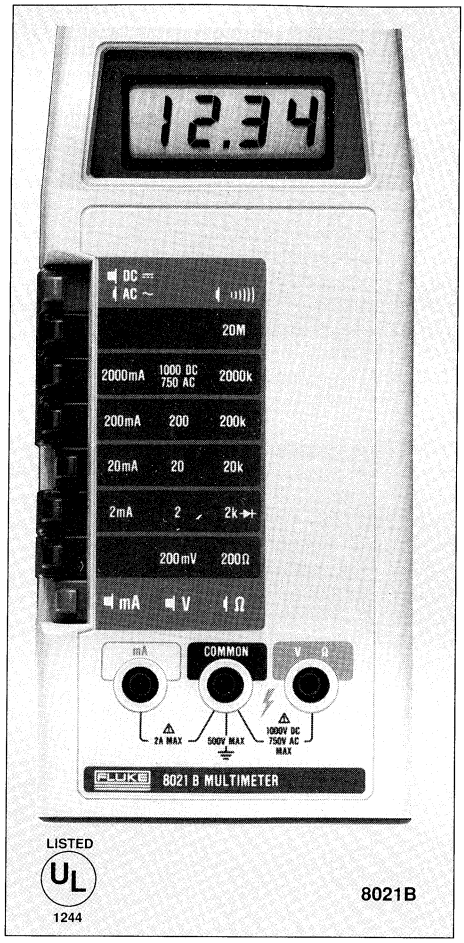
Accessories (Also see Section 5)

TL20 Industrial Test Lead Set
TL70 Replacement Test Lead Set
Y8132 Test Lead Set
Y8134 Universal Test Lead Kit
Y8140 Test Lead Set
C25 Soft Carrying Case
C90 Vinyl Carrying Case
C100 Hard Carrying Case
A81 Battery Charger/Eliminator
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Termocouple Converter
80T-150U Universal Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
80J-10 Current Shunt
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Clamp-on Current Probe
80i-1010 DC/AC Current Probe
80i-kW Current/Power Probe

Handheld Multimeters

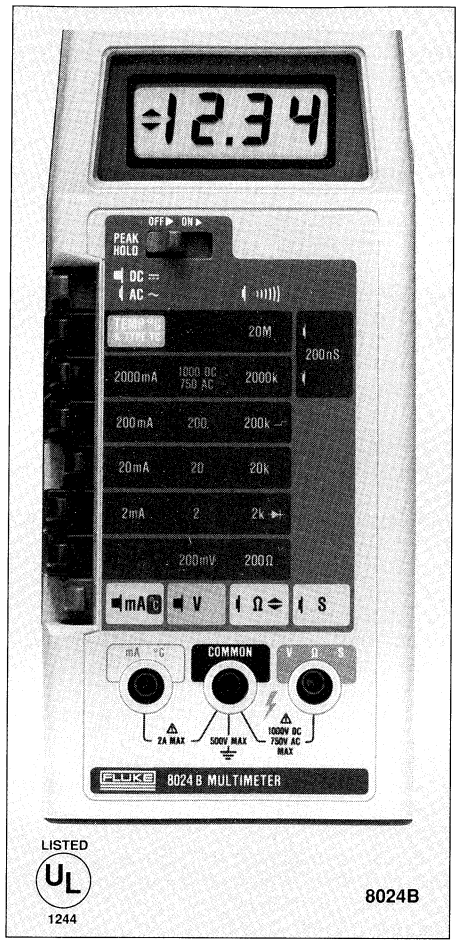
8020B, 8021B, 8024B & 8026B (B-Series)

T&M EXPRESS LINE



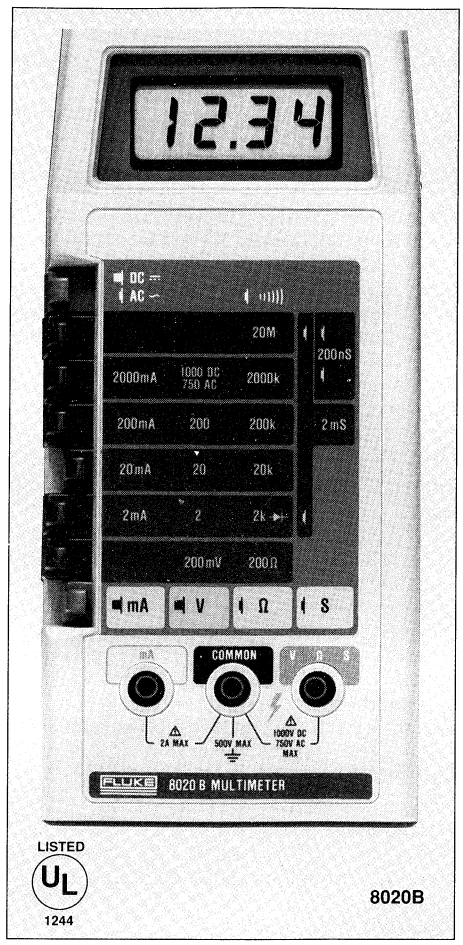
LISTED UL 1244

8021B



LISTED UL 1244

8024B



LISTED UL 1244

8020B

8021B, Rugged & Economical

- 3 1/2 digits (2000 counts)
- High-speed audible continuity
- 0.25% basic dc accuracy
- Extensive overload protection
- Six functions including diode test
- Tilt bail with detent position
- Shock and vibration per MIL-T-28800, Class 5
- UL 1244 listed
- Two year warranty

8024B More than a DMM

- 3 1/2 digits (2000 counts)
- High-speed audible continuity (50 µs response)
- 0.1% basic dc accuracy
- Full overload protection
- All basic DMM functions
- Tilt bail with detent position
- Shock and vibration per MIL-T-22880, Class 5
- UL 1244 listed
- Two year warranty
- Conductance
- Peak-hold (10 ms response)
- Temperature (any K-type thermocouple)
- Fast ac or dc transient capture
- Logic level detection

8026B & 8020B Precision

- 3 1/2 digits (2000 counts)
- High-speed audible continuity testing
- 0.1% basic dc accuracy
- Extensive overload protection
- All basic DMM functions
- Tilt bail with detent position
- Shock and vibration per MIL-T-22880, Class 5
- UL 1244 listed
- Two year warranty
- Conductance
- Diode Test
- True rms (8026B only)

8021B

This rugged 3½ digit handheld DMM was designed for the person who needs the following six basic measurement functions: dc and ac volts, dc and ac amps, ohms, and diode test.

Both electrical and mechanical features make the DMM the world's best in its class. For instance, the 8021B meets the vibration and shock test requirements for Class 5 instruments outlined in U.S. Military Specification MIL-T-28800. Overload protection circuits prevent damage to the instrument caused by accidental operator errors, including voltage input transients up to 6 kV. The current input has two in-series fuses, one for normal overload situations — a common 2A, 250V variety — and a second for high-energy fault conditions, like accidentally connecting the DMM to a 480V ac power line. A crystal-controlled oscillator gives the Fluke handheld DMM the best 60 Hz or 50 Hz line noise rejection available in any hand-held DMM.

The simple front panel layout makes the DMM easy to use. A comprehensive owner's manual clearly explains the unit's operation, and typical measurement techniques are covered so you can get the most out of your DMM.

8024B

Designed with the field service technician in mind, this instrument provides a unique combination of functions that reduces the number of tools needed for on-location repairs. Temperature capability (use any K thermocouple), peakhold (measure motor starting currents or line transients), and a logic level indicator in combination with features more commonly found on DMMs will make this multimeter an integral part of any customer service tool kit.

The 8024B, like all Fluke handheld DMMs, will withstand the rigors of field service. It is used around the world by people who demand exceptional performance, reliability, and ruggedness.

Peak-Hold

This function works for dc or ac voltage or current measurements and is for capturing transient dc peaks or ac surges. For dc, the most positive value will be displayed on the LCD, and peaks typically as short as 5 ms are captured. Average-sensing, rms-indicating techniques are used for ac for transients as short as 150 ms for 48 to 450 Hz waveforms. The decay rate of the display is less than one digit per second.

This feature is especially useful for measuring voltage pulses in electro-mechanical equipment or surge currents in electric motors. Currents as high as 1000 amps may be measured using the optional current probe 80i-1010 clamp-on ac/dc current probe.

Temperature

The 8024B directly displays temperature (in degrees Celsius) when used with optional K-type thermocouples. The input of the 8024B has a temperature-compensated reference junction.

Temperatures from -20°C to +1265°C can be measured depending on which of the following K-type thermocouples are used: the Y8102 is a sheathed probe, good to +925°C, for liquid immersion or penetration measurements; the Y8103 is a bead thermocouple, good to +260°C, for air or gas temperature measurements. The Y8104 is a termination kit for attaching any K-type thermocouple to the 8024B.

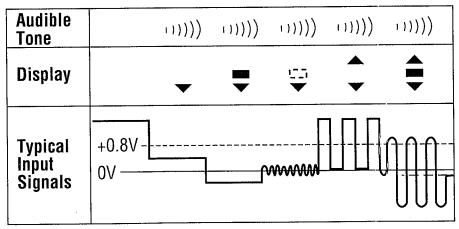
Now you can measure component heat rise, motor temperatures, heating and cooling equipment, etc.

Fluke's high-resolution semiconductor temperature probe, the 80T-150U, will also work with the 8024B as well as all other Fluke DMMs. It has better resolution and accuracy but covers a smaller temperature range (to +150°C or +302°F). The 80T-150U is suited for surface, air, and some liquid immersions.

Logic Level Detection

This function serves the same purpose as an oscilloscope or logic probe in detecting level transitions that last 50 microseconds or longer.

A pulse stretcher is used to detect low-duty cycle pulses .



8026B & 8020B

Both the 8026B and 8020B provide features that make them ideal for troubleshooting relays, cables, switches, and for locating intermittent shorts and opens. The 8026B and 8020B offer capabilities that allow you to check leakage current of diodes, cable insulation, connectors, printed circuit boards, etc.

The 8026B and 8020B are equipped with extensive internal protection against overloads, transients to 6 kV, or operator errors. The current input is protected with two in-series fuses — 2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V fuse will blow when accidentally attached to a source of more than 250 volts — like a 480-volt power line. Over 20% of the components are devoted exclusively to overload protection.

True RMS

Most ac meters are accurate only when measuring sinewaves. In modern electronic and electrical equipment, however, measurement errors on the order of 20% or more may result from radically non-sinusoidal waveforms such as squarewaves, pulses, or the outputs from silicon controlled rectifiers. True-rms sensing circuits such as found in the 8026B prevent such errors.

Recommended 8020B Family Replacements (for best possible value)

Model	Replacement	Applicable Features
8020B	Fluke 85	.1% basic dc accuracy
8021B	Fluke 83	.25% (8021B) and .3% (83) basic dc accuracy
8024B	Fluke 87	Peak Min Max (87, 1 ms update) (8024B 10 ms update). Add 80TK for temperature
8026B	Fluke 87	True rms meters

8020B, 8021B, 8024B & 8026B (B-Series)

Specifications

B-Series*

	8021B	8020B	8024B	8026B
DC Voltage				
Accuracy*	200 mV, 2V 20V, 200V, 1000V ranges Highest resolution 100 µV on 200 mV range.			200 mV, 2V, 20V, 200V, 1000V ranges Highest resolution 100 µV on 299 mV range 0.1% + 1
	8021B	**8020B**	**8024B**	
	0.25% + 1	0.1% + 1	0.1% + 1	
Overload Protection	1000V dc or peak ac on all ranges except 200 mV (15 sec. max. above 300V dc or rms). 6 kV, 10 µsec pulses, maximum 5 pulses/sec.)			1000V dc or peak ac on all ranges except 200 mV (15 sec. max. above 300V dc or rms). (6 kV, 10 µsec pulses, maximum 5 pulses/sec.)
Input Impedance	10 MΩ			10 mΩ
NMRR	>60 dB (50 Hz, 60 Hz)			>60 dB (50 Hz, 60 Hz)
CMRR (kΩ unbalance)	>100 dB at dc 50 Hz, 60 Hz			>100 dB at dc 50 Hz, 60 Hz
AC Voltage				
Accuracy*	**8021B**		**8020B/8024B**	>5% of range
	Range	**45 Hz to 450 Hz**	**45 Hz to 1 kHz**	**to 2 kHz**	**to 5 kHz**	**Range**	**45 Hz-1 kHz**	**to 2 kHz**	**to 5 kHz**	**to10 kHz**
	200 mV	1.0% + 3	0.75% + 2	1.5% + 3	5% + 5	200 mV	0.5%+2	0.5%+2	0.5%+2	2%+3
	2V	1.0% + 3	0.75% + 2	1.5% + 3	5% + 5	2V	0.5%+2	0.5%+2	1%+3	2%+3
	20V	1.0% + 3	0.75% + 2	1.5% + 3	5% + 5	20V	0.5%+2	0.5%+2	1%+3	2%+3
	200V	1.0% + 3	0.75% + 2	1.5% + 3	—	200V	0.5%+2	1%+2	—	—
	750V	1.0% + 3	1.0 % + 2	—	—	750V	0.5%+2	—	—	—
Overload Protection	750V ac, 100V dc on all range except 200 mV (15 sec. max. above 300V rms)					750V ac, 100V dc on all range except 200 mV (15 sec. max. above 300V rms)				
Input Impedance	10 MΩ (<100 pF)					10 MΩ (<100 pF)				
CMRR (1kΩ unbalance)	<60 dB (50 Hz, 60 Hz)					<60 dB (50 Hz, 60 Hz)				
Crest Factor:	Does not apply					1:1 to 3:1				
Conversion Type	Average sensing, calibrated to tread rms of sine wave.					True rms ac coupled				
Current										
Accuracy (dc)*	Highest resolution 1 µA on 2 mA range					Highest resolution 1 µA on 2 mA range				
	Range	**8021B**	**8020B**	**8024B**						
	2 mA, 20 mA, 200 mA, 2000 mA ranges	0.75% + 1	0.75% + 1	0.75% + 1		2 mA, 20 mA, 200 mA, 2000 mA ranges	0.75% + 1			
Accuracy (ac)*	2 mA (45-450 Hz)	3.0% + 3	3.0% + 2	4.0% + 2		**Range**	**45 Hz-450 Hz***	**to 1 kHz***		
	20 mA, 200 mA, 2000 mA (45-450 Hz)	2.0% + 3	1.5% + 2	1.5% + 2		2 mA	3.0% + 2	—		
	(to 1 kHz)	—	1.5% + 2	1.5% + 2		20 mA	1.5% + 2	1.5% + 2		
						200 mA	1.5% + 2	1.5% + 2		
						2000 mA	1.5% + 2	1.5% + 2		
Overload Protection	2A/250V fuse in series with 3A/600V fuse					2A/250V fuse in series with 3A/600V fuse				
Burden Voltage	<0.3V all ranges (<0.9V on 2000 mA)					<0.3V all ranges (<0.9V on 2000 mA)				

**True RMS ac coupled*

Specifications, continued

	8021B	8020B	8024B	8026B
Resistance Conductance				
Accuracy	**Range** / **8021B** / **8020B** / **8024B**			**Range** /
	200Ω / 0.3% + 3	0.2% + 3	0.2% + 3	200Ω / 0.2% + 3
	2 kΩ to 200 kΩ / 0.2% + 1	0.1% + 1	0.1% + 1	2 kΩ to 200 kΩ / 0.1% + 3
	2000 kΩ / 2.0% + 1	2.0% + 1	0.15% + 1	2000 kΩ, 20 MΩ / 2.0% + 1
	20 MΩ / 2.0% + 1	2.0% + 1	2.0% + 1	2 mS / 0.2% + 1
	2 mS / —	0.2% + 1	—	200 nS / 2.0% + 10
	200 nS / —	2.0% + 10	2.0% + 10	
	Lowest resolution 0.1Ω on 200Ω range			Highest resolution on 0.1Ω on 200Ω range
Continuity beeper (typical threshold)	<600Ω	<600Ω	<600Ω	<600Ω
Diode Test	Use 2 kΩ, 200 kΩ, 20 MΩ range			Use 2 kΩ, 200 kΩ, 20 MΩ range
Overload Protection	500V rms (15 sec. max. above 300V)			500V rms (15 sec. max. above 300V)
Open Circuit Voltage	<1.5V for all ranges (3.5V on 2 kΩ)			<1.5V for all ranges (3.5V on 2 kΩ)
General				
Max. CM Voltage	500V with respect to earth ground			500V with respect to earth ground
Display	3-1/2 digit LCD (1999 count)			3-1/2 digit LCD (1999 count)
Temperature	Operating: 0°C to 50°C. Storage: -35°C to +60°C			Operating: 0°C to 50°C. Storage: -35°C to +60°C
Humidity	0 to 90% (0°C to 35°C) (0 to 80%, 2 MΩ, 20 MΩ and 200 nS ranges) 0 to 70T (35°C to 50°C)			0 to 80% (0°C to 35°C) 0 to 70% (35°C to 50°C)
Temperature Coefficient	0.1x specified accuracy/°C applies from 0°C to 18°C and from 28°C to 50°C			0.1x specified accuracy/°C applies from 0°C to 18°C and from 28°C to 50°C
Shock & Vibration	Per MIL-T-22880, Class 5			Per MIL-T-22880, Class 5
Power	Single 9V battery 200 hours (8021B, 8020B), 100 hours (8024B) (alkaline)			Single 9V battery 200 hours (alkaline)
Size	45 mm H x 86 mm W x 180 mm L (1.8 in H x 3.4 in W x 7.1 in L)			45 mm H x 86 mm W x 180 mm L (1.8 in H x 3.4 in W x 7.1 in L)
Weight	0.37 kg (13 oz), 8021B, 8020B, 0.48 kg (17 oz), 8024B			0.37 kg (13 oz)
Calibration	2 years for specified accuracy			1 year for specified accuracy
Warranty	2 years parts and labor			2 years parts and labor
Special Functions	Display hold, peak hold, temperature, level detector, (8024B)			

**Accuracy specifications are ±(% of reading + number of digits). Accuracy specified for temperature range of 18°C to 28°C.*

Ordering Information

Models

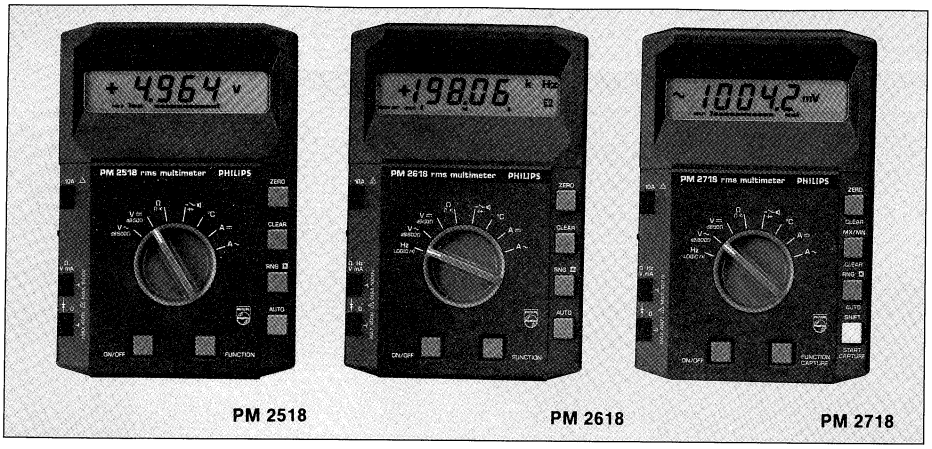
8020B Digital Multimeter
8021B Digital Multimeter
8024B Digital Multimeter
8026B Digital Multimeter

Accessories (Also see Section 5)

TL20 Test Lead Set
Y8132 Test Lead Set
Y8134 Deluxe Test Lead Kit
Y8140 Test Lead Set
C90 Soft Case
A81 Battery Eliminator
83RF High Frequency Probe, 100 MHz
85RF High Frequency Probe, 500 MHz
80TK Thermocouple Module
80T-150U Temperature Probe
80K-6 High Voltage Probe
80K-40 High Voltage Probe
Y8100 DC/AC Current Probe
Y8101 AC Current Probe
80i-400 AC Current Probe
80i-410 DC/AC Current Probe
80i-600 AC Current Probe
80i-1010 DC/AC Current Probe

PM 2518, PM 2618, PM 2718 (Series 18)

T&M EXPRESS LINE



Series 18 Handheld Multimeters

- High resolution analog bargraph
- Logic measurements to 10 MHz
- Frequency measurements to 200 kHz
- Min/Max and data hold
- mAs option for medical applications
- Electronic closed case calibration
- 750V ohms protection
- 0.1%, 0.07% and 0.04% basic accuracy
- Backlit LCD option
- Benchtop performance in handheld size

These Series 18 DMMs are portable and compact, convenient for use in the laboratory or field, they also include all the performance and features expected of benchtop instruments.

The range of three models allows you to select exactly the functions you need for your application and environment, from general purpose testing, through communications and digital measurements, right up to R&D. Series 18 DMMs offer an excellent combination of value, convenience and performance.

High Accuracy Display

The 4+ digit display permits fast, high resolution measurements to be made on all functions. For example, 5V is measured to the nearest millivolt, with an accuracy of 0.1% or better.



AC True rms Values, Accurate up to 100 kHz

The Series 18 DMMs have a custom true rms converter that guarantees accurate measurements on all ac signals (AC coupled). The following table compares the readings given for various input waves for the Series 18 meters and standard averaging instruments

Signal Form	∿	⊓	∿	⋀
RMS value	5V	5V	5V	5V
Reading on Series 18	5V	5V	5V	5V
% error	0	0	0	0
Reading on averaging meter	5V	5.55V	4.7V	3.2V
% error	0	11	6	36

750V Protection for Reliability

With standard 750V input protection on all except current ranges, the Series 18 handheld meters have excellent protection against accidental overload.

They can be connected to three-phase power supplies and the function switch can be rotated through the ohms range without damaging the meter.

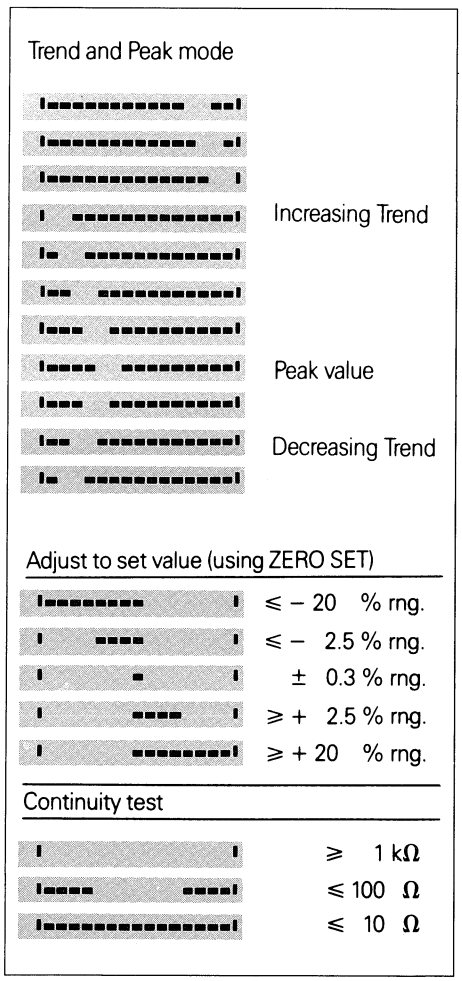
Standard dc and ac voltage range is 1 kV, protected to withstand 2.5 kV spikes, ensuring that these meters are not damaged in tough measuring conditions.

Bargraph Display

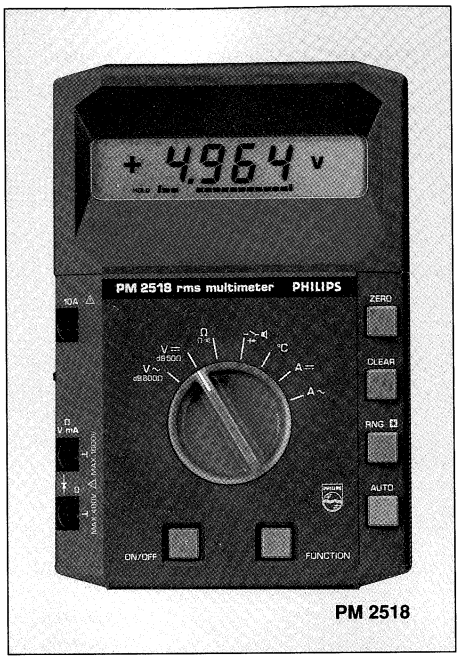
In checking signal trends or looking for peak values, the new Series 18 bargraph display is a step forward over conventional analog pointer systems. For example, as long as the input signal is increasing, the rotating bargraph moves to the right. When autoranging of the digital display value occurs, the bargraph continues to move to the right, always giving a clear indication of the signal trend, even when the signal crosses meter ranges.

For accurate detection of peak values, for example when tuning communication equipment, the bargraph has a maximum resolution equivalent to 8 counts on the digital display, or 0.08% of an analog scale.

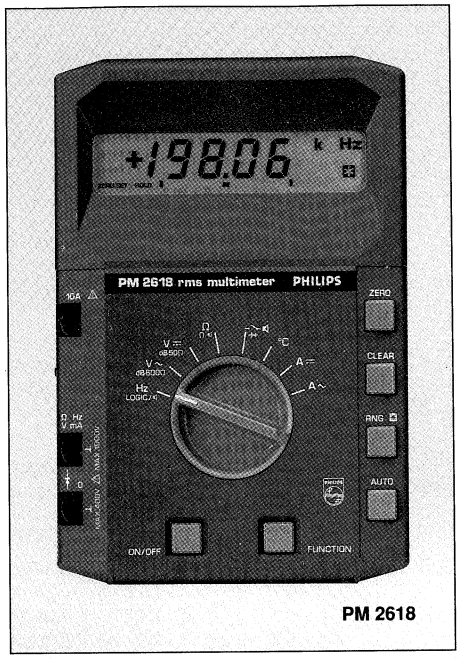
For adjustment to set values, the ZERO SET mode of the new Series 18 meters allows the bargraph to function as a highly sensitive minus-null-plus indicator. This allows accurate analog-indicated settings to any value within the meter's measuring range to an accuracy of 0.3%. Continuity testing not only gives an audible warning, but also a visual indication on the bargraph display.



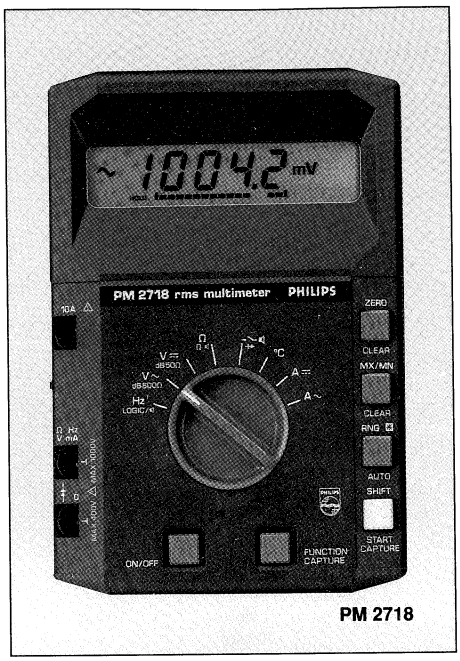
PM 2518, PM 2618, PM 2718 (Series 18)



PM 2518



PM 2618



PM 2718

4

Choice of Models

PM 2518

- AC True rms (AC coupled)
- 750V ohms protection
- Analog bargraph
- Closed-case calibration
- Relative measurements
- dB measurements
- Temperature measurements
- 0.1% dc accuracy
- 40 kHz range

PM2618

All PM 2518 features plus ...

- 0.07% dc accuracy
- 70 kHz AC range
- 200 kHz counter
- 10 MHz logic detection
- mAs option

PM2718

All PM 2618 features plus ...

- 0.04% dc accuracy
- 100 kHz ac range
- Min/Max. measurements
- Data capture and hold

Added Features

10 MHz LOGIC Detection (PM 2618 and PM 2718 only)

Digital signal activity at speeds of more than 10 MHz can be meaningfully indicated by the LOGIC function. This allows not only high, low, bad or pulsed logic levels to be detected, but also gives an indication of the duty cycle at the measured point. The ability to distinguish between bad levels and real open circuits considerably reduces troubleshooting time.

At 'any logic', compatibility is simply achieved by connecting the measuring leads to the low and Vcc levels in the circuit to be tested, and pressing the ZERO button. The thresholds for the LOGIC mode are then set to 25% (low) and 75% (high) of this value, thereby covering the full range of logic levels — from low-power CMOS to industrial hardwired logic.

INPUT	DISPLAY
	HOLD n PROBE
	HOLD nnnn PROBE
	HOLD U PROBE
	HOLD PROBE
	HOLD bAd PROBE
	HOLD PROBE
open circuit	HOLD OPEN PROBE

mAs Version (PM 2618 only)

Where milliamp second measurements are required, for example in medical environments, the PM 2618/32 version allows these to be made in addition to any other standard functions. A single switch allows selection of mA, mAs measure or mAs zero. Measurement of pulses from 0.5 ms to 1 s in the range 10 uAs to 20 As ensures compatibility with current and future X-ray systems and scanners. This special version also includes the backlight display, with automatic on/off switching depending on the ambient light level.

Resistance Measurements from Short Circuit to 100 MΩ

Fast circuit-continuity checks are possible with a beeper that gives an instant warning of short-circuits, while resistance values from 100 mΩ to 100 MΩ are displayed clearly and with optimum resolution via the autoranging.

PM 2518, PM 2618, PM 2718 (Series 18)

Function	Meter Ranges	Resolution	Accuracy (% reading = % range)			Input characteristics	Response time	Overload protection	Notes
			PM 2518	PM 2618	PM 2718				
Vdc	1V 10V 100V 1000V	100µV 1mV 10 mV 100 mV	0.1 + 0.02 0.1 + 0.02 0.1 + 0.02 0.1 + 0.02	0.07 + 0.02 0.07 + 0.02 0.07 + 0.02 0.07 + 0.02	0.04 + 0.02 0.04 + 0.02 0.04 + 0.02 0.04 + 0.02	10 MΩ 10 MΩ 9.1 MΩ 9.1 MΩ	Manual < 1s Auto < 1.5S	1000 Vrms 2.5 kV spike	
Vac (ac. coupled, True RMS, crest factor 2)	1V 10V 100V 1000V	100 µV 1 mV 100V 1000V	40 Hz to 3 kHz 0.5 + 0.1 3 kHz-40 kHz per kHz 0.20 + 0.05	40 Hz to 3 kHz 0.4 + 0.1 3 kHz-10 kHz per kHz 0.15 + 0.03	40 Hz to 3 kHz 0.3 + 0.1 3 kHz-100 kHz per kHz 0.1 + 0.03	>2 MΩ <20 pF	Manual <1s Auto <1.5s	1000 Vrms 2.5 kV spike	
Idc	20 mZ 200 mA 2A 10A(20A<20s)	10 µA 100 µA 1 mA 10 mA	0.5 + 0.1 0.5 + 0.1 0.5 + 0.1 0.5 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	0.4 + 0.1 0.4 + 0.1 0.4 + 0.1 0.4 + 0.1	<25 mV drop <250 mV drop <25 mV drop <250 mV drop	Manual <1s Auto <1.5s	20 mA and 200 mA ranges fuse protected	Voltage drop excludes fuse on 20 mA and 200 mA ranges
Iac (ac coupled True RMS, crest factor 9)	20 mA 200 mA 2A 10A(20A<20s)	10 µA 100 µA 1 mA 10 mA	0.06 + 0.3 40 Hz-400 Hz	0.6 + 0.3 40 Hz-400 Hz	0.4 + 0.3 40 Hz-400 Hz	Voltage drop as Idc	Manual <1s Auto <2	as Idc	as Idc
R	1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MQ 100 MΩ	100 mΩ 1Ω 10Ω 100 Ω 1 kΩ 100 kΩ	0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.3 + 0.1 0.5 + 0.1 5 + 3	0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.2 + 0.1 0.4 + 0.1 5 + 3	0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.15 + 0.05 0.3 + 0.1 5 + 3	1 mA drive 100 µA drive 10 µA drive 1 µA drive 100 nA drive 10 nA drive	Manual <1s Auto <3s 10s	750V	Open input Voltage 3V 100 MΩ Manual ranging
Hz PM 2618 and PM 2718 only	20 kHz 200 kHz	1 Hz 10 Hz	N.A. N.A.	0.1 + 0.01 0.1 + 00.1	0.1 + 0.01 0.1 + 0.01	≤1 Vpp sensitivity 2 MΩ//3pF			10 Hz lower limit Gate time 1s
°C via Pt 100 100Ω RTD	-250°C to + 1000°C	0.1•C	1°C in range -20 to + 100°C	1°C in range -20 to 100°C	1°C in range -20 to + 100°C	1 mA drive current	dependent on probe		PM 9249 range -60°C to +200°C
Diode Test	1 Vdc	100 µV	0.3 + 0.1	0.3 + 0.1	0.3 + 0.1	1 mA drive	<1s	750V pk	
Continuity Test	1 kΩ	100 MΩ	0.5 + 0.1	0.5 + 0.1	0.5 + 0.1	1 mA drive	<0.2s	750V pk	Beeper
dB Vac	-51 dB to + 43 dB	0.1dB(>100 mV) 1 dB (<100 mV)	as Vac	as Vac	as Vac	Referenced to 1 mW 600Ω	as Vac	as Vac	
dB Vdc	-47 dB to +53.8 dB	0.1 dB(>10 mV) 1 dB (<10 mV)	±0.1dB(>10mV) ±1dB(<10mV)	±0.1dB(>10mV) ±1dB(<10mV)	±0.1dB(>10mV) ±1dB(<10mV)	Referenced to 1 mW 50Ω	as Vdc	as Vdc	1 mW 50Ω
mAs	20 mAs 200 mAs 2 As 20 As	10 µAs 100 µAs 1 mAs 10 mAs	N.A.	1% + 0.3% (in 3%...100% of range)	N.A.	as Idc	as Idc	as Idc	Optional PM 2618 only

Easy to Read in the Dark

Where measurements have to be made under poor lighting conditions, for example among tightly packed equipment or in out-of-the-way areas, special backlight versions of the Series 18 DMMs have a display light that switches on automatically. If no new measurement is made, the backlight switches off after a short period to conserve battery life. Complete power-down of the instrument takes place after 30 minutes on both standard and backlit versions. Combined with low power consumption in normal use, this contributes to a battery lifetime of hundreds of hours.

Direct Temperature Readings

The optional PM 9249 Platinum RTD 100 probe gives direct temperature readings from -60 to +200°C, with a resolution of 0.1°C for air, liquid or surface temperatures.

Direct Gain and Loss Measurements

Measurements on amplifiers or communications equipment frequently require the conversion of readings into dB values. This is available with a single button operation on the Series 18, to a resolution of 0.1 dB and eliminating the need for separate calculations.

Relative Reference Values

Measurements of tolerances or component deviations from specified values are simple with the Series 18. A reference relative value can be set using the ZERO button, so the user does not always have to make the measurement relative to zero and calculate the deviation. Measurements are then made automatically, relative to that reference value.

200 kHz Frequency Counter Function (PM 2618, PM 2718 only)

A fully automatic counter function works at frequencies from 1 Hz to 200 kHz. Read-out is direct, with a scale indication showing Hz or kHz. It is highly sensitive, making it suitable for audio applications.

MIN/MAX Read-Out (PM 2718 only)

To monitor minimum and maximum levels in test set-ups, all the user has to do is connect the PM 2718 and leave it to measure. Minimum and maximum readings can be recalled and displayed at any time; and maximum and minimum readings of low-frequency signals (±1Hz) can be measured and read within a few seconds.

Data Capture and Hold

The PM 2718's data capture function allows a measured value to be frozen on the display, essential when working in situations where access to the measurement point is difficult. The PM 2718 offers this as standard and it is optionally available on all Series 18 instruments with the data hold probe PM 9267. The user simply connects the measuring leads, waits for the "beeper" to confirm that the measurement has been acquired, and it can be read whenever it is needed.

Closed-Case Calibration

The new Series 18 DMMs are the first compact battery-powered units to offer closed-case calibration, a facility normally found only on much more expensive instruments. This facility allows savings in calibration time and cost and ensures error-free calibration.

The instruments can be recalibrated without opening the case by connection of an appropriate standard and switching the unit to "CAL" mode. For volume users recalibration is possible in an automated system environment. The optional PM 9181 GPIB/IEEE-488 interface speeds calibration by enabling these meters to be triggered, ranged, read and recalibrated over the GPIB/IEEE 488 standard bus.

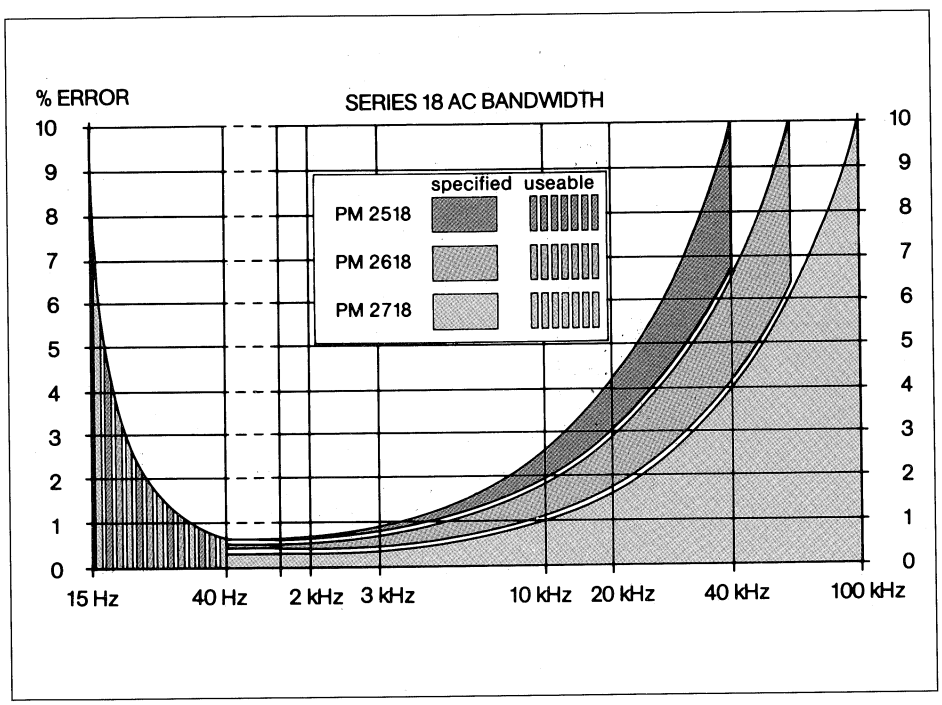
Specifications

General

Display: LCD, 12mm height with range and message characters
A/D Conversion System: Delta modulation, auto-zeroing, 11,000 counts
Reading Rate: 2.5 measurements/s
CMMR DC: >100 dB
CMMR 50/60 Hz: >80 dB
SMMR 50/60 Hz: >60 dB
Ranging: Fully automatic except 100 MΩ
Range Selection: Auto-range up at 110% of fs; Auto-range down at 10% of fs; Manual ranging by key
Overload: Indicated by OL on display
Underload (dB): Indicated by UL on display
Crest Factor Overload: Indicated by ⚡ on display
High Voltage 110V: Indicated by ⚡ on display
Max. V x Hz: 10^7

Logic Function (PM 2618 and PM 2718 only)

Vcc of test unit entered by use of ZERO key on meter
Default Vcc: 3.2V (gives 0.8V and 2.4V)
Logical 0 Level:≤0.25Vcc
Logical 1 Level:≥0.75Vcc
Threshold Resolution: ±50mV
Max. Vcc: 100V
Min. Pulse Duration: 100 ns using 1:1 probe
Max Frequency: 10 MHz using 1:1 probe (above 10 kHz)



Beeper Function: On/Off via FUNCTION key; Low tone for logical 0. High tone for logical 1; intermittent high tone for pulse

Relative Measurement (using ZERO button)

Applicable Functions: All
Set Reference: On pushing ZERO button; last displayed value is used as reference
Recall Reference: By pushing and holding ZERO
Clear Reference: By key combination or Auto range selection

BEEPER Functions

PM 2518 and PM 2618: Dual tone selectable for ohms; Low ≤10%, high ≤continuity; Low ≤10%, high ≤1% logic; see logic function
PM 2718: As PM 2618 plus data captured indication

mAs Measurement

Ranges: 20 mAs, 200 mAs, 2 As, 20 As
Maximum Input Current On 20A Socket: 10A continuous, 20A for 20s
Resolution: 10μAs in 20 mAs range
Number of Representation Units: 2200
Accuracy: ± (1% of reading + 0.3% of range), covering 3%...100% of range
Temperature Coefficient: ± (0.06% of reading + 0.06% of range)
Drift: <2 digits/s
Min. Pulse Width: 0.5 ms
Max. Pulse Width: 1s
Voltage Drop Over Shunt:
20 mAs, 2 As Range: <25 mV at 20 mA resp. 2A
200 mAs, 20 As Range: <250 mV at 200 mA resp. 20A
Voltage Drop Over Input Sockets:
20 mAs, 2 As Range: <100 mV at 20 mA resp. 2A
200 mAs, 20 As Range: <1V at 200 mA resp. 20A
Protection: 250V rms ranges 20 mAs; Range 2 As, 20 As not protected; Max. current 20A for 20 sec.
Max. Common Mode Voltage: 400V
Zero Setting Integration: By switching the ERASE knob
Relative Reference Setting:
ON/RECALL: with pushbutton ZERO
OFF; with pushbutton CLEAR
Maximum Voltage:
HI and LO 250V rms
HI and GROUND 400V rms
LO and GROUND 400V rms

Environmental Conditions

Reference Temperature: 23°C ± 2°C
Rated Range of Use: 0...+45°C
Operating Range of Use: -10...+55°C
Storage & Transport: -40...+70°C
Limits of Humidity for Operation: 20...80%

Power requirements

Power Supply: 4 x R14 batteries or PM 9218 A Power Supply Adapter
Power Consumption: /02 versions 45 mW typical; /12 versions 180 mW typical (light on)

4

PM 2518, PM 2618, PM 2718 (Series 18)

Safety and Calibration

Calibration Interval: 1 year
Max Dew Point: +28°C
Safety: Class II acc. to IEC 348/VDE 0411/UL 1244

Mechanical Specifications

Size: 170 mm L x 55 mm W x 188 mm H (6.7 in L x 2.2 in W x 7.4 in H)
Weight: 0.7 kg (1.5 lb)

Included with instruments: PM 9266 safety leads and probes, operating manual, spare fuses

Ordering Information

Models

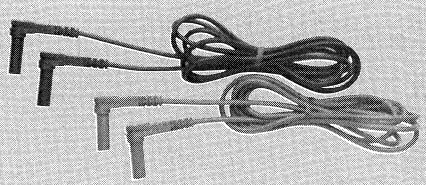
PM 2518/02 Standard version
PM 2518/12 Standard version with backlit display
PM 2618/02 Extended version
PM 2618/12 Extended version with backlit display
PM 2618/32 mAs version with backlit display
PM 2718/02 High accuracy version
PM 2718/12 High accuracy version with backlit display

Accessories

PM 9210/00 High frequency, 50Ω, 150 mV probe 10 kHZ to 1GHz
PM 9212/00 Accessories for HF probe PM 9210
PM 9213/00 High frequency 10 mV probe 10 kHz to 100 MHz
PM 9244/00 AC and DC current shunt up to 31.6A
PM 9245/00 AC current transformer 10A to 150A
PM 9246/03 High tension probe
PM 9249/01 Platinum RTD Temperature probe
PM 9267/01 Data hold probe
PM 9278/02 Ever-ready case
PM 9053 Adaptor Banana (m) - BNC (f)
PM 9071 Measuring cable 135 ohm Banana (m) - Banana (m)
PM 9072 Measuring cable 135 ohm BNC (m) - Banana (m)
PM 9215/50 Logic view probe 10 MHz (for PM 2618 and PM 2718 only)
PM 9218A/011 Mains adaptor 220V/50 Hz to 9V dc
PM 9218A/013 Mains adaptor for 115V/50...60 Hz to 9V dc (USA)
PM 9218A/014 Mains adaptor for 240V/50...60 Hz to 9V dc (U.K.)

Multimeter Accessories

NEW



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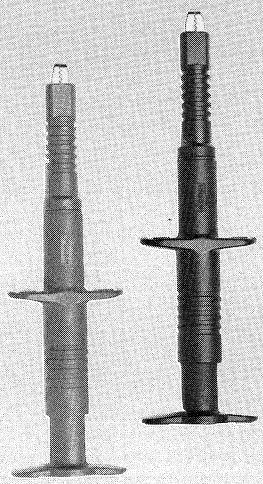
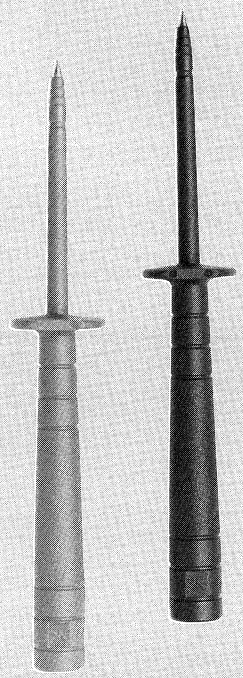
NEW



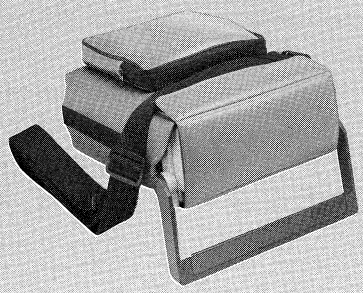
AC20 Page 142

NEW



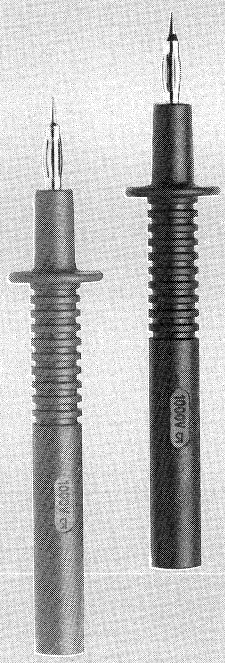
TP80 Page 143 **TP22** Page 143

NEW



C40 Page 150

NEW



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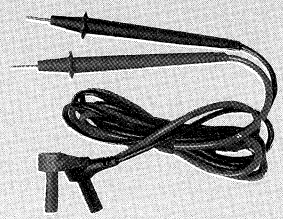


TL70 Page 141

Today's multimeters can become even more powerful tools through the use of accessories. High voltages and currents can be scaled down to levels that are safe to measure with a digital multimeter (DMM).

Temperature modules and thermocouple probes can convert a DMM to be used in situations that might otherwise require an oscilloscope.

This section includes a wide assortment of carrying cases, test leads and special accessories, too. In total, Fluke and Philips offer more accessores for more digital multimeters than anyone in the world.

Our accessories are unsurpassed in quality of design and workmanship. And, they are compatible with other manufacturers' DMMs.

Fluke-Produced Accessories Selection Guide	Page 138
Philips-Produced Accessories Selection Guide	Page 140
Test Leads	Page 141
Probes	Page 143
Current Clamps	Page 146

Fluke-Produced Accessories

Available through Distributors

Fluke-Produced Accessory Selection Guide

Model Number	Item	Handheld															Bench/Portable					Bench/System				
		21	23	25, 27	73	75	77	83	85	87	8020B	8021B	8024B	8025B	8026B	8060A	8062A	8010A	8012A	37	8050A	45	8840 Series	8500 Series	8920A	8921A	8922A
TL20	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	(4)	•	•	•	—	—	•	•	•	•	—	—	—	—
TL22	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	—	—	—	—
TL24	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	—	—	—	—
TL26	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	—	—	—	—
TL28	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	—	—	—	—
TL70[13]	Test Lead Set	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	•	(4)	(4)	(4)	—	—	(4)	(4)	(4)	(4)	—	—	—	—
Y8131[13]	Test Lead Set	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	(4)	(4)	—	—	—	—	•	(1)	•	(1)
Y8132[13]	Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	—	—	—	—
Y8133[14]	Test Lead Kit	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	(1)	•	(1)
Y8134	Test Lead Kit	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	•	—	—	—	—
Y8140	Test Lead KIt	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-H	Touch-Hold Probe	—	(5)	(5)	—	—	(5)	(5)	(5)	(5)	—	—	—	(5)	—	—	—	•	•	(5)	•	—	—	—	—	—	—
83RF	R.F. Amplitude Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
85RF	R.F. Amplitude Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80TK	Temperature Module	•	•	•	•	•	•	•	•	•	•	•	(5)	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-150U	Temperature Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-SP	Temperature Probe	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8102	Temperature Probe	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8103	Temperature Probe	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8104	Temp Termination	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80K-6[14,15]	H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
80K-40[14]	H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(1)	•	(1)
Y8100[14]	Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(8)	•	(1)	•	(1)
Y8101[14]	Current Probe	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(8)	(3)	(3)	(3)	(3)
80i-400	Current Probe	(7)	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	(8)	—	—	—	—
80i-410	Current Probe	(10)	(10)	•	(10)	(10)	(10)	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	(8)	—	—	—	—
80i-600[14]	Current Probe	(7)	•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(8)	(3)	(3)	(3)	(3)
80i-1010	Current Probe	(10)	(10)	•	•	(10)	(10)	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	(8)	—	—	—	—
80i-kW	Current/Power Probe	(10)	(10)	•	•	(10)	(10)	•	•	•	•	•	•	•	•	•	•	—	—	•	•	•	(8)	—	—	—	—
LCA-10[15]	Line Current Test Adapter	—	•	•	•	•	•	•	•	•	—	—	—	•	—	—	—	—	—	•	—	•	—	—	—	—	—
Y9108	BNC Adapter	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	•	—
Y9109	BNC Adapter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	•
80J-10[14]	Current Shunt	•	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	•	•	•	(5)	•	•	•	(5)	•	(5)	•	•	•	•	(1)	•	(1)
A81[15]	Battery Eliminator	—	—	—	—	—	—	—	—	—	•	•	•	—	•	•	•	—	—	•	—	—	—	—	—	—	—

Fluke-Produced Accessory Selection Guide (continued)

Model Number	Item	Handheld															Bench/Portable					Bench/System				
		21	23	25, 27	73	75	77	83	85	87	8020B	8021B	8024B	8025B	8026B	8060A	8062A	8010A	8012A	37	8050A	45	8840 Series	8500 Series	8920A	8921A	8922A
C20	Hard Case	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C25	Soft Case	(6)	(6)	•	—	(6)	(6)	(6)	(6)	(6)	(9)	(9)	(9)	—	(9)	(9)	—	—	—	—	—	—	—	—	—	—	—
C40	Soft Case	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—
C50	Soft Case	•	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C70	Holster	•	(4)	—	•	•	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81G	Holster Grey	—	—	—	—	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C81Y	Holster Yellow	—	—	—	—	—	—	(4)	(4)	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C86	Hard Case	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	•	—	—	—	—	—	—
C90	Soft Case	(6)	(6)	—	—	(6)	(6)	—	—	—	•	•	•	—	•	•	•	—	—	—	—	—	—	—	—	—	—
C100	Hard Case	•	•	•	•	•	•	•	•	•	•	•	•	(4)	•	•	•	—	—	—	—	—	—	—	—	—	—
Y8205	Soft Case	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	•	—	•	—	—	—	—	—	—

- • *Means Compatible and recommended*
- — *Not compatible, not recommended, or not applicable*
- *(1) Y9109 Adapter required*
- *(2) On some ranges inputs must be shunted to equal 10 MΩ*
- *(3) Current-measuring option required or A90*
- *(4) Included with DMM*
- *(5) Feature of DMM alone*
- *(6) Accomodates DMM with Holster*
- *(7) Compatible, 320A maximum*
- *(8) Requires ac option for ac current*
- *(9) Loose fit*
- *(10) 1 amp resolution for ac current*
- *(11) Minimum specified accuracy is 10A for ac current*
- *(12) Minimum specifiied accuracy is 20A for ac current*
- *(13) Listed to UL Safety Standards UL 1244*
- *(14) Factory Mutual Approved*
- *(15) UL recognized*

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

**For additional accessories see Section 20*

5

Compatibilty Chart for Test Leads and Attachments

Test Leads	Test Probes and Clips									
	TP20	TP22	TP80	AC20	AC70	AC75	AC80	AC83	AC85	AC89
TL20 Set	Δ	•	•	Δ	–	–	•	•	•	•
TL22 Leads	•	•	•	•	–	–	•	•	•	•
TL24 Leads	•	•	•	•	–	–	•	•	•	•
TL26 Set	–	–	–	–	–	–	–	–	–	–
TL28 Set	–	–	–	–	–	–	–	–	–	–
TL70 Set	–	–	–	–	•	–	–	–	–	–
Y8131 Set	•	•	•	•	–	•	•	•	•	•
Y8132 Set	•	•	•	•	–	•	•	•	•	•
Y8133 Kit	•	•	•	•	–	Δ	•	•	•	•
Y8134 Kit	•	•	•	•	–	Δ	•	•	•	•
Y8140 Set	–	–	–	–	–	–	–	–	–	–

- • *Compatible and recommended*
- – *Not compatible, not recommended, or not applicable*
- Δ *Included with test lead set or kit*

Philips-Produced Accessories

Philips-Produced Accessory Selection Guide

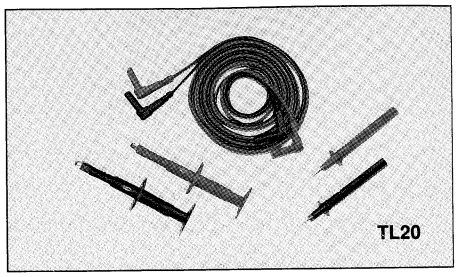
Model Number	Item	Handheld					Bench/System				
		PM 2504	PM 2505	PM 2518/02	PM 2618/02	PM 2718/02	PM 2525	PM 2528	PM 2534 PM 2535	PM 2544	PM 2554
PM 9260/00	Test Lead Set	(4)	(4)	–	–	–	•	–	–	–	–
PM 9264/01	4-Wire Test Lead	–	–	–	–	–	•	•	•	–	–
PM 9265/01	Screened Cable	–	–	–	–	–	–	•	•	–	–
PM 9266/03	Test Lead Set	–	–	(4)	(4)	(4)	(4)	(4)	(4)	–	–
PM 9210	HF Probe	•	•	•	•	•	•	–	•	•	–
PM 9211	Hold Probe	–	–	–	–	–	–	•	–	–	–
PM 9212	Accessory Set for PM 9210	•	•	•	•	•	•	–	•	•	–
PM 9213	Low Cost HF Probe	•	•	•	•	•	•	–	•	•	–
PM 9215/50	Logic View Probe	–	–	–	•	•	–	–	–	–	–
PM 9267/01	Hold Probe	–	–	•	•	•	•	–	•	–	–
PM 9263/01	Hold Probe	–	–	–	–	–	–	•	–	–	–
PM 9246/03	30 kV Probe	•	•	•	•	•	•	•	•	•	–
PM 9249/01	Temperature Probe	–	–	•	•	•	•	•	•	–	–
PM 9051	Adapter BNC(m)-Banana (f)	–	–	–	–	–	–	–	–	–	•
PM 9053	Adapter Banana(m)-BNC(f)	•	•	•	•	•	•	•	•	•	–
PM 9061	Adapter BNC(f)-BNC(f)	–	–	–	–	–	–	–	–	–	•
PM 9067	T-Piece BNC (1 x m, 2 x f)	–	–	–	–	–	–	–	–	–	•
PM 9218A/xxx (16)	Power Line Adapter (110V)	•	–	•	•	•	–	–	–	–	–
PM 9111/01	Power Line Adapter (220V)	–	•	–	–	–	–	–	–	–	–
PM 9244	30A Shunt	•	•	•	•	•	•	•	•	•	–
PM 9245	100A Transformer	•	•	•	•	•	•	•	•	•	–
PM 9278/02	Hard Case	–	•	•	•	•	–	–	–	–	–
PM 9279/01	Hard Case	–	–	–	–	–	–	–	–	•	–
PM 9877 J/2	Thermocouple Module J-type	–	–	–	–	–	•	–	•	–	–
PM 9877 K/2	Thermocouple Module K-type	–	–	–	–	–	•	–	•	–	–
PM 9071	Banana-Banana 135 Ohm	•	•	•	•	•	•	•	•	•	–
PM 9072	Banana-BNC 135 Ohm	–	–	–	–	–	–	–	–	–	•
PM 9074	BNC-BNC 50 Ohm	–	–	–	–	–	–	–	–	–	•
PM 9075	BNC-BNC 75 Ohm	–	–	–	–	–	–	–	–	–	•
PM 9190/01	RS-232 Interface	–	–	–	–	–	–	–	•	–	–
PM 9193/01	Analog Out	–	–	–	–	–	–	–	•	–	–
PM 9280/02	Rackmount	–	–	–	–	–	–	–	•	–	–
HM 9606/00 (17)	19" Kit for 1x Counter + 1x Meter	–	–	–	–	–	•	–	•	–	–
HM 9606/02 (17)	19" Kit for 1x Meter	–	–	–	–	–	•	–	•	–	–
PM 2193/01	3E Rackmount Kit	–	–	–	–	–	•	–	–	–	–

- • *Means compatible and recommended*
- – *Not compatible, not recommended, or not applicable*

(4) Included with DMM

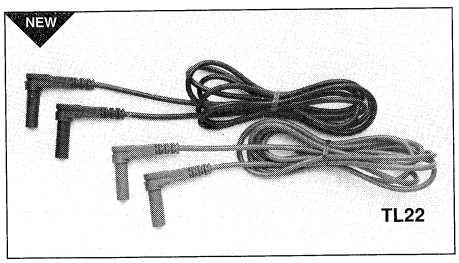
(16) xx = 013 for 110V/xxx = 011 for 220V/xxx = 014 for 240V

(17) North America only



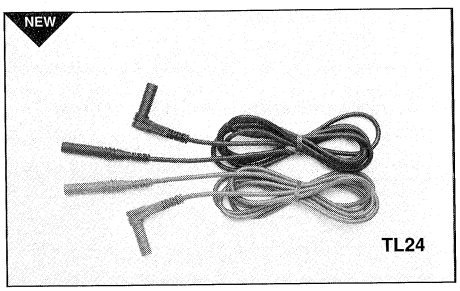
TL20 Industrial Test Lead Set

Set consists of TL22 sixty-three inch silicon insulated test leads that remain flexible from -100°C to 300°C (-148°F to 572°F). Leads have shrouded right-angle connections. Also includes TP20 interchangeable stainless steel test probes and AC20 safety alligator clips. See Selection Guide for compatible DMMs.



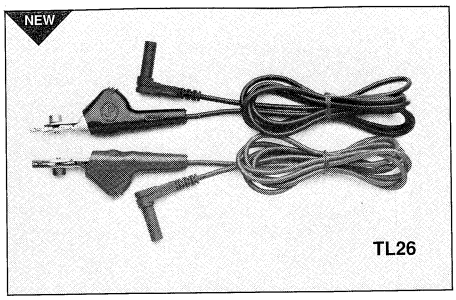
TL22 Flexible Test Leads

Heat-resistant, silicone-rubber insulation, usable from -100°C to +300°C (-148°F to 572°F). Extreme flexibility combined with superior strain relief. Extra-long length of 63" (1.6m) and shrouded right-angle connectors on both ends. Set of one red and one black. Compatible with all DMMs that accept safety-shrouded inputs.



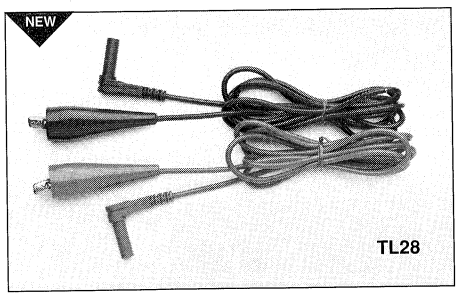
TL24 Flexible Test Leads - Straight

Same as TL22s except that one end has a shrouded, straight connector. Set of one red and one black.



TL26 5-Way Multipoint Test Lead Set

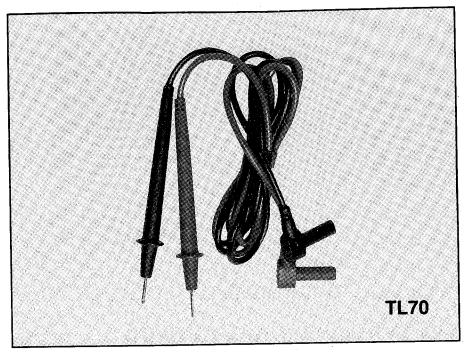
Industry-standard test lead set for telecom and automotive applications. The multi-purpose test clip on these test leads allows 5-ways to connect to a device under test. 1) Has a U-shaped nose for blade-shaped terminals. 2) Notched jaw for gripping screw heads, bare wire, or terminals. 3) Serated teeth for gripping threaded or wire-wrapped terminals. 4) Cluster of sharp needles for piercing small guage (#22-28 AWG) wires. 5) Large piercing needle for penetrating larger guage wires. Set of one red and one black. Rated for 250V and 10A. Silicone-rubber insulated test leads are heat-resistant and remain flexible from -100°C to +300°C (-148°F to 572°C). Length of leads is 60" (1.52m). Right angle banana plug on one end is compatible with all DMMs that accept safety-shrouded inputs.



TL28 2-Way Clip Test Lead Set

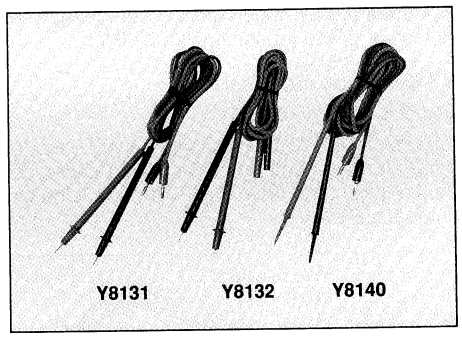
These test leads have solid, spring-loaded copper clips with a wide 1/2" jaw opening and serated teeth for gripping threaded or wire-wrapped terminals. Also has a large piercing needle for penetrating larger guage wires. Rated for 250V and 10A. Recommended for use with automotive, marine, aviation, and low-voltage industrial circuits. Set of one red and one black. Silicone-rubber insulated test leads are heat-resistant and remain flexible from -100°C to +300°C (-148°C to 572°C). 60" (1.52m) test lead length.

Shrouded right-angle connector on one end is compatible with all DMMs that accept safety-shrouded inputs.



TL70[1] Test Lead Set

Safety-designed right angle test leads with safety-shrouded banana plugs. Strain relief where wire joins probes. 48" (1.2m) long. Maximum voltage of 1500V, maximum current of 10A. Set of one red and one black. Compatible with all DMMs that accept safety-shrouded inputs. Compatible with AC70 Alligator Clips.



Y8131 Replacement Test Lead Set

Four-foot (1.2m) test leads feature exposed banana plugs on one end and detachable probes with solid pin tips and finger guards on other end. Maximum voltage of 2000V, maximum current of 10A. Compatible with AC75 Alligator Clips. See Selection Guide for compatible DMMs.

Y8132[1] Replacement Test Lead Set

Same as Y8131 except straight, shrouded banana plugs are on both ends. See Selection Guide for compatible DMMs.

Y8140[2] Test Lead Set

Slim, retractable, insulated, needle-point tips adjust to desired length. Tough, thin insulation extends all the way to the points to prevent shorting adjacent components or conductors. Needle points easily pierce varnish and thin insulation to give good electrical contact. Four-feet (1.2m) long. Exposed banana plugs. Maximum voltage of 1000V, maximum current of 2A. See Selection Guide for compatible DMMs.

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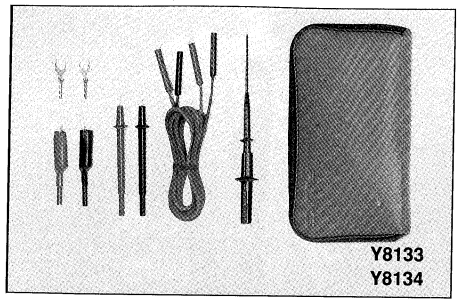
[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*

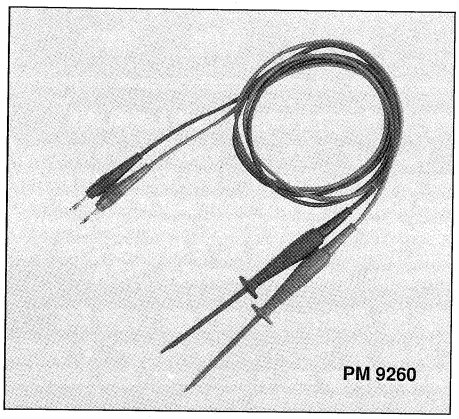


Y8133 Standard Test Lead Kit

Y8133 includes a black and a red insulated wire lead each having an exposed banana plug on one end and a safety-designed, shrouded banana plug on the other. Leads have strain relief for long life. Also included are two insulated alligator clips, two spade lug tips, a spring-loaded hook tip, and two probes with solid metal pin tips, finger guards, and pouch. Any of the clips, tips, and probes may be plugged onto the shrouded banana plug on either wire lead. See Selection Guide for compatible DMMs.

Y8134 Shrouded Test Lead Kit (Shown)

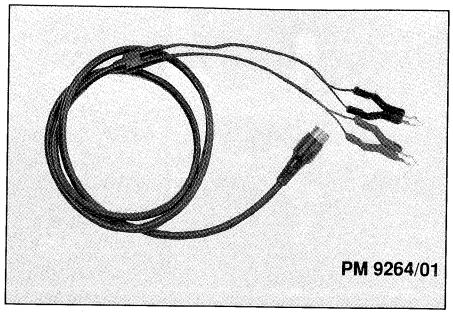
Same as Y8133 Test Lead Kit except banana plugs are shrouded by an insulating shield on both ends of each lead. See Selection Guide for compatible DMMs.



PM 9260/00 Test Lead Set

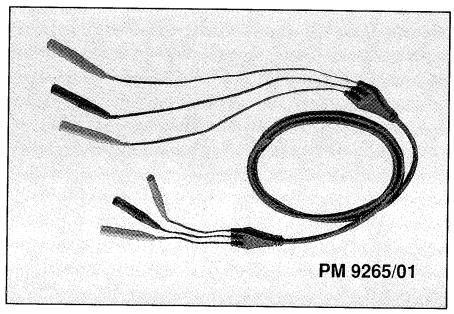
Three-foot (1m) test leads feature exposed banana plugs on one end and detachable probes with solid pin tips and finger guards on other end. See Selection Guide for compatible DMMs.

[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*



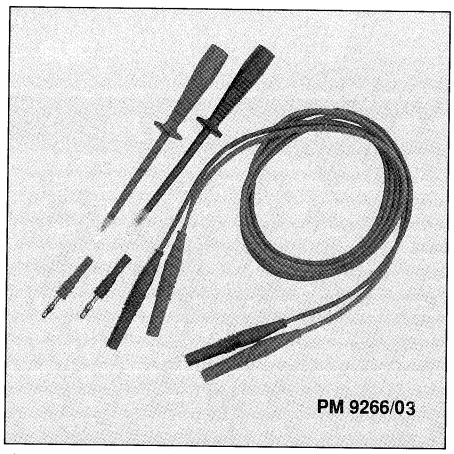
PM 9264/01 4-Wire Test Leads/Clips

4-wire test lead for resistance measurements. One side with 5-pole DIN connector and one side with Kelvin clips. See Selection Guide for compatible DMMs.



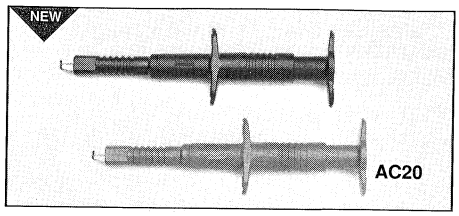
PM 9265/01 Shielded 3-Wire Test Lead

Safety-designed, shielded 3-wire test lead 3 feet (1m) long. See Selection Guide for compatible DMMs.



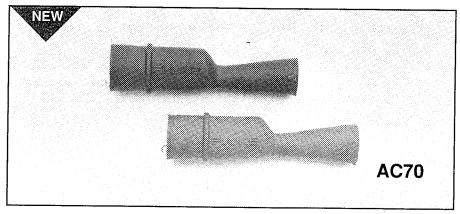
PM 9266/03 Test Lead Set

Three-foot safety designed silicon insulated test leads (UL-Approved) with detachable probes and adapters to "non-safety" 4 mm banana plugs. See Selection Guide for compatible DMMs.



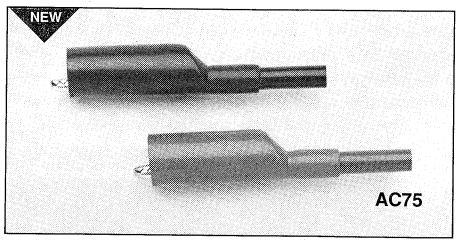
AC20 Industrial Test Clips

Safety-designed, spring-loaded alligator clips with a wide 3/4" (19 mm) jaw opening. Maximum voltage of 1000V, maximum current of 10A. Easy to use while wearing high-voltage gloves. Set of one red and one black. Recommended for use with TL22 test leads. Compatible with all right-angle test leads having standard .160" (4 mm) diameter banana plugs, with or without safety shrouding.



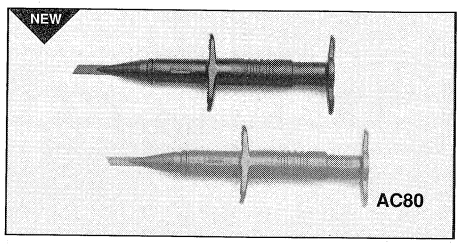
AC70 Alligator Clips

Package of four slip-on, insulated alligator clips. Maximum voltage of 1000V, maximum current of 10A. Two red and two black. Compatible with TL70 or other standard .080" (2mm) diameter pin-tip size probes.



AC75 Banana Jack - Alligator Clips

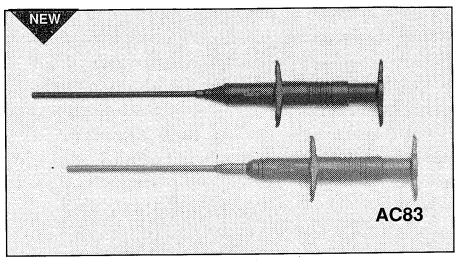
Package of four, insulated, alligator clips with banana jacks. Standard 5/16" (8 mm) jaw opening. Two red and two black. Compatible with test leads Y8131 through Y8134.



AC80 Hook-Style Test Clips

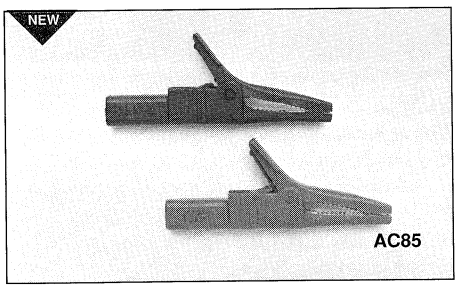
Set of safety-designed, spring-loaded clips

with hook grip. Hook size is .400" x .080" (10 mm x 2 mm). Maximum voltage of 1000V, maximum current of 3A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.



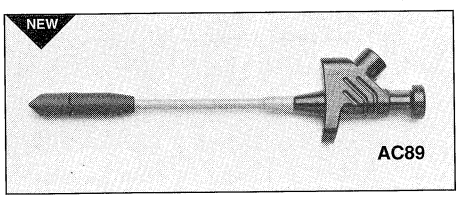
AC83 Pin-Grabber Test Clips

Spring-loaded, pin-grabber hooks for use with test points in close contact areas. Shaft length is 4" (100 mm) and grabber extends 3/8" (9.5 mm). Maximum voltage of 1000V, maximum current of 1A. Set of one red and one black. Banana jack compatible with all test leads having standard diameter banana plugs, with or without shrouding.



AC85 Large Jaw Alligator Clips

Fully insulated, banana jack - alligator clips. Recommended for use with automotive, marine, aviation, and low-voltage industrial circuits. Large 3/4" (19 mm) jaw opening. Maximum voltage of 250V, maximum current of 10A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without shrouding.

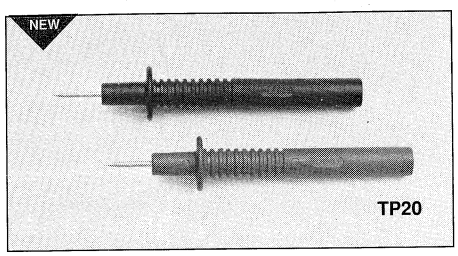


AC89 Insulation Piercing Clip

Pierces insulated wires for otherwise inaccessible test points. Clamp-type test clip has spring-loaded stainless steel tip. Pierces insulated wires from 30 AWG (.25 mm²) to 14 AWG (1.5 mm²).

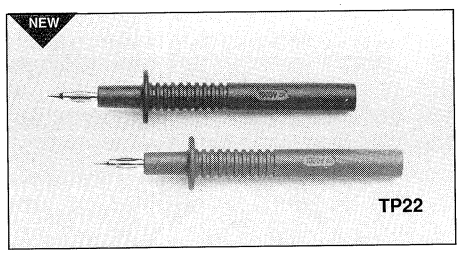
[1] Listed to UL Safety Standards UL1244
[2] Factory Mutual Approved
[3] UL recognized

Maximum voltage of 250V, maximum current of 5A. Recommended for use with test leads having shrouded, standard diameter banana plugs.



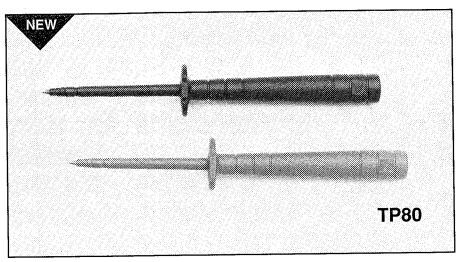
TP20 Industrial Test Probes

Safety-designed, test probe with very sharp, extra-long, stainless steel tip for reaching deep test points or recessed component leads. Also suitable for piercing insulation. Finger guard protection. Maximum voltage of 1000V, and maximum current of 10A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.



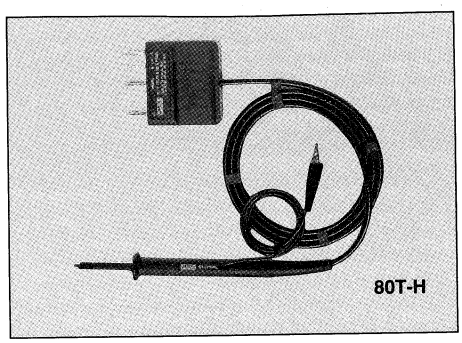
TP22 Banana Plug - Test Probes

4 mm, safety-designed, plug-on, test probes. Test probe tip can be plugged into a standard diameter banana jack. Maximum voltage of 1000V, maximum current of 10A. Finger guard protection. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.



TP80 Electronic Test Probes

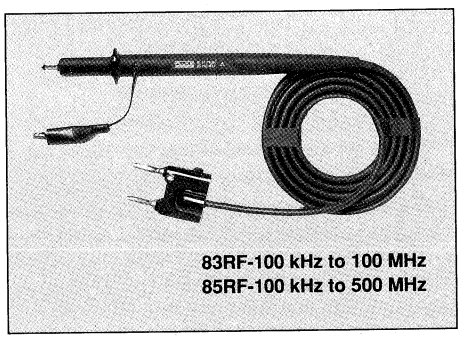
Designed for electronic probing of high density components or boards. IC insulator cap prevents shorting of adjacent IC legs. Test probe has a tapered .160" (4 mm) steel tip. Maximum voltage of 1000V, maximum current of 10A. Set of one red and one black. Compatible with all test leads having standard diameter banana plugs, with or without safety shrouding.



80T-H Touch-Hold Probe

The 80T-H is a direct signal-through test probe with a touch and hold feature. Touch-and-hold allows voltage or resistance readings to be held on a digital multimeter display following contact of the probe tip with the test point. Operator can devote full attention to manipulating the probe until the measurement is complete, then remove the probe and observe the reading on the DMM. Activation of a pushbutton on the probe causes the DMM to hold the last number displayed until the pushbutton is released. Works with 8010A, 8012A, 8050A only.

Voltage Rating
Tip to Common: 1000V dc or peak ac maximum
Common to Ground: 60V dc or 42V peak ac maximum
Input Capacitance: 150 pF maximum
Lead Resistance: 0.58Ω maximum



83RF[2] High Frequency Probe

The 83RF converts a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 100 MHz, ac voltmeter. Conversion from ac to dc is on a one-to-one basis over a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±1 dB above 1V; ±1.5 dB below 1V (at 1 MHz with 10 MΩ load)
Frequency Response: ±1 dB 100 kHz to 100 MHz (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 250 MHz

5

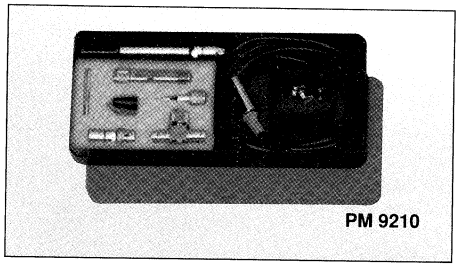
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

85RF[2] High Frequency Probe

The 85RF is designed to convert a 10 megohm input resistance dc voltmeter into a high frequency, 100 kHz to 500 MHz, ac voltmeter. Ac to dc conversion ratio is one-to-one over a range of 0.25 to 30V rms. The probes dc output is calibrated to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±0.5 dB above 0.5V (at 1 MHz with 10 MΩ load) ±1 dB below 0.5V
Frequency Response: ±0.5 dB 100 kHz to 100 MHz; ±1.0 dB 100 MHz to 200 MHz;* ±3.0 dB 200 MHz to 500 MHz* (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 700 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sine wave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

**Referred to high and low inputs at probe tip*


PM 9210

PM 9210 High Frequency Probe
PM 9212 Accessory Kit

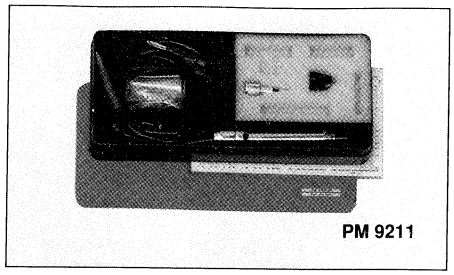
The PM 9210 converts a DMM input into a high frequency 100 kHz to 1 GHz ac voltmeter.

PM 9212 accessory set for PM 9210. Includes attenuator, T-piece and terminator

Specifications	PM 9210	PM 9210 w/PM 9212
Frequency Range	100 kHz-1 GHz	100 kHz-1 GHz
Straight Line Within 5%	100 kHz-6 MHz	100 kHz-6 MHz
Maximum Deviation	3 dB	3.5 dB
Voltage Ranges (f.s.)	150 mV-15V*	15V-200V
Maximum Voltage AC	30V	200V
Maximum Voltage DC	200V	500V
Input Capacitance	2 pF	2 pF
T-Piece	Optional	Included
Frequency Range		1.25 at 700 MHz 1.15 at 1 GHz (with Attenuator)

**Not available in North America*

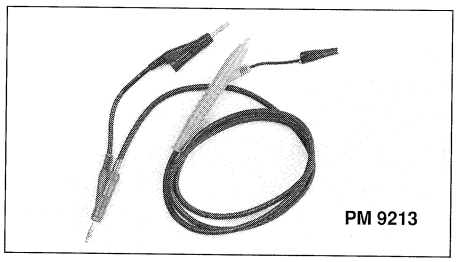
[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*


PM 9211

PM 9211 High Frequency Probe

The PM 9211 converts the DMM input of a PM 2528 into a high frequency 10 kHz...1 GHz AC voltmeter. See Selection Guide for compatible DMMs.

Specifications	PM 9211	PM 9211 w/Atten.
Frequency Range	10 kHz-1 GHz	10 kHz-1 GHz
Straight Line Within 5%	100 kHz-6 MHz	100 kHz-6 MHz
Maximum Deviation	3 dB	3.5 dB
Voltage Ranges (f.s.)	2 mV-2V	2V-200V
Maximum Voltage AC	30V	200V
Maximum Voltage DC	200V	500V
Input Capacitance	2 pF	2 pF
T-Piece	Included	
Frequency Range	1.25 at 700 MHz	1.15 at 1 GHz


PM 9213

PM 9213 Low Cost HF Probe

The PM 9213 converts the input of a DMM into an ac voltmeter. See Selection Guide for compatible DMMs.

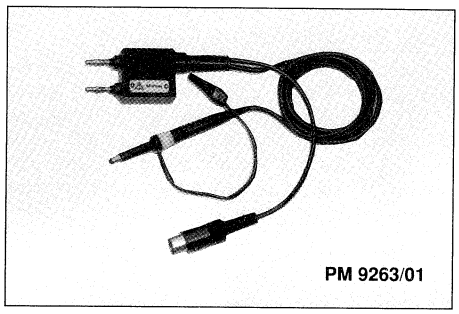
Frequency Range	10kHz - 100 MHz
Straight Line Within 5%	30 kHz - 30 MHz
Maximum Deviation	3 dB
Voltage Ranges (f.s.)	10 mV - 15V
Maximum Voltage AC	30V
Maximum Voltage DC	350V
Input Capacitance	40 pF

PM 9215/50 10 MHz Logic Probe

The PM 9215/50 is a passive probe without signal attenuation for use with the logic view function of the PM 2618 and PM 2718. The probe gives the full 10 MHz capability in the logic view function without signal distortion and reflection. The PM 9215/50 can also be used as a shielded probe in other functions of the PM 2618 and PM 2718 (Vac, Vdc, Hz).

Attenuation: 1x
Input Impedance (probe + instrument)
Logic View: 2 MΩ//<100 pF
Other Functions: Instrument impedance //47 pF
Probe Series Resistance: <200Ω

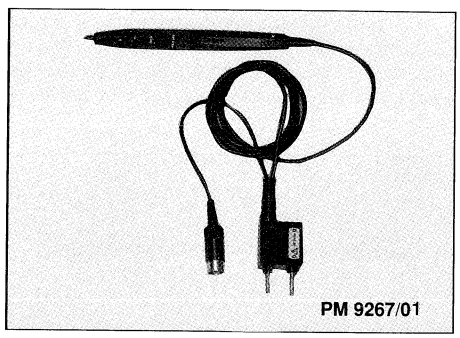
Max Input Voltage
Low to Ground: <42V dc
High to Ground: <130V (dc or ac rms)
Operating Conditions: In accordance with IEC 359
Rated Range of Use: 0°C to +55°C
Relative Humidity (excl condensation): 20% to 80%
Limit Range of Storage and Transport: -40°C to +70°C


PM 9263/01

PM 9263/01 Data Hold Probe

The PM 9263/01 is a data hold probe for the PM 2528 DMM. It offers the possibility to "freeze" the display if a correct measurement is performed.

Maximum Input Voltage: 30 kV rms
Input Resistance: 130Ω
Input Capacitance: 300 pF
Rated range of Use: -10...+55°C
Storage and transport: -25...+70°C
Humidity Operating Limits: 10...80%
Maximum Dew Point: +25°C

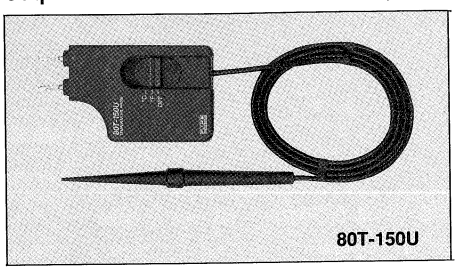

PM 9267/01

PM 9267/01 Data Hold Probe

The PM 9267/01 is a data hold probe for the PM 2518, PM 2618 and PM 2718 DMMs. It offers the possibility to "freeze" the display if a correct measurement is performed.

Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%

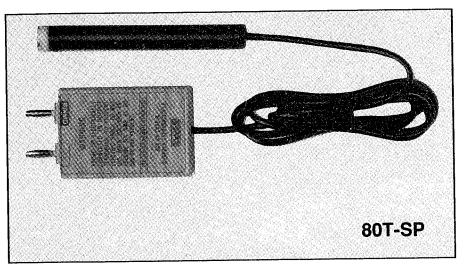
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug



80T-150U Temperature Probe

The 80T-150 is a universal temperature probe designed to provide virtually all DMMs withtemperature measuring capability. Intended for air, surface, and non-corrosive liquids, the probe provides direct temperature conversion of 1 mV dc per degree. A three-position switch on the unit acts as a power switch and is used for selecting Celsius or Fahrenheit scaling for the output. In addition, the OFF position of the power switch allows the battery condition to be determined via the external DMM. Operating power for the 80T-150U is derived from a standard 9 volt battery. Typically, the battery provides more than 1600 hours of continuous operation before replacement is necessary. An outstanding feature of particular importance to electronically-oriented users is the probe's ability to stand off voltages to 350V dc or peak ac. This allows voltages to be present on devices whose temperature is being measured. Resolution is 0.1° on the 200 mV range of a 3-digit DMM. Most accurate DMM temperature probe system.

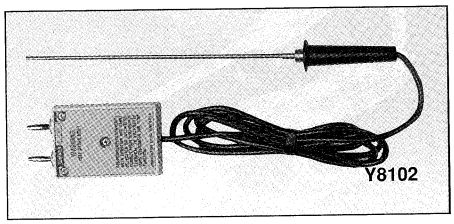
Temperature Range: -50°C to +150°C or -58°F to +302°F, cable 70°C maximum
Celsius-Fahrenheit Selection: Switch selected
Sensitivity: 1 mV per °C or °F
Resolution: 0.1°C or 0.1°F recommended max
Ambient Temperature Range for Unit: 0°C to +50°C
Relative Humidity: 90%, non-condensing from 0°C to 35°C
Accuracy: (Including nominal 0.25% voltmeter error, in +15°C to +35°C ambient). ±1°C (1.8°F) 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C



80T-SP Type K Surface Thermocouple

For use with 8024A and 8024B for measuring the temperature of flat or slightly convex surfaces.

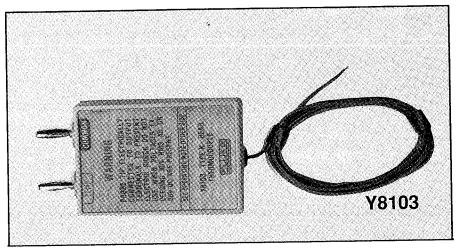
Time Constant: 4 seconds typical on metal surface; 15 seconds max for a 260°C change
Range: 0°C to 260°C, handle and cable 105°C maximum
Accuracy: ±2.2°C from 0°C to 260°C (with respect to NBS thermocouple tables). Also depends on good contact between the tip and the surface to be measured.
Probe Diameter: 12.5 mm (.5 in)
Probe Length: 9.4 cm (3.75 in)
Conductor Length: 1.12m (48 in)



Y8102 Type K Thermocouple Probe

Designed for use with Fluke 8024A and 8024B Digital Voltmeter. Sheath material is Inconel, especially good for liquid immersion measurements.

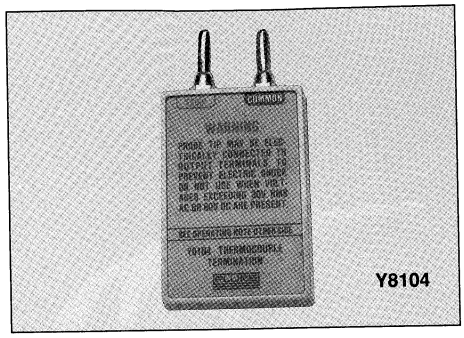
Time Constant: 10 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to 926°C (32°F to 1700°F)
Accuracy: ±2.2°C from 0°C to 276.7°C and ±0.75% of reading from 276.7°C to 926°C
Probe Diameter: 3.18 mm (0.125 inch)
Probe Length: 15.2 cm (6 inches)
Conductor Length: 1.12 meters (48 inches)



Y8103 Type K Bead Thermocouple

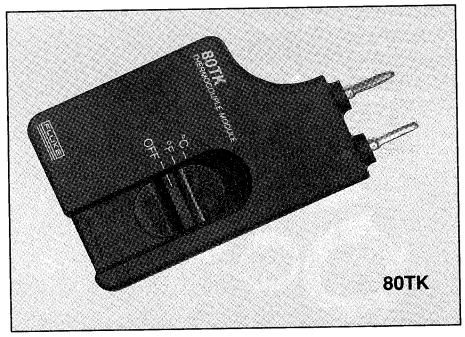
For use with 8024A and 8024B in any application except liquid immersion or penetration. Exposed tip provides fast response. Teflon insulation. Four feet.

Time Constant: 2 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to +260°C (32°F to +500°F)
Accuracy: ±2.2°C from 0°C to +260°C
Useable Range: To -40°C (-40°F)



Y8104 Thermocouple Termination

The Model Y8104 Thermocouple Termination provides isothermal termination for any Type K thermocouple wire connected to 8024A and 8024B. The isothermal nature of the Y8104 ensures that there is no temperature difference between the junctions created by the instrument and the connection of the thermocouple to the terminals. Maximum wire size is #14 AWG.



80TK Thermocouple Module

The Fluke 80TK Thermocouple Module is a low cost temperature measurement accessory designed to work with any digital multimeter. It converts the microvolt output from a "K" type thermocouple into a 1 millivolt per degree signal.

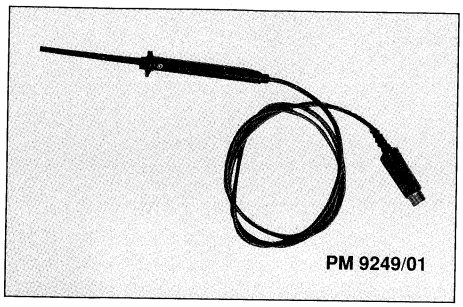
The on-off switch allows selection of degrees "C" or "F" output scaling. Input is via a "mini" thermocouple connector, with provision inside for hardwiring. **A bead thermocouple, with miniconnector attached, is included with the 80TK.** Immersion probes and surface probes are also available, as are additional bead probes.

The output of the 80TK may be read on any DMM having 10 Mohm or greater input impedance and a 3-digit display. It is powered by a standard 9V battery, with a typical operating life of 1600 hours. Battery condition can be checked on the DMM with battery test instructions printed on the 80TK.

Measurement Range: -50°C to 1000°C (-58°F to 1832°F)
Ambient Operating Range: 0°C to 50°C, 32°F to 122°F

Accuracy

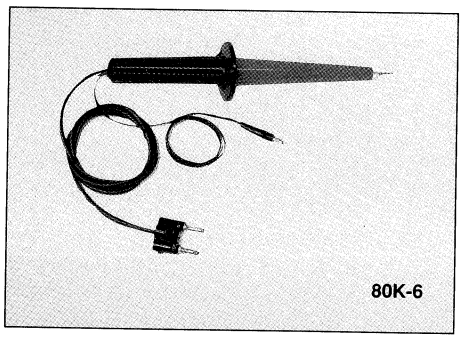
-50°C to -20°C 2.5% ±2°C -58°F to -5.8°F 2.5% ±3.6°F	350°C to 500°C 1.75% ±2°C 665°F to 932°F 1.75% ±3.6°F
-20°C to 350°C 0.5% ±2°C -4°F to 662°F 0.5% ±3.6°F	500°C to 1000°C 2.0%±2°C 933°F to 1832°F 2.0% ±3.6°F



PM 9249/01 Temperature Probe

The PM 9249/01 is a temperature probe for the PM 2518, PM 2618, PM 2718, PM 2525, PM 2528, PM 2534 and PM 2535. The probe contains a PT 100 element and gives the temperature in degrees Celcius with a high accuracy.

Application: Surface and liquids
Temperature Range: -60°C to 200°C
Resolution: 0.1°C
Accuracy (excl DMM): ±0.5%
Connector: 5-pole DIN (180°)

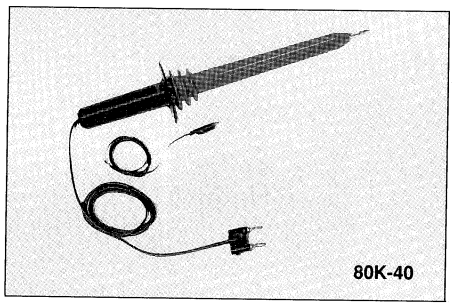


80K-6[2,3] High Voltage Probe

The 80K-6 extends the voltage measuring capability of an ac/dc voltmeter up to 6000 volts. A 1000:1 voltage divider provides a high input impedance. High accuracy is provided when the divider is used with a voltmeter having a 10 MΩ input impedance. A molded plastic body houses the divider and protects user from voltage being measured.

Voltage Range: 0 to 6 kV, dc or peak ac
Input Impedance: 75 MΩ, nominal
Division Ratio: 1000:1
Accuracy: DC to 500 Hz, ±1%; 500 Hz to 1 kHz, ±2%

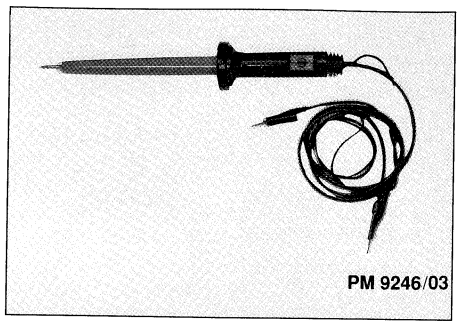
Above 1 kHz: Output reading falls; typically, -30% at 10 kHz
DVM Compatibility: The 80K-6 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electric utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.



80K-40[2] High Voltage Probe

The Model 80K-40 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 40,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

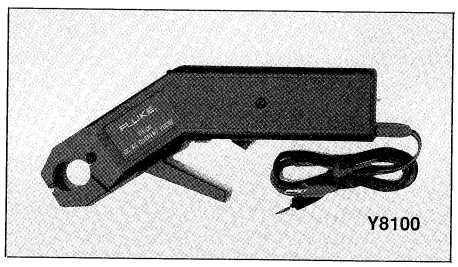
Voltage Range: 1 kV to 40 kV dc or peak ac, 28 kV rms ac
Input Resistance: 1000 MΩ
Division Ratio: 1000:1
DC Accuracy: ±2% from 20 kV to 30 kV (calibrated 1% at 25 kV); changes linearly from 2% at 30 kV to 4% at 40 kV and from 2% at 20 kV to 4% at 1 kV
AC Accuracy: ±5% at 60 Hz
DVM Compatibility: The 80K-40 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electrical utility applications in which high voltage is also accompanied by high energy. They are also not intended for use on 3 phase line-to-line measurements. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.



PM 9246/03 High Voltage Probe

The PM 9246/03 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 30,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

Maximum Input Voltage: 30 kV
Attenuation: x1000
Input Impedance: 600 MΩ ±1%
Accuracy: ±2%
Temperature Coefficient: ±200 ppm/°C
Voltage Coefficient: ±0.5 ppm/V
Input Impedance Meter: 10 MΩ, 100 MΩ or 1.2 MΩ
Output Connectors: 2 x 4 mm banana plug



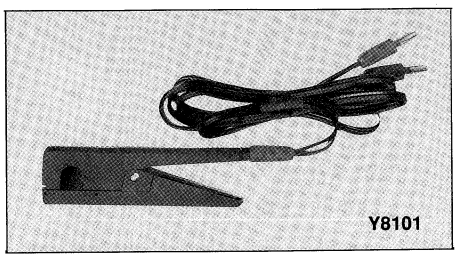
Y8100[2] Clamp-on DC or AC Current Probe

The Model Y8100 is a clamp-on, Hall-effect probe that can be used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac/dc) current measurements. The pistol shape allows safe, easy, one-hand operation when making current measurements. Two ranges, 20A and 200A, produce a 2V output at full range current. The probe battery-low indicator light lets the operator know when the battery voltage is too low for proper operation.

Ranges: 20A ac or dc and 200A ac or dc
Accuracy: DC to 200 Hz, ±2% of range; 200 Hz to 1 kHz, 1-100A add ±3% of reading; 200 Hz to 1 kHz, 2-100A add ±6% of reading

[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*

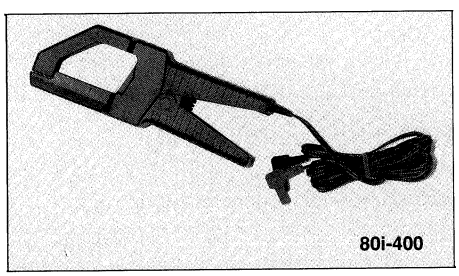
Working Voltage: Core to output; 600V dc or 480V ac maximum; output to ground; 42V dc or 30V ac maximum
Maximum Conductor Size: 1.9 cm (.75 in)



Y8101[2] Clamp-on AC Current Probe

The Y8101 is a small clamp-on current transformer designed to extend the current measuring capability of a DMM or ac current meter up to 150 amperes. The coil on the clamp-on core serves as the secondary of a 1000:1 ratio transformer. The current-carrying conductor being measured serves as the primary.

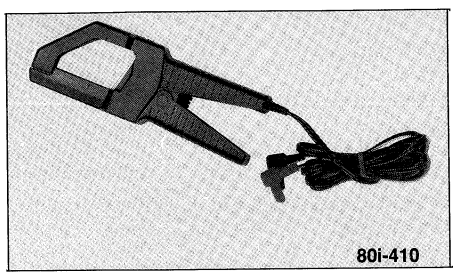
Current Range: 1A to 150A
Accuracy: ±(2.5% of reading + 0.15A), 48 Hz to 440 Hz; ±(3% of reading + 0.15A), 440 Hz to 1200 Hz
Division Ratio: 1000:1
Working Voltage: 300V ac rms maximum
Maximum Conductor Size: 1.11 cm (0.43 in)
Usable Current Range: 0.1A to 200A, 5 seconds maximum above 150A



80i-400 Clamp-on AC Current Probe

The Model 80i-400 is a clamp-on current probe designed to extend the current capability of an ac current meter to 400 amperes. A clamp-on, 1000- turn coil designed into the probe allows measurements to be made without breaking the circuit under test. The current carrying conductor being measured serves as the primary. The unique shape of the 80i-400 jaw will accommodate a single 750 MCM THHN (30 mm diameter) conductor or two 500 MCM THHN (25 mm diameter each) conductors run in parallel.

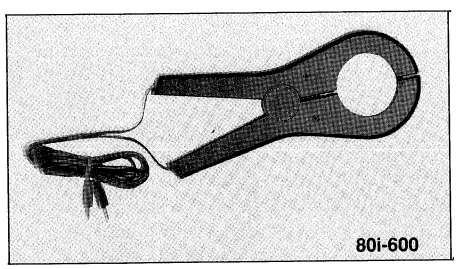
Current Range: 1A to 400A
Accuracy: ±(3% of reading +0.4A), 48 Hz to 440 Hz; ±(4% of reading +0.4A), 440 Hz to 1000 Hz
Division Ratio: 1000:1
Working Voltage: 660V ac rms maximum
Maximum Conductor Size: 1 ea 30 mm (1.18 in) or 2 ea 25 mm (0.98 in)
Usable Current Range: 0.1A to 600A, 5 seconds maximum above 400A



80i-410 Clamp-on DC/AC Current Probe

The Model 80i-410 ac/dc current probe extends the ac or dc capacity to 400 amps. This Hall-effect probe is relatively insensitive to conductor position within the jaws for good repeatability. Physical dimensions are identical to 80i-400 and will accommodate similar conductors. Output signal 1 mV per amp.

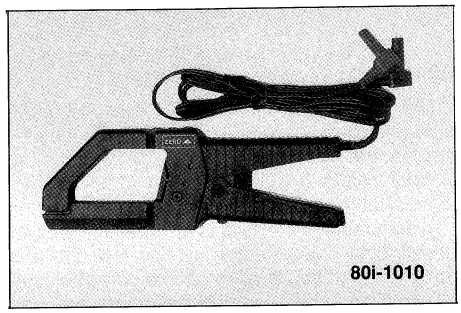
Specified Current Range: 5A to 400A ac or dc
Usable Current Range: 2A to 600A ac or dc
Accuracy: ±(5% + 2.5A) dc to 62 Hz
Working Voltage: 660V rms
Maximum Conductor Size: 1 ea 30 mm (1.18 in) or 2 ea 25 mm (0.98 in)



80i-600[2] Clamp-on AC Current Probe

The Model 80i-600 is a clamp-on current transformer designed to extend the current measuring capability of a DMM or current meter to 600 amperes. A coil on the clamp-on transformer core allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1000:1 transformer. The current-carrying conductor being measured serves as the primary. Because of a high efficiency, evenly distributed winding, wire size and location of the wire within the transformer jaws will not affect the accuracy of current measurements.

Current Range: 1A to 600A
Accuracy: ±(2% of reading), 50 Hz to 1 kHz; ±(3% of reading) typical, 30 Hz to 50 Hz or 1 kHz to 10 kHz
Division Ratio: 1000:1
Working Voltage: 750V ac rms maximum
Maximum Conductor Size: 5 cm (2 in)
Usable Current Range: 0.1A to 2000A, 5 seconds maximum above 600A



80i-1010 Clamp-on DC/AC Current Probe

The 80i-600 is a battery powered clamp-on current probe that is used with a voltmeter to measure dc currents up to 1000 amps or ac currents up to 700 amps. The jaws will accommodate a single 750 MCM THHN or two 500 MCM THHN conductors. A convenient thumbwheel ZERO control improves accuracy of dc currents down to 1 amp. Typical frequency response is -3 dB at 6 kHz.

Specified Current Range: 1A to 1000A dc, 1A to 700A ac
Accuracy: (% of reading)

Range	DC	AC, 48 to 62 Hz	AC, 62 to 440 Hz
1A to 100A	2% + 1A	2% + 1A	3% + 1A
100A to 700A	3%	3%	5%
700A to 1000A	5%	Not specified	

Output Signal: 1 mV per amp dc or ac
Working Voltage: 660V rms maximum
Maximum Conductor Size: 1 ea 30 mm (1.18 in) or 2 ea 25 mm (0.98 in)

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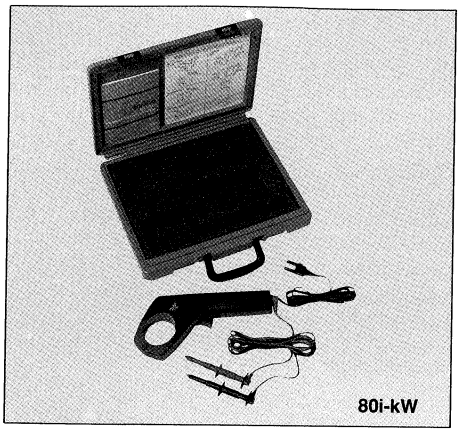
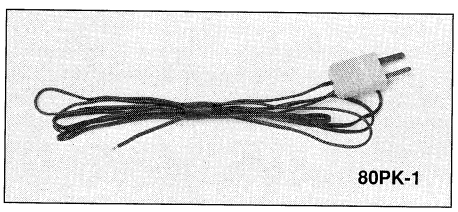
[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*



80i-kW Current/Power Probe

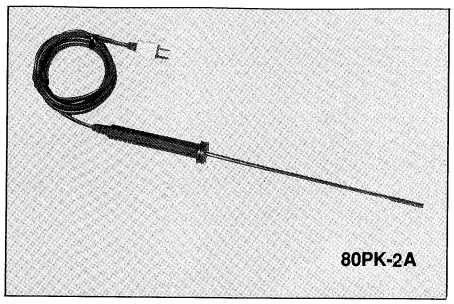
The 80i-kW Current/Power Probe is a battery powered clamp-on probe. Used with a voltmeter to measure dc current from 1 to 1300 amps, ac current from 1 to 1000 amps and ac power from .5 to 330 kW. Includes carrying case, test leads and manual with instructions for measuring power and finding power factor for single phase and three phase circuits. Compatible with multimeters that accept Fluke safety designed shrouded test leads.

Basic Accuracy: ± (2% + 2 amps) for current; ± (3.5% + .5kW) for power
Jaw Size: 60 mm ($2^3/_8$ in) x 73 mm ($2^7/_8$)



80PK-1 K-Type Bead Probe

Accuracy (with respect to NBS tables): ±1.1°C (2.0°F) over the range of 0°C to 260°C (32°F to 500°F); typically within 1.1°C of NBS tables over the range of -40°C to 0°C (-40°F to 32°F)
Restrictions: Must be used in Teflon-compatible environments and is not suitable for liquid immersion. The 260°C (500°F) continuous temperature rating is primarily determined by the Teflon insulation.



80PK-2A K-Type Immersion Probe

Accuracy: (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 1090°C (559°F to 1922°F)	±.0.75% of Rdg

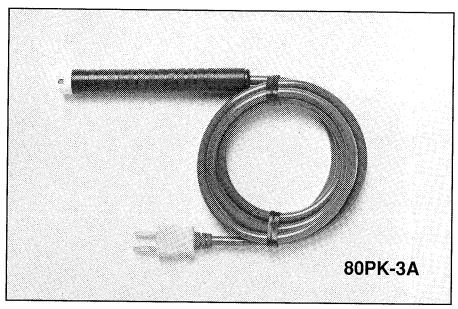
Restrictions: The sheath material of the 80PK-2A is Inconel. It should not be used in the presence of sulfur above 537°C (1000°F).

80PK-4A K-Type Air Probe

Accuracy (with respect to NBS tables)

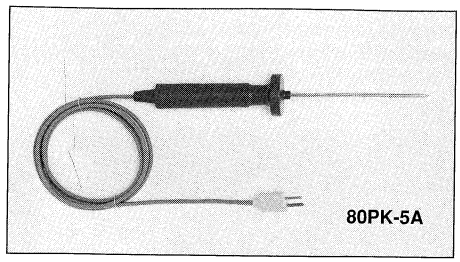
Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 816°C (559°F to 1598°F)	±.0.75% of Rdg

Restrictions: The 304 stainless steel baffle should not be exposed to halides or sulfides.



80PK-3A K-Type Surface Probe

Accuracy (with respect to NBS tables): ±1.1°C (2.0°F) over the range of -28°C to +260°C (-18.4°F to 500°F)
Restrictions: The 260°C continuous temperature rating is primarily determined by the Teflon support piece. The Teflon insulation should not be exposed to temperatures exceeding 260°C (500°F) nor to open flame, since this can cause release of toxic material.

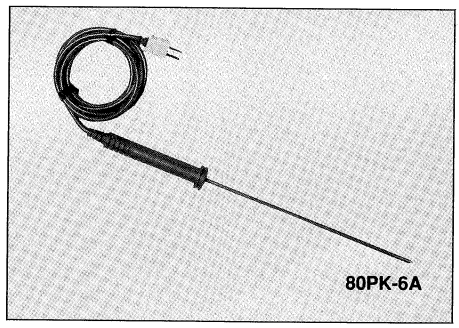


80PK-5A K-Type Piercing Probe

Accuracy (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 816°C (559°F to 1500°F)	±.0.75% of Rdg

Restrictions: The sheath material of the 80PK-5 is 316 stainless steel. It should not be exposed to halides or sulfides.



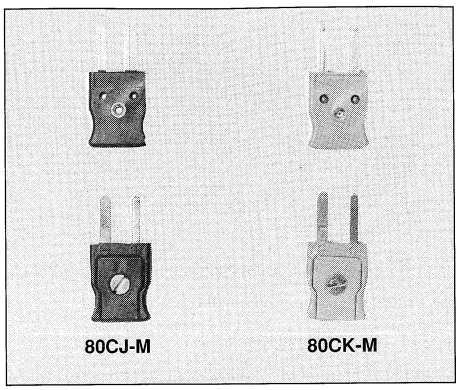
80PK-6A K-Type Exposed Junction Probe

Accuracy (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	±4% of Rdg
-110°C to -40°C (-166°F to -40°F)	±4.4°C (7.92°F)
-40°C to 275°C (-40°F to 527°F)	±2.2°C (3.96°F)
275°C to 870°C (559°F to 1598°F)	±.0.75% of Rdg

Restrictions: The sheath material is 304 stainless steel. It should not be exposed to halides or sulfides. In addition, the probe should not be used in reducing atmospheres or a vacuum.*

** Because of the open access to the inside of the sheath via the exposed bead, the probe must not be immersed in liquid or saturated vapor. Immersion of the probe in liquid or saturated vapor could result in "wicking" of the substance, and possible corrosion.*



80CJ-M Male Mini Connector

Package of two male black mini-connectors (20 guage max.) for use with Fluke 50 Series. Isothermal screw terminals for attachment of J-type thermocouple wire.

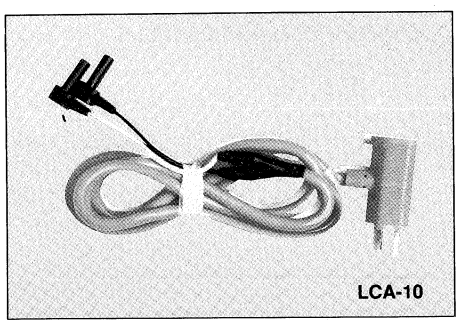
80CK-M Male Mini-Connector

Package of two male mini-connectors for use with Fluke 80TK or Fluke 50 Series. Isothermal screw terminals for attachment of K-type thermocouple wire.

Fuses

Fuse-2A 2A/250V fuse, 5 ea
Fuse-3A 3A/600V fuse, 1 ea
Fuse-20A 20A/600V fuse, 1 ea
Fuse-630 mA 630 mA/250V sand-filled, 5 ea

These fuses are provided to ensure proper protection for Fluke DMMs. These are the only fuses that should be used.



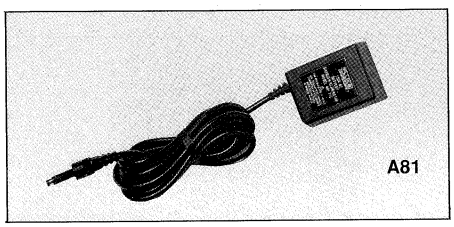
LCA-10[3] Line Current Test Adapter

The LCA-10 Line Current Test Adapter is a low-cost multimeter accessory that allows you to quickly and accurately measure the amount of current used by 120V ac line-powered devices.

The LCA-10 looks similar to an extension cord except that one end has Fluke-compatible safety-designed shrouded banana plugs. These plugs connect the LCA-10 to the high current input (typically 10A) of your multimeter. Inserting the banana plugs into the multimeter places the 120V ac live wire in series with the multimeter current shunt. The other end of the cord plugs into a 120V ac receptacle. The device being measured plugs into the LCA-10 receptacle.

Plug and Receptacle: U.S. NEMA 5-15 compatible (3 wire, straight blade, 15A, 125V ac)
Output Connections: Safety-designed shrouded banana plugs
Maximum Current: 10A ac continuous, 20A ac for 30 seconds
Wire: 5 feet of 16 gauge SJT

[1] *Listed to UL Safety Standards UL1244*
[2] *Factory Mutual Approved*
[3] *UL recognized*



A81 Battery Eliminator

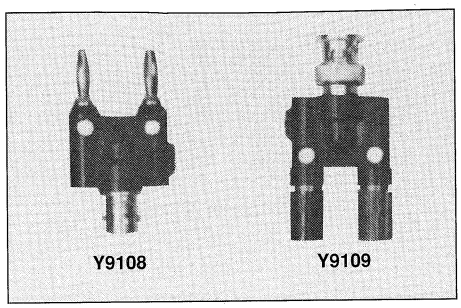
The A81 provides line operation for DMMs without discharging their disposable batteries. Available in three line voltage versions. Specify version desired. See Selection Guide for compatible DMMs.

A81-115 115V input (U.S. plug)
A81-230 230V input (European plug)
A81-100 100V input (U.S. plug)

80J-10 Current Shunt

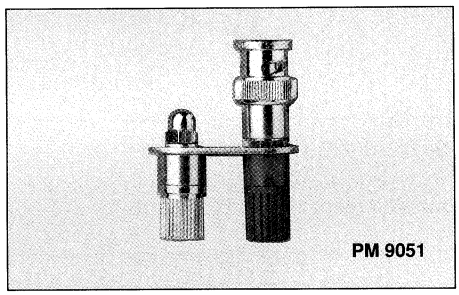
An inexpensive, simple-to-use accessory that lets you measure ac or dc current using any sensitive voltmeter having banana jack inputs with a standard 3/4" spacing. Two 5-way binding posts become the current input terminals. The precision, .01Ω shunt resistor will pass 10 amperes continuously without overheating, or up to 20 amperes for one minute. Not compatible with Y8132, Y8134 or TL70 test lead sets.

Sensitivity: 10 mV per ampere
Shunt Resistance: 0.01Ω
Accuracy: ±0.25%, from dc to 10 kHz, typically rising to 1 dB at 100 kHz
Series Inductance: 8.3 nH
Overload: <20A, not fused

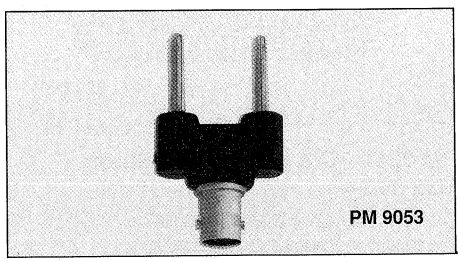


Y9108 BNC-Banana Adapter

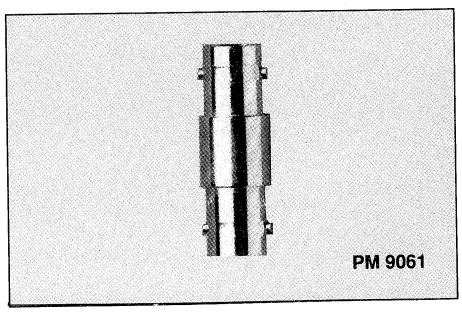
BNC-to-banana adapters permit interconnection between equipment having BNC plugs and equipment with double banana jacks. Caution: Do not use BNC Connectors for floating measurements.



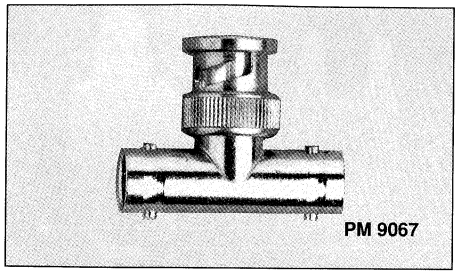
PM 9051 Adapter BNC (m) - Banana (f)



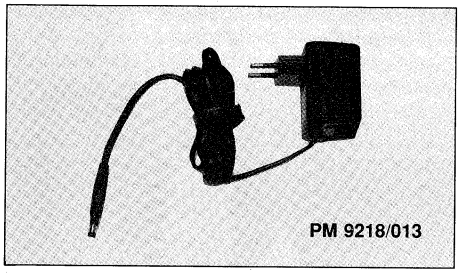
PM 9053 Adapter BNC (m) - Banana (f)



PM 9061 Adapter BNC (f) - Banana (f)

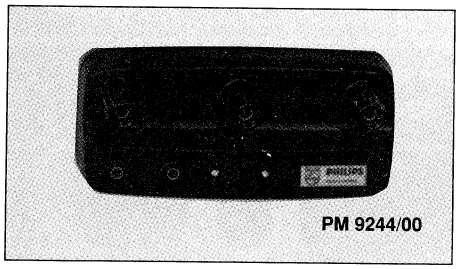


PM 9067 T-piece 1xBNC (m) 2xBNC (f)



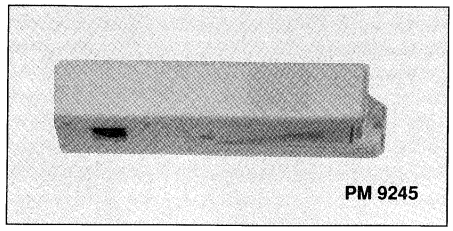
PM 9218/013 Power Adapters

Provides power cord operation for PM 2518.
Line Voltages: 110V, 220V and 240V ±10%



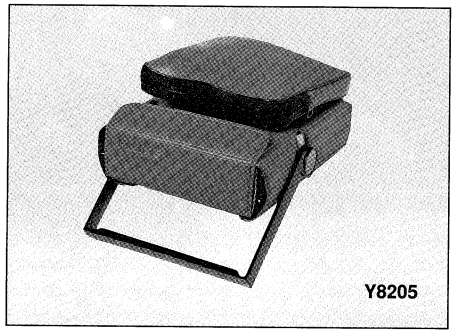
PM 9244 AC & DC Current Shunt Max 31.6A

Current Ranges: 10A and 31.6A
Frequency Range: DC to 1 kHz
Output Voltage: 100 mV or 31.6 mV at full range
Accuracy: ±1% (100 mV range); ±2% (31.6 mV range)
Size: 140 mm W x 55 mm H x 65 mm D (5.5 in W x 2.2 in H x 2.6 in D)



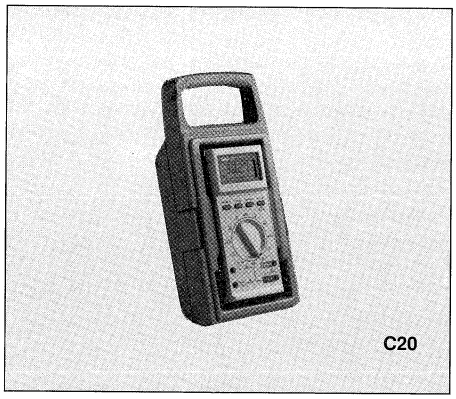
PM 9245 AC Current Transformer

Range: 10A to 150A
Transfer Factor: x1000
Accuracy: ±0.5% at 50 Hz; 2% for 40 Hz to 10 kHz
Maximum Voltage to Ground: 400V (ac or dc)



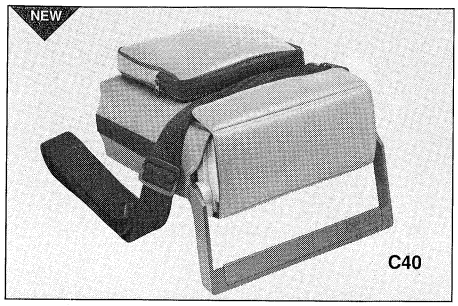
Y8205 Soft Carrying Case

A soft vinyl plastic case designed for the storage and transport of either an 8000A, 8010A, 8012A, 8050A, 2165A, 2166A, 2168A, 2175A, 2176A, or 8600A DMM. A separate storage compartment is provided for test leads and other compact accessories.



C20 Hard Carrying Case

The C20 is a heavy duty hard case made of shock resistant polypropylene. A carrying handle, operator's guide decal, and storage compartment for test leads and other small items is included. The cover is secured by two latches that also latch the case top to the back of the case for convenient storage and to form a tilt-up stand. For Fluke 25/27 and included with Fluke 8025A.



C40 Carrying Case

A soft vinyl plastic case designed for the storage and transport of a 45 DMM. A separate storage compartment is provided for test leads and other compact accessories.

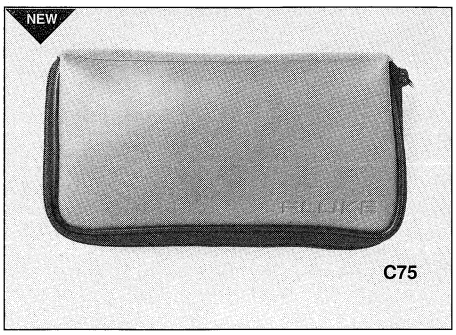


C25 Soft Carrying Case

Thickly padded vinyl with tough exterior and interior and heavy-duty water resistant zipper. Holds DMM and test leads. Includes combination belt loop/carrying strap and two storage or long temperature probes.
Size: 190.5 mm H x 108 mm L x 31.8 mm D (7.25 in H x 4.25 in L x 1.25 in D)

C50 Soft Carrying Case

A soft, zippered vinyl case for Fluke 21, 23, 73, 75, 77 Multimeters when not in C70 Holster. Includes pocket for test leads. Use C25 with holster.



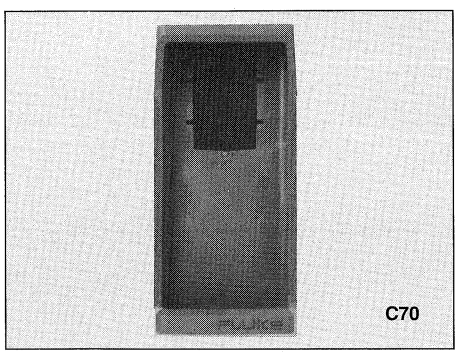
C75 Test Lead Case

Vinyl carrying case with two inside pockets. Designed to carry test leads, test probes, or clips. Will not accomodate an AC83, high voltage probes, current clamps, or long temperature probes.

Size: 190.5 mm H x 108 mm L x 31.8 mm D (7.25 in H x 4.25 in L x 1.25 in D)

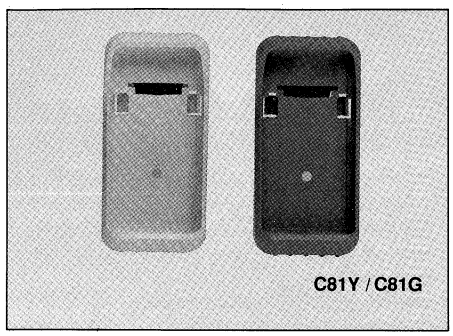
C90 Soft Carrying Case

Constructed of double-wall, fabric-backed vinyl with padded interior and zippered closure for complete protection. Inside pocket holds test leads and operator's instruction card. Carrying strap doubles as belt loop holder. Accomodates 20 and 70 Series DMMs in C70 Holster. Not compatible with 25 and 27 DMMs.



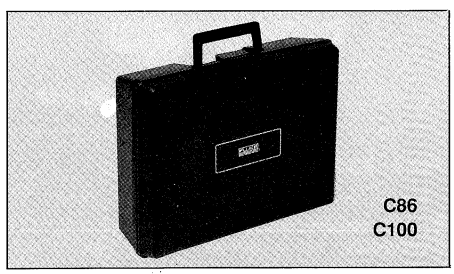
C70 Multipurpose Holster

The C70 is for Fluke 21, 73 and 75 Multimeters and is included with the Fluke 23 and 77 models. It is made of a tough semiflexible plastic that snaps over the instrument to absorb shocks and protect the meter from rough handling. The holster also doubles as a tilt stand and includes a belt clip. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.



C81G/C81Y

The C81G and C81Y fit Fluke 80 series multimeters. Yellow version (C81Y) is included with multimeter. Gray version (C81G) is optional. Made from durable semiflexible plastic, the C81 holster snaps in place around the multimeter to protect it from rough handling. Unique Flex-Stand™ has multiple positions and uses, including tilt stand, belt loop, pipe hook etc, for best viewing position of meter. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.

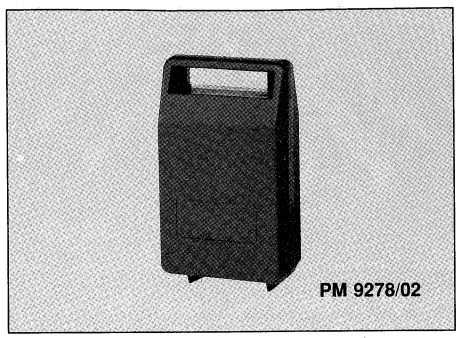


C86 Hard Carrying Case

8010A, 8012A, 8000A, 8050A, or 8600A DMM. This rugged case provides the DMM with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads and other compact accessories.

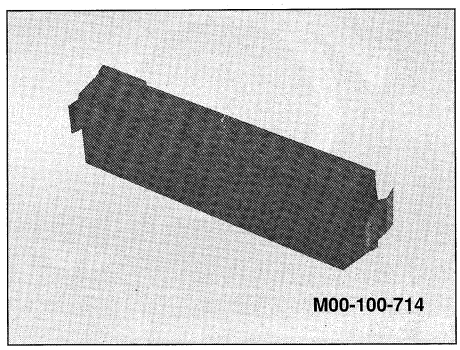
C100 Hard Carrying Case

A tough, polypropylene case that provides protection against rough handling and bad weather. Will also hold 80i-600, 80i-400 or Y8101 Current Probes and smaller accessories. Resembles C86. See Selection Guide for compatible Handheld Multimeters.



PM 9278/02 Ever-ready Case

Sturdy shock resistant case with paddings on the inside, for shock absorption and space for accessories (for PM 2518, PM 2618 and PM 2718).

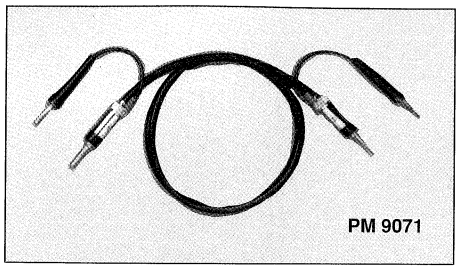


M00-100-714 Panel Protectors

A front panel protector is a molded plastic, snap-on accessory which fits over the front panel of a DMM, counter, etc. The cover provides protection for the front panel controls, and is useful for storing or transporting the instrument.

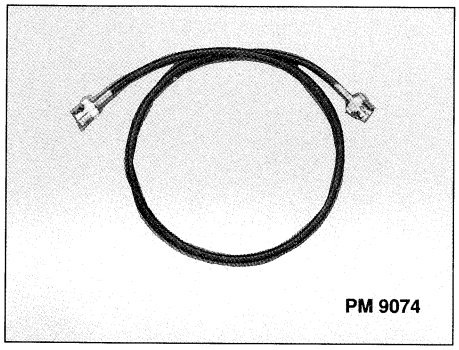
M00-100-714 is designed to fit the 8000A and 8600A DMM, and the 1900A, 1910A, 1911A, and 1912A Counters.

5



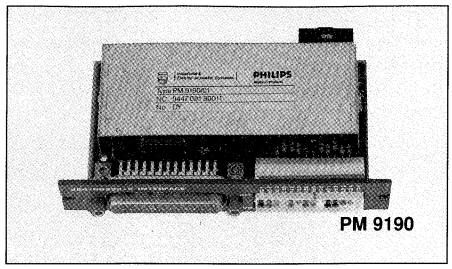
PM 9071 Measuring Cable 135Ω Banana (m) - Banana (m)

PM 9072 Measuring Cable 135Ω Banana (m) - BNC (m)



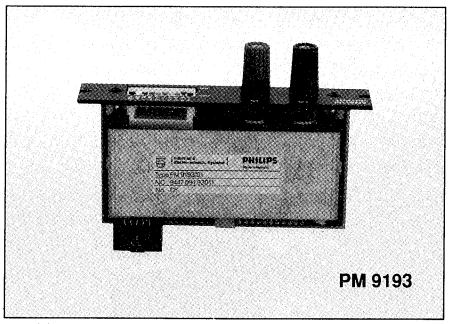
PM 9074 Measuring Cable 50Ω BNC (m) - BNC (m)

PM 9075 Measuring Cable 75Ω BNC (m) - BNC (m)



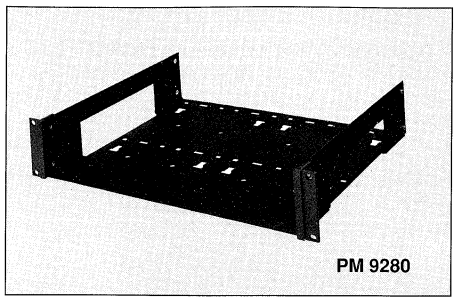
PM 9190/01 RS-232/V-24 Interface

The PM 9190/01 plug-in unit is an RS-232 (or V-24) interface for the PM 2534 and PM 2535.
Connector: 25-pole male D-type
Character Length: 7 or 9 bits
Baud Rate: 110...9600 Baud
Stop bits: Communication mode 1 bit; Multidrop mode 2 bits
Parity: Odd, even or none
Handshake: Hardware CTS-DTR protocol; software XON-XOFF
Dimensions: 118 W x 25 H x 60 mm D (4.6 x 1 x 2.4 in.)



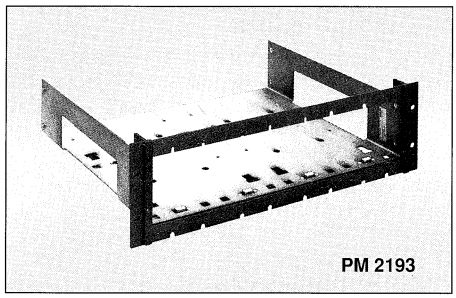
PM 9193/01 Analog Output Opt

Can be used with PM 2534 and PM 2535
Power Supply: 5V (±5%)
Connector: 4 mm female banana type
Output Voltage: 0V to 1V
Output Protection: Short-circuit protected
Output Resistance: 200Ω
Accuracy: ±0.25% of reading ±0.25% of range
Size: 118 mm W x 25 mm H x 60 mm D (4.6 in W x 1 in H x 2.4 in D)



PM 9280/02 19-inch Rackmount

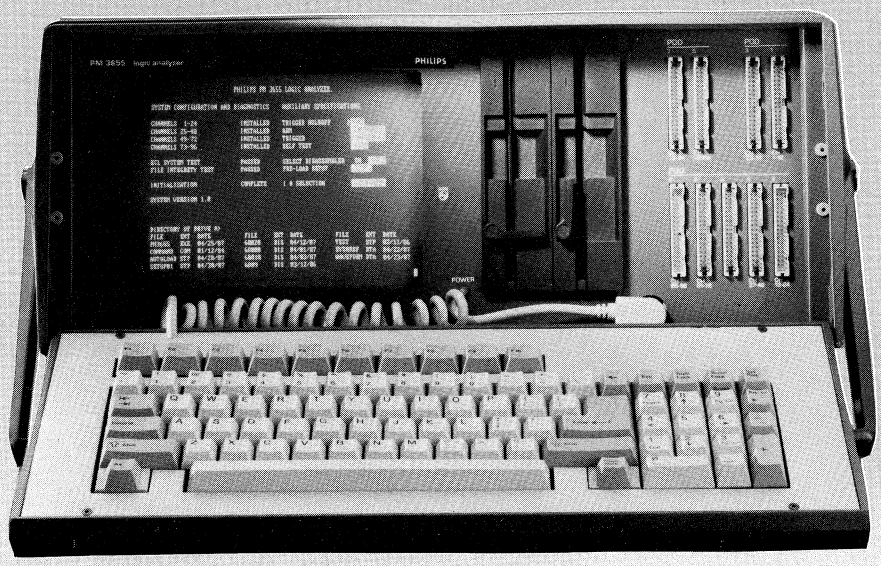
The PM 9280/02 rackmount kit makes it possible to mount a PM 2534 or PM 2535 in a 19-inch system with a height of 2E (88 mm/3.5")



PM 2193/01 Rackmount kit

Rackmount kit PM 2193/01 can contain up to 8 system 21 units or a combination of one PM 2525 DMM with 4 system 21 units. Height: 3/E (133 mm 5.22")

Logic Analyzers



PM 3655 Page 155

The PM 3655 offers a full 100 MHz sampling rate, synchronous or asynchronous, on all 96 channels, extremely fast for an instrument of this price. Moreover, using this full speed does not compromise performance of any other function. This is true of all the functions of this instrument — using glitch capture does not use any of the 2k bits of memory per channel or reduce speed; the PM 3655 operates at full speed and channel width, with glitch capture and retains 2k bits per channel.

Furthermore, it is expandable with a maximum of 4, 24-channel plug-in modules, allowing the user to specify exactly the power needed, while still having expandability assured. Also, operation is based entirely on the familiar PC, with normal keyboard, high resolution screen and menu-driven operation; and it also has a separate bus-architecture allowing it to function as an MS-DOS PC without affecting logic analysis capabilities.



PM 3570 Page 160

Introduction Page 154
100 MHz 96-Channel Low-cost Logic Analyzer Page 155
400 MHz 115-Channel Logic Analyzer Page 160
Accessories Page 167

Introduction

Logic Analyzers: Cost-Effective Tools for Digital Development

Today, there is a fast-moving trend for digital technology to replace analog in products in virtually every field; from washing machines and other domestic appliances to professional products and systems of every possible kind. Against this background, the right development and testing tools are absolutely essential in the product design process. It is no longer sufficient just to identify faults; their origins must also be located.

The ideal answer to this requirement is provided by the Philips range of logic analyzers.

These instruments offer powerful state and timing analysis capabilities to locate hardware and software faults; and on some instruments a combination of the two — a valuable feature during the critical hardware/ software integration process. Philips logic analyzers offer complete capabilities for analysis of hardware and software performance; in many cases all the user's problems can be handled by a single instrument.

Careful attention has also been given to ergonomic aspects of these high-performance instruments, ensuring that they are simple to use and easy to understand.

Suitable for All Applications

Philips logic analyzers are suitable for applications at all levels, from research and development, production, to field service and education. Each model offers both state and timing modes to give the user a total logic analysis capability, at clock speeds of up to 400 MHz for the top-of-the-range PM 3570 model.

Every type of application is covered by the Philips range. The top model is the PM 3570, an extremely advanced analyzer for systems-based applications, with 115 channels and a clock speed of up to 400 MHz, prepared for 32-bit applications. The PM 3655 is a low-cost, full specification 100 MHz analyzer with 96 channels. This instrument has none of the performance trade-offs between speed, width and memory usually associated with instruments of this price.

Overviews of instrument set-up are displayed using a menu structure, showing at-a-glance the status of each measuring mode and considerably simplifying operation.

A variety of display formats, including a wide range of disassemblers for specific microprocessor types, allows the user to achieve the optimal display format for a particular application.

Note: All products with a PM or PF prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Data Acquisition

For data acquisition from the system under test, Philips offers a selection of compact, lightweight test probes which do not mechanically strain the connection points. These probes present a very high input impedance of 1 megohm to the test circuit, together with a very low capacitive load, so that they do not interfere with its normal functioning. A variety of probe types are available for easy connection to the test circuit, including touch, DIL clip, pin-grid, LCC (leadless chip carrier) or low profile. Test leads are color-coded for easy identification.

Varying threshold levels enable the analyzers to handle different logic families, including ECL, TTL, MOS and CMOS. The number of input channels varies according to the instrument — the PM 3570 has 83 dedicated state channels and 32 timing channels; the PM 3655 has 96 channels all available for state and timing analysis.

Data sampling can be either synchronous for state analysis, or asynchronous for timing analysis.

Data Storage

The logic analyzer's memory is an important performance factor: the memory must be large enough to store all parallel output data, and fast enough to handle the sampling rate required for a particular application or test system. The transitional memory principle used on the high-performance PM 3570 instrument greatly increases the efficiency of memory utilization, making timing windows effectively much wider than on conventional instruments. The PM 3655 has a full 2 kbytes memory available on each channel, irrespective of the tasks being performed by the instrument, including glitch capture.

For state analysis, Philips PM 3570 logic analyzer offers 1k-words of state analysis memory. Extensive qualification facilities optimize use of memory by enabling data sampling on only those system actions that actually need to be monitored. Qualification can be performed on clocks, words, triggers or blocks of data.

Versatile System Connection

Philips logic analyzers are controllable via RS-232 and GPIB/IEEE-488* interfaces allowing convenient use in PC-controlled environments. In these cases, individual user programs can be used for applications like watchdog system monitoring, and storage and retrieval of measurement set-ups and data on floppy or hard disk.

The PM 3655 not only has Centronics, RS -232 and GPIB/IEEE-488 interfaces for system operation as standard, but is designed with all the functionality of a PC. Operation of the logic analysis functions is a menu driven and as familiar as a PC; in addition it can operate as a full function, MS-DOS PC with disk storage.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3570: Logic Analyzers for Tomorrow's Systems

With the PM 3570 logic analyzer, Philips gives system engineers a powerful tool that meets the challenge of today's leading-edge technology. With no less than 115 channels and an extremely fast 400 MHz acquisition speed, it is prepared to handle 32-bit development projects. With 35, 59 or 83 state channels, PM 3570 is a powerful and versatile instrument that covers most requirements for software testing and debugging.

Transitional timing analysis ranges from 32 channels at 100 MHz, 8 channels at 400 MHz or mixed-speed combinations. Dedicated personality adapters and family-oriented disassemblers provide support for 8-, 16- and 32-bit microprocessors.

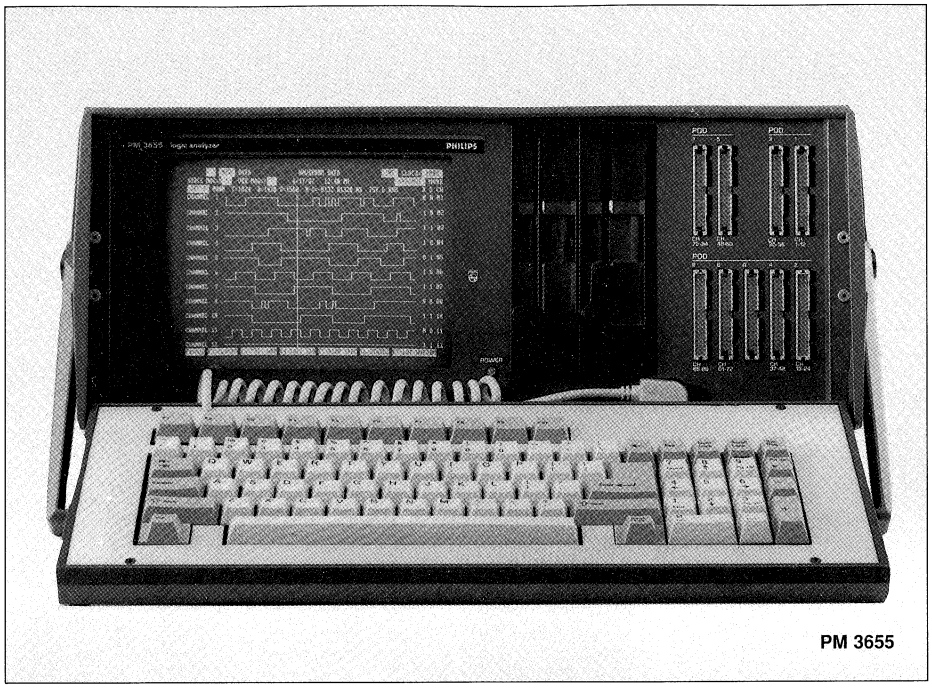
PM 3655: The Full Function Low-Cost Logic Analyzer

The PM 3655 offers a full 100 MHz sampling rate, synchronous or asynchronous, on all 96 channels, extremely fast for an instrument of this price. Moreover, using this full speed does not compromise performance of any other function. This is true of all the functions of this instrument — using glitch capture does not use any of the 2k bits of memory per channel or reduce speed; the PM 3655 operates at full speed and channel width, with glitch capture and retains 2k bits per channel.

Furthermore, it is expandable with a maximum of 4, 24-channel plug-in modules, allowing the user to specify exactly the power needed, while still having expandability assured. Also, operation is based entirely on the familiar PC, with normal keyboard, high resolution screen and menu-driven operation; and it also has a separate bus-architecture allowing it to function as an MS-DOS PC without affecting logic analysis capabilities.

PM 3655

GPIB IEEE-488



PM 3655

PM 3655 100 MHz 96 Channel Low-cost Logic Analyzer

- Full 100 MHz sampling speed on all 96 channels for timing and state analysis
- 2k bits of memory always available on all 96 channels
- 5 ns glitch capture on all channels, at full 100 MHz and with full 2 kbits memory
- Sophisticated multi-level triggering and 4 clock qualifiers
- High quality, high impedance probes
- Supports 8-, 16-, 32-bit micros and RISC architectures
- Modular design: field installable 24-channel modules
- Easy, familiar operation
- MS-DOS PC functionality

The PM 3655 is a low cost logic analyzer offering very powerful performance, always fully available regardless of the combination of functions in use, or the application. The user need make no compromise in performance demands - sampling speed is 100 MHz on all channels with no width or depth trade-offs; the full 2k bits memory per channel is always available; and the glitch capture does not reduce the speed or use any memory.

The PM 3655 offers the kind of performance not usually available in low-cost logic analyzers. This has been achieved with high performance ECL technology. Although it required greater effort in optimizing the design to obtain this high performance, ECL imposes none of the compromises at high speed associated with MOS.

Full Performance

The PM 3655 offers an extremely fast sampling rate for an instrument in this price class: 100 MHz on all 96 channels (synchronous and asynchronous), at full channel width performance that handles the latest micro technology, as well as preparing you for the next generation.

For capture of complex data flows or extended timing analysis, each channel has 2 kbits memory, available with full channel width at full speed, even when glitch capture is in operation.

The 5 ns Glitch mode allows capture of very brief transients - again at full speed on all channels, with no loss of width or depth.

Triggering is comprehensive, so the user can find exactly the data required, and includes a powerful multilevel trigger word sequencer, true range recognition and 4 clock qualifiers. An Area Trace facility also serves to effectively extend memory.

These high performance levels also include the probes, which are high spec high impedance, so they do not distort signals or mask glitches.

Modularity

The PM 3655 has a maximum of 4 plug-in modules, each of 24 channels, giving the user a maximum of 96, with each channel capable of state and timing analysis at the full 100 MHz. Thus the user need not buy more power than needed, but is still assured of future expansion. A wide range of micro-specific disassemblers and personality adapters is available, for reduced effort in set-up, and this range is constantly being expanded.

Simple, Familiar Operation

Operation of the PM 3655 is based on the familiar PC. It is menu driven; entry is via a normal keyboard with display of up to 24 channels simultaneously on a high-resolution screen; and the user can define channel labels or trigger words. It also has on-line disk storage, with full HELP and tutorial facilities supplied on disk.

Plus PC Functionality

Also, to make it a real added-value instrument, the PM 3655 can function as a full MS-DOS based PC, with a completely separate bus-architecture that does not limit any of the logic analysis capabilities. In addition to the 5 1/4" disk drive, 4 expansion slots are provided for LAN cards, internal modems, memory expansion and so on. Instrument set-ups can be stored on disk for later use, and measurement data can also be stored for later analysis, on a different machine if necessary. PM 3655 will run additional MS-DOS software such as word processing packages, increasing the versatility even further. It has Centronics, GPIB/IEEE-488* and RS 232 interfaces as standard.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

6

PM 3655

100 MHz State Analysis on 96 Channels

In state analysis, logic analyzers synchronize data acquisition using clock signals from the target. If the acquisition speed of the analyzer is too slow for the target clock, real time state analysis is impossible, so the speed of the analyzer is critical in determining its range of application.

The PM 3655 logic analyzer can perform state analysis at 100 MHz on up to 96 channels. This provides a safe operating margin not only for the analysis of designs with today's modern microprocessors, which are already operating at speeds of up to 30 MHz, but not for tomorrow's higher speed processors. Indeed, the combination of clock speed and number of channels make the PM 3655 suitable for the analysis of 8-, 16-, and 32-bit applications, including the up and coming RISC architecture CPUs, ECL gate arrays and fast bit slice designs. And this doesn't mean for just some designs - set up and hold times of 2.5 ns ensure samples are correctly taken and all trigger word recognizers run at 100 MHz, for all applications.

96 Channels in Groups of 24

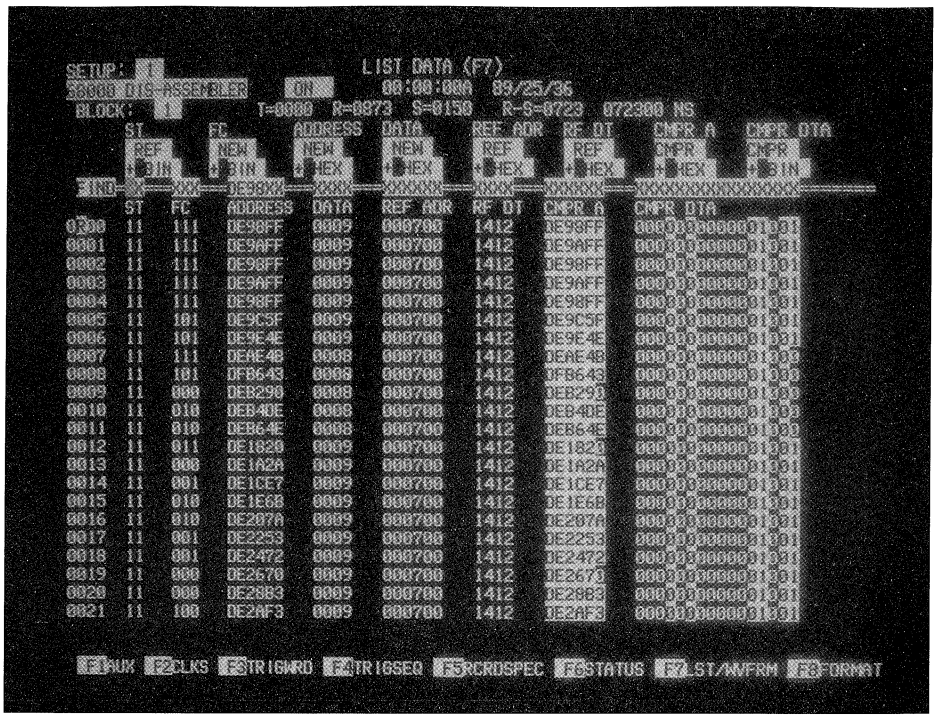
The modular design of the PM 3655 allows you to start with the minimum number of channels to satisfy your needs for simple timing and state applications, and add in extra cards to provide a maximum of 96 channels as your applications become more sophisticated. Each field installable 24 channel card, can be operated as an independent or interdependent logic analyzer for extra versatility. Each card can use a unique clock, clock qualifier and trigger; or the same clock qualifiers even when they are using different clocks. For added flexibility, different pre- and post-triggering parameters can be set for each card.

Powerful Triggering

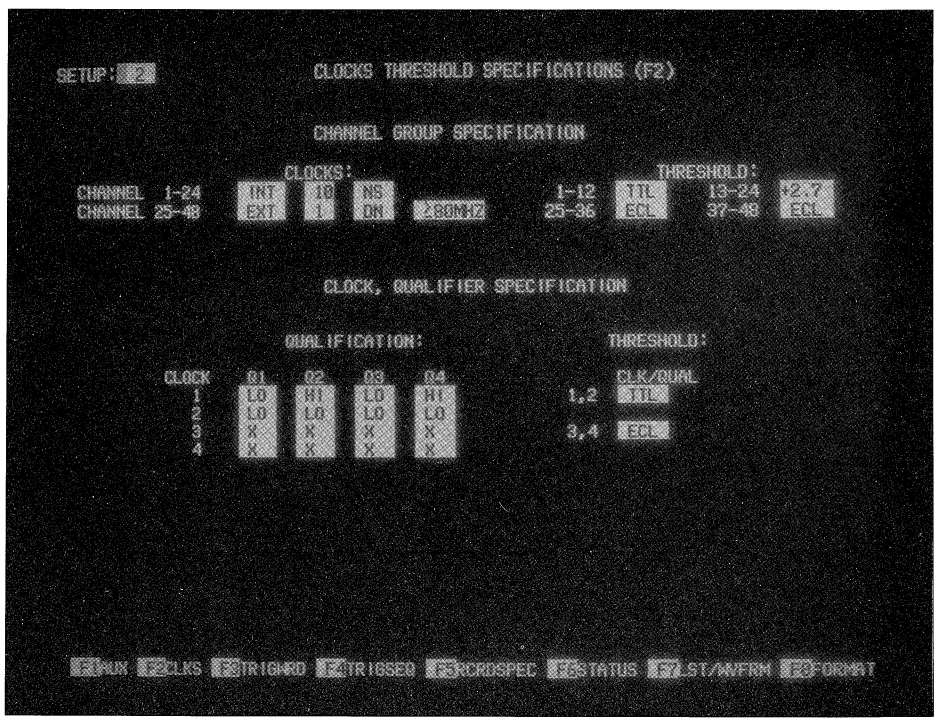
The PM 3655 can check for 4 trigger conditions and can simultaneously check for occurrence of 3 different trigger words from a choice of 12. Branching can be to the next or to a previous level; destination can be set individually per trigger word. Trigger words can be set to monitor up to 96 channels, i.e. over the full width of the analyzer.

Data acquisition can be stopped on any or all of the 24 channel modules, on any of 4 trigger levels. This allows both the cause of an error and the consequences to be captured by triggering different groups of channels, at different trigger levels.

A unique TIME-OUT triggering function can be defined on each trigger level, which locks in on events occurring within a user-specified time interval. If the events programmed on that trigger level do not occur within the pre-defined time limit, the TIME-OUT will activate and cause the trigger sequencer to proceed to another trigger level.



1. This state display highlights the differences between new acquisitions and reference memory, and also illustrates the wide number of channels that can be seen at once. The FIND feature allows a search for a specific word in memory.



2. Clock and threshold specifications allows clocks to be assigned to the 24 channel cards and thresholds to be set for ECL, TTL or variable. Four qualifiers can be allocated to each clock. Modules function as independent — or interdependent — logic analyzers in either state or timing modes.

2 kbit Memory Depth per Channel

Each channel in the PM 3655 can record an ample 2 kbits of states or events, providing long traces of, for example, a microprocessor's instruction flow.

The trigger position can be set at any position in the data memory and can be programmed to a one-sample resolution. Trigger position can be set to a different value for each of the 24 channel blocks, allowing from 2 kbits of pre-trigger data to 2 kbits of post-trigger data to be captured.

Using the trigger delay function (up to 65334 clocks/events), events occurring long after the trigger can also be captured.

Area Trace

By programming the PM 3655 to record only specific information, memory capacity can be optimized. Upper and lower range recognizers can be enabled or disabled on each of the 4 trigger levels. When the range recognizers are enabled, the analyzer will only record values that fall within the selected ranges and all others will be discarded. Not only does this make more efficient use of available memory, it also allows you to concentrate on only relevant data.

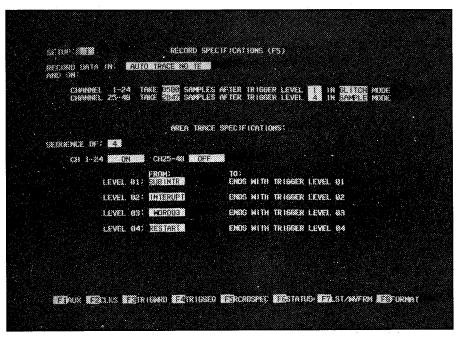
100 MHz Timing Analysis on 96 Channels

Each of the 24 channel groups can be used to perform timing analysis. All 96 channels can run at 100 MHz and the 2 kbit memory on each channel combines high resolution with a minimum of 20 µs recording length at the fastest clock speeds. All channels can be run off the same clock to provide a full 96 channel timing analysis.

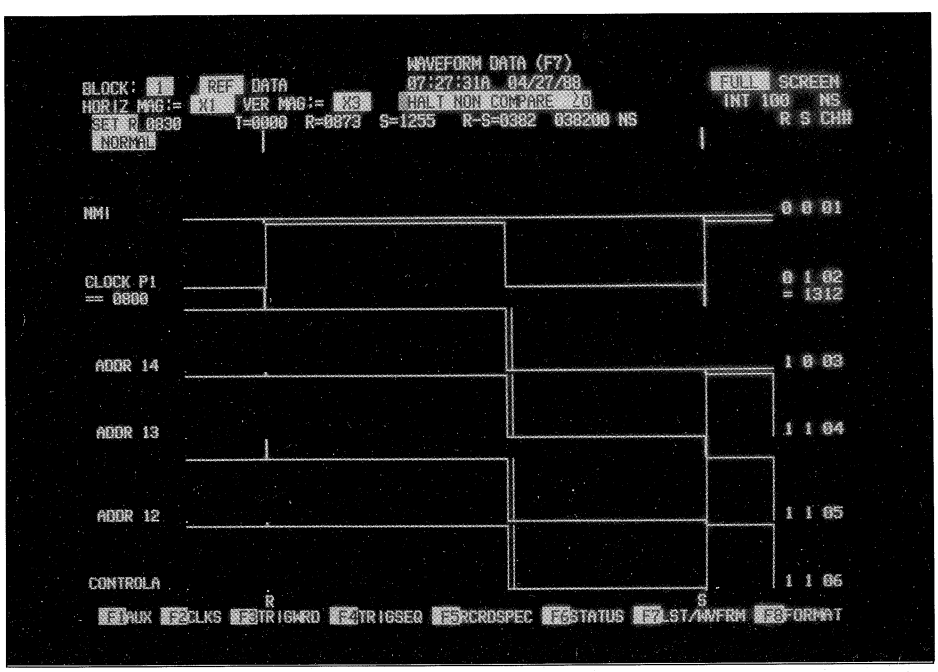
Powerful Triggering

Up to 12 trigger words and four trigger levels can be used for timing analysis. Time filters can be used to "qualify" the trigger condition; only triggering when the data is valid for more or less than a specified number of clocks. Events can also be counted creating a powerful timing trigger potential. State and timing trigger sequences can be integrated: for example, results from a state analysis can be used to qualify a timing trigger sequence; or you can trigger on combinations of trace results and timing data.

All these features combine to provide endless timing possibilities ranging from isolating trouble caused by too fast or too slow chip response times to debugging real time applications.



4. Record specifications screen shows the auto trace with no trigger enable. Each module's trigger point can be set to any amount of pre- or post-trigger data. And the trace qualification can be set, for each trigger level, to monitor an address range, I/O port, etc.



3. This timing diagram shows horizontal and vertical expansion, great for documentation.

Glitch Capture

The 5 ns glitch capture feature can be activated on all 96 channels without compromising either the maximum resolution (100 MHz) or reducing the memory available (2 kbits/channel).

In addition, high impedance (1 MΩ/8 pF) probes ensure that short glitches are not suppressed by too much capacitive load and that in general, signals are not distorted.

Monitoring

The analyzer can set to capture a single event, when the acquisition is frozen on error detection, or continuously monitor signal activity. In this case, the AUTO-TRACE mode continuously updates the display on a set trigger condition or at regular 1 second intervals, allowing the user to monitor changes in the system without manually restarting the logic analyzer. This feature is invaluable for monitoring real-time applciations or debugging communications.

Comparison

The PM 3655 can also be set to capture data which is equal to, or not equal to, a set of reference data. A maximum allowed skew between the data may also be specified. The compare cycles are short, so the PM 3655 does not spend much time away from its main function of monitoring the system. Captured data can also be stored on disk, allowing you to monitor a system for intermittent faults and analyze the data at a later stage.

Combined State/Timing Analysis

Each of the 24 channel groups can be assigned its own clock; either the internal clock for timing analysis or one of four external clocks for state analysis. This allows groups of channels to monitor a microprocessor while others are performing timing analyzes on, for example, interrupt lines. As indicated earlier, state and timing trigger sequences are completely integrated allowing a mix of states and timing events to be checked.

Data Display Options

PM 3655 has sophisticated on-screen display features showing detailed information for fast problem identification, analysis, and solution.

A full timing diagram containing up to 24 channels can be displayed on the large 9 inch CRT. Signals can be displayed in any convenient sequence (as opposed to the usual pin number order) - for example all data lines together, clock signals next to data lines and so on, and a signal may be displayed in more that one position. In this way, you can directly see how the triggering relates to a signal or group of signals.

Furthermore, a comparison display allows you to observe the difference between a set of reference data and a set of captured data. Functions that allow the user to compensate for timing skew between the signals are built-in.

6

PM 3655

Waveforms

The displayed signals can be randomly selected from all 96 channels and displayed in any desired order. You can create up to four screens, allowing all 96 channels to be displayed. Each signal is identified by its pin number and an individual signal name to help you to analyze your results, and cursors can be used for timing measurements.

The horizontal zoom feature allows expansion of the time axis to measure more accurately timing differences between signals. A few critical signals can be selected for concentrated study by expanding the vertical axis with the vertical zoom. Both axes can be scrolled.

Data List

Data can also be shown as state lists. The state list layout can be set up as desired, using as many columns as necessary, mixing new data with reference data, showing bus data in hexadecimal and/or ASCII, and even showing individual lines in binary. This free format layout allows you to maximize the amount of useful information displayed and thus speed up problem analysis.

Disassembly List

Microprocessor specific disassemblers translate the data into machine code to ease program tracing and interpretation. The personality disassembler modules also arrange the data bus, address bus and status lines into a logical order on the display.

Split Screen

A split screen option allows you to display both state and timing signals simultaneously to observe both hardware signals and software flow. You can also combine waveforms and state lists, or disassembly lists, into one screen to check timing and state analysis at the same time. Both windows can be simultaneously scrolled, or scrolled independently so, for example, you can study program flow separately from the timing analysis.

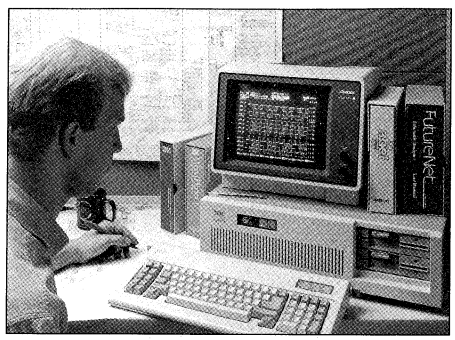
Familiar Operation Plus a PC

ASCII Keyboard

A familiar ASCII keyboard makes it easy to enter signal labels. Function keys give you direct access to any of the screens making most information available with a single keystroke. "Fill-in-the-form" style menus and pre-set selections make entry of labels and trigger words easy and it is simple to toggle between all the options. When finished, you have a complete picture of the set-up with no hidden sub-menus to obscure details.

Mass Storage

A 5¼" double-sided double density floppy disk drive allows you to store captured data and frequently used setting, or to load reference data. Disks are MS-DOS compatible allowing files to be post- or even pre-processed. Series of measurements can be executed automatically by invoking special command functions similar to macros.

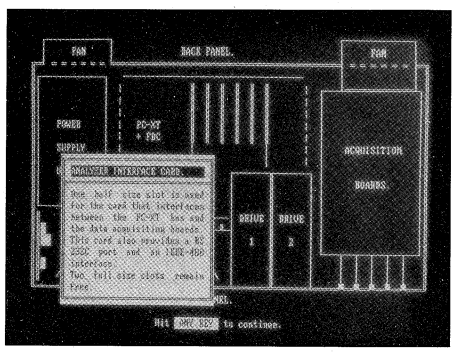


5. PM 3655 data running on a PC.

Additional PC Functionality

The PM 3655 can also be used as a personal computer. The 8 MHz 8088 main processor is PC/XT (turbo)-compatible with a separate bus architecture which ensures the logic analysis functions are not affected in any way. This allows the PM 3655 to run a range of MS-DOS software packages, so you can write reports on a word processing package, or integrate acquired data into spreadsheet packages. Your data can also be analyzed on a PC, as long as it has Hercules graphics.

Readily available software can also be used to convert the unit into an intelligent workstation, while four expansion slots allow you to upgrade or customize the logic analyzer with PC-plug in cards. These include internal modems, memory cards and LAN cards. A clock/calendar, Centronics printer port, RS-232C and GPIB/IEEE-488 interfaces are standard on the PM 3655.



6.The tutorial offers a "manual on disk" for quick overview of the PM 3655 operation. You can run it on the logic analyzer itself or on a PC.

Specifications

Technical Specifications

Signal inputs

Data: 24 channel per block with a maximum of 4 blocks (96 channels)
Clocks: Internal; 50 Hz (20 ms)...100 MHz (10 ns) selectable in a 1-2-5 sequence. External; up to 4, each from DC to 100 MHz selectable positive or negative edge. Clocking; any clock can run any or all Data Blocks
Qualifiers: Up to 4; can be ANDed with any external clock. Each selectable for high or low state
Input Impedance: 1 MΩ/5-7 pF typical (8 pF max) at wire ends; all Data, Clock and Qualifier inputs
Min. Detectable Pulse: 12 ns in "SAMPLE MODE"; 5 ns in "GLITCH MODE".
Thresholds: Data-selectable in groups of 12 channels each. Clocks/Qualifiers-selectable in groups of 2 clocks and 2 qualifiers each. Range-selectable fixed TTL (+1.4 V), ECL (-1.3). Variable -4.8...+7.5V in 100 mV increments.
Input Voltage: ±50 V continuous, ±100 V spikes with a max. duration of 50 µs.
Set-up Time: Data; must be present 2.5 ns (2 ns typically) before clock edge. Qualifers; must be present 5 ns (3 ns typically) before clock edge.
Hold Time: Data; must be held 2.5 ns (2 ns typically) after clock edge. Qualifiers; must be held 5 ns (3 ns typically) after clock edge.
Skew: Channel to channel 3 ns max.

Trigger

Type: "Edge"; this means that you must transition into the word selected for the instrument to recognize it. There is one exception; on level one of the trigger sequence, all "x's" (don't care) in the trigger word, will cause unit to automatically take a sweep of data and go into display
Width: Each trigger event may be specified as a 1 to 96 bit wide word (depending upon model) and terminate recording of all or each block of 24 channels
Specification: Trigger words can be specified in Hex or Binary format
Position: Trigger location may be specified anywhere in memory from 0 to 2038 and defaults to memory location 0047
Delay: Record window also may be delayed by clocks or events from 0 to 65534
Conditions: 4 levels with up to three words and a 255 clock time out per level, with multiple branch between levels. Full "IF-THEN-ELSE" control on each level. Area trace on each block, up to 96 channels wide. Any level can terminate any or all bolcks selected. When transferring from one level to the next the analyzer may not recognize trigger words for 40 ns worst case (30 ns typically).
Digital Filter: Trigger on words "greater" than 0-15 clocks long; trigger on words "less" than 2-15 clocks long

Recording

Glitch Mode: Every channel is capable of "glitch" catching down to 5 ns, selectable in blocks of 24 channels each
Memory Size:
1 card; 24 x 2048 bits deep
2 cards; 48 x 2048 bits deep
3 cards; 72 x 2048 bits deep
4 cards; 96 x 2048 bits deep
Conditions: Single trace-records data from start until trigger is found; completes recording, stops and automatically goes into display. Auto trace-continuously captures and displays data with or without a trigger word.
Compare/Non-Compare-R and S cursors used to select comparison zone. Comparison skew can be specified from 0-9 clocks for synchronous/asynchronous recording. Unit continues to run until condition is found; stops and goes into display.
In Timing, non-equal data between cursors shown as a one. In State non-equal data is displayed in reverse video.
Storage-back-up memory stores all recorded data and is selectable by block.
Set-ups - 2 set-ups are provided without accessing disc memory.

Display

Timing: Max. 24 channels per display
Horizontal Expansion; x1, x2, x5, x10
Vertical Expansion - 3, 6, 12, 24 channels
Any channel may be moved to any other location for display functions.
Cursors-Trigger-R and S. Difference between R and S shown in samples (external clock) or time (internal clock).
State: Data display selectable in ASCII, HEX, BINARY, OCTAL and DECIMAL by individual channel or block. Also, can be grouped in any combination up to 192 channels with eight separate groups available.
Disassemblers: 8-,16- and 32-bit CPUs shown in their respective mnemonics (disassemblers are optional). Devices currently supported are listed towards the end of this chapter.

Probes

Data: Maximum 8 data pods, each having 2 probes with 6 channels and two grounds leads each
Clock/Qualifier: Separate clock/qualifier pod with one probe for each function, each having 4 inputs
Disassembler (optional): Personality probes and cables are provided for matching 8-, 16- and 32-bit microprocessors
Circuit Interconnect: Pods are supplied with individual channel leads with 0,025 square sockets attached. Miniature clips are supplied for each lead. Cable lengths from probes to Logic Analyzer are 4' ±0.5' for clock/qualifier pod and 6' ±0.5' for data pods.

PC-XT Turbo Operating System

Keyboard: Full ASCII IBM PC "XT" keyboard with 10 soft keys
Computer: IBM PC-XT-Compatible capable of running MS-DOS. (8088, running at 8 MHz, can be set to run at 4.77 MHz)
Memory Size: 256 kbytes expandable to 640 kbytes (optional)
Disk Storage: Storage and down loading from system to floppy disk of setups, data and disassemblers
Disk: One 5¼" DS DD floppy drive (360 K) as standard. Space is provided for a second drive
Display: Amber CRT with self prompting menus. Reverse Video indicates programmable fields
Expansion: Ability to add up to two ½ size IBM "XT" Boards and two full size IBM "XT" Boards for additional features

System Interfaces

RS 232: Included as standard. Baud rates 9600, 4800, 2400, 1200, 600, 300, 150 and 100. Programmable separator. Control level: key simulation. Instrument settings and/or measurement data can be up/down loaded.
GPIB/IEEE-488: Included as standard. Implements SH1, AH1, T6, L4, SR1, LR1, DC1 and DT1. **Control level:** Key simulation, full instrument programmability. Instrument settings and/or measurement data can be up/down loaded. Programmable separator (CRLF is default). Serial and parallel polling. Talker/listener.
Parallel Printer Output (Centronics): Included as standard
External Start: 50 ms pulse, TTL active low via rear panel 9 pin "D" connector
External Trigger In: TTL active low via rear panel 9 pin "D" connector. Pulse width 20 ns min. This signal may be part of the trigger sequence and is selectable in the first word location on each level.
Trigger Out: TTL active low after block 1 trigger recognition via rear panel 9 pin "D" connector. Output signal varies depending on clock frequency, and location of block 1 trigger in trigger sequence. If last location, trigger out is steady state until re-start.

General Specifications

Power: 90...132 V_{AC}, 50...60± 2 Hz; fuse 5 A Slo Blo 200...264 V_{AC}, 50...60 ± 2 Hz; fuse 2.5 A Slo Blo. Maximum continuous power available 420 W (300 W typically). Conforms to IEC 348 safety class 1.
Power Interruption: 10 ms (nominal power supply) No influence on setting and data storage.
Temperature:
Rated range of use: +5...+35°C (+41...95°F)
Operating range: 0...+40°C (32...104°F)
Storage and transport: -40...+70°C (-40...158°F)
Humidity:
Rated range of use: 20...80% non-condensing
Storage and transport: 5...95%
Altitude:
Rated range of use: 5000 m (16000 ft)
Storage and transport: 15000 m (50000 ft)
Shock and Vibration: Meets IEC 68, CSA 22, 151, standards.
Electrical Interference: Conducted VDE 0871 Class B, FCC class A; radiated VDE 0871 class B, FCC class A
Size: 535 mm x 215 mm x 585 mm (w x h x d); 21" x 8.5" x 23"
Weight:
48 ch configuration; 22.2 Kg (49 lbs)
96 ch configuration; 23.1 Kg (51 lbs)

Ordering Information

Models*

PM 3655/201** Logic analyzer, 24 channels
PM 3655/501** Logic analyzer, 48 channels
PM 3655/701** Logic analyzer, 72 channels
PM 3655/901** Logic analyzer, 96 channels
Note: Each model includes a complete set of logic pods and one clock and qualifier pod.

Accessories

PF 8650 24 channel state/timing expansion module
PF 8600 12 channel logic pod
PF 8601 Clock/qualifier pod

Options

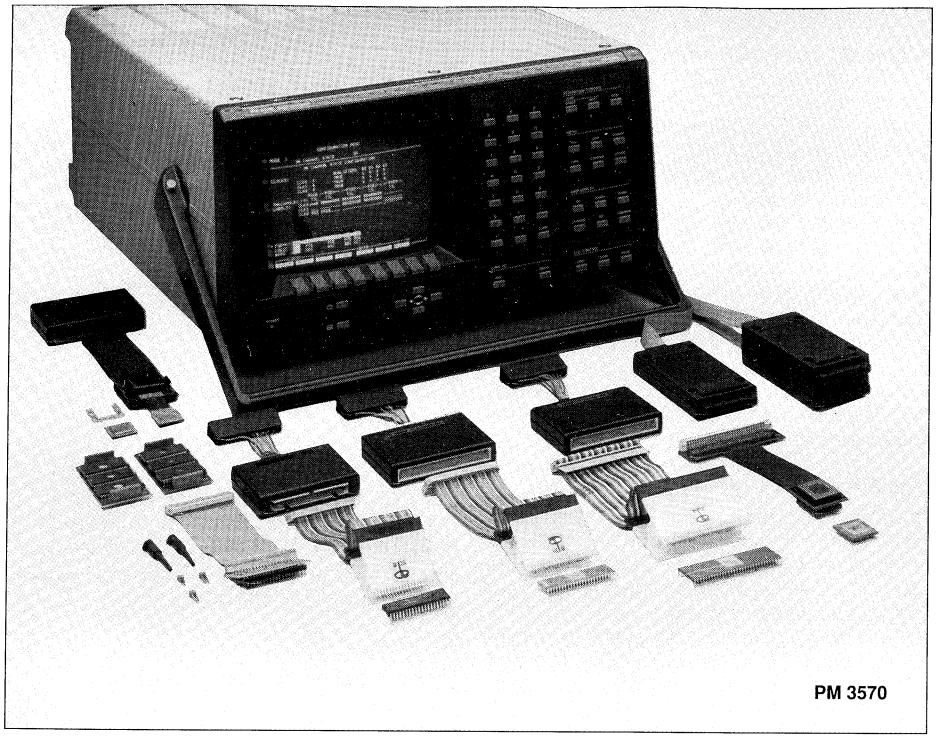
PF 8610 Personality adaptor and disassembler for 8085
PF 8611 Personality adaptor and disassembler for 6800
PF 8612 Personality adaptor and disassembler for 6809
PF 8613 Personality adaptor and disassembler for 6502
PF 8614 Personality adaptor and disassembler for Z80
PF 8620 Personality adaptor and disassembler for 68000
PF 8624 Personality adaptor and disassembler for 8068/8088
PF 8819/30 50 Miniclips (red)
PF 8819/90 30 Miniclips (black)
PM 8819/91 Detachable leadset
**These models are configured for Universal European power and line cord requirements; for alternative 90...132 V configuration, substitute /_3 in model number (instead of /_1), and state country of destination.*
***Subject to export regulations*

6

PM 3570

GPIB IEEE-488

RS-232



PM 3570

PM 3570 Logic Analyzer

- Configurable logic analyzer up to 115 channels
- 400 MHz transitional timing for infinite acquisition memory depth
- Time correlation mode between state and timing with dual screen display
- Performance analysis
- Wide range of 8, 16 and 32 bit microprocessor disassemblers
- Multi-level fully conditional triggering with selective data acquisition
- GPIB/IEEE-488 and RS-232C remote control interfaces

Keeping ahead of today's fast-moving technological advances demands the right development environment. Including the necessary tools to monitor every stage of the process: from the development and testing of hardware and software subsystems, right through to total-system integration and performance testing.

With the PM 3570 Logic Analyzer, Philips gives system engineers a powerful tool to streamline and speed the development process. A tool that meets the challenge of today's leading-edge technology. Prepared for 32-bit development projects with no less than 115 possible channels and ultra-fast 400 MHz acquisition.

State Analysis

Modular system upgrading for up to 115 state channels.

Transitional Timing Analysis

Transitional timing analysis with a capability extending from 32 channels at 100 MHz (with speeds up to 400 MHz), alternately usable as up to 32 additional state channels (to provide an unmatched total of 115 state channels).

Combi and Time-Correlated Modes

The photo shows time-correlated state and timing analysis with dual-screen display plus 32 channels simultaneously in state and timing modes without the need for dual-probing.

Performance Analysis

To optimize the speed of your code and monitor execution in real time, the PM 3570 offers extensive performance analysis features. When more speed is needed, what sections of your code should you rewrite in assembly language? The PM 3570 is the tool to make the right choice the first time.

Transitional Timing

A Philips innovation that gets maximum mileage out of the logic analyzer's memory by capturing only those events that the operator wants to see. Transitional timing ensures that even the smallest pulses are captured, but without capturing the same information several times and wasting precious memory. For example, two 5 ns pulses, separated in time by more than 20 minutes, can easily be captured in a single acquisition shot!

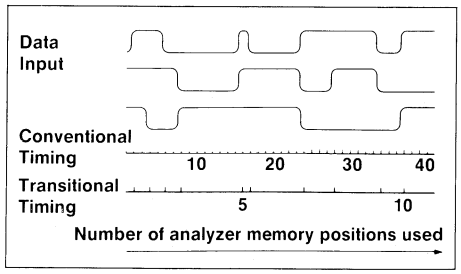
Broad Microprocessor Support

Philips has one of today's broadest ranges of dedicated subsystems for microprocessor support. Extending right up to the latest 32-bit devices, with support for newly introduced chips following fast.

Plus Fluke and Philips Worldwide Support

The PM 3570's tangible benefits in performance and technology are backed-up by renowned support. Based on our own know-how as a leading manufacturer and user of advanced microprocessor-oriented systems.

That know-how enables us to provide the user with the most advanced tools, as well as all the support needed to get maximum benefit out of the investment.



Both transitional and conventional timing analyzers give the same time resolution, but a transitional analyzer only uses memory in case there are changes on the data channels.

Softkey Simplicity

One of PM 3570's most significant user features is its softkey simplicity. Eight softkeys, uniquely defined by adjacent on-screen labels, let the user enter instructions step-by-step.

These eight keys provide direct, easy access to over 300 different functions.

Future-Oriented Concept

PM 3570 is part of a total future-oriented concept in logic analysis. Whatever application, it's virtually certain that this instrument will match it: whether it's state-oriented (8-bit, 16-bit and onwards), hardware-oriented (high-speed ECL), or both.

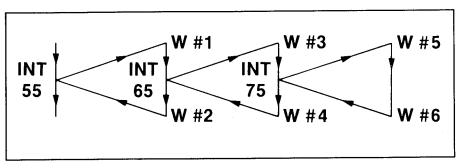
It is possible to expand up to 115 state channels, or 83 state channels plus 32 timing channels running at 100, 200 and 400 MHz.

State Analysis

PM 3570 provides a flexible, modular state analysis capability with up to 83 channels; starting with a standard 35-channel configuration and expandable in two further 24-channel steps. In addition, the high-speed 32-channel timing module can also be switched to state analysis, providing a total of no less than 115 state channels, usable for multi-channel testing applications.

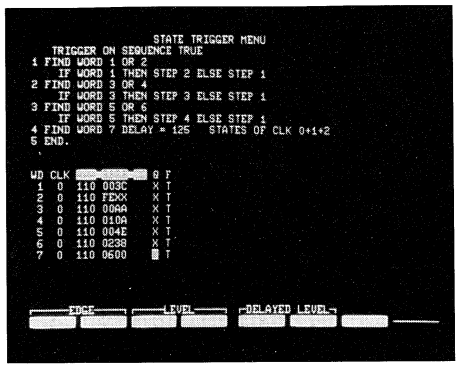
Trigger Menu

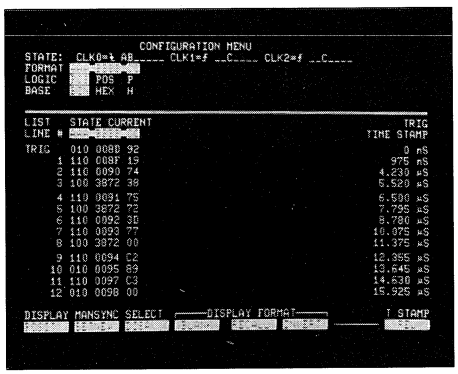
The operation of the trigger menu function is illustrated by this example of a three-deep priority interrupt on the 8085 processor. Here, WORD 1 identifies that the INT 5.5 service routine has been called, WORD 2 identifies the end of the routine. WORD 3 identifies the start of the INT 6.5 routine. If WORD 2 is encountered before WORD 3, the trigger if reset to step 1 to avoid a further INT 5.5 service routine. The same is true if WORD 4 is encountered before WORD 5, but the trigger is then set to step 2 to await the next INT 6.5 interrupt. PM 3570 is only triggered on WORD 6 when the full three-deep interrupt has occurred.That is, when INT 6.5. which is, in turn, interrupted by INT 7.5.



State List With Time-Stamping

In addition to versatile display facilities, it is also important to know which time intervals have elapsed between the consecutive states of the system under test. With PM 3570, it is possible to measure these elapsed times by time-stamping all the required states in the state list. Time-stamping can be absolute, i.e. starting from a defined starting point (trigger word) after which time runs cumulatively, or relative, in which the elapsed time of each state is shown individually.

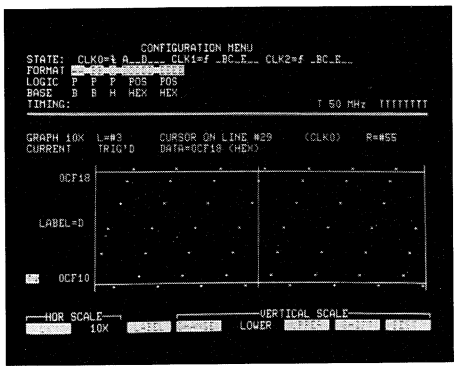




State Graph Display

The graph display plots state analyzer memory contents against memory addresses — often useful for tracking overall software flow, or in monitoring analog-to-digital conversion. State graph display and state list are tightly coupled. As a result, moving the cursor in the graph display automatically co-scrolls the state list, and vice versa.

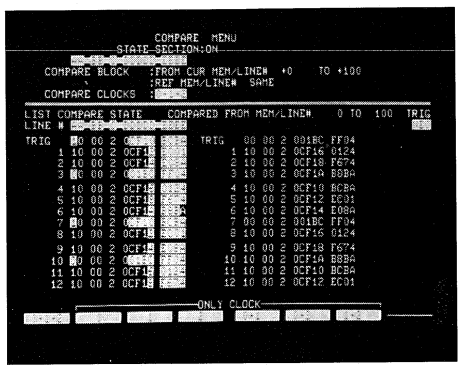
Recognition of repetitive loops or illegal memory accesses is much quicker than in a state list. So placing the cursor on a specific point of interest in the graph display, and then switching-over to the state list, directly reveals that area in terms of system state lines.



Compare Facilities

The PM 3570 provides sophisticated compare facilities for the fast location of system faults such as wrongly executed branches or incorrect data transfers. Data patterns of interest can be stored in reference memory, after which single- or multi-shot acquisitions of the new system data can be compared with the reference pattern.

Sections of the compared memory can be masked off and shifted, while further qualification is possible on a channel-by-channel or sampling-clock basis. Compared results are then displayed, with differences high-lighted in reverse video.



Transitional Timing Analysis

Philips' renowned transitional timing principle ensures optimal utiliaztion of available memory capacity by capturing only status changes; instead of conventional systems which capture data continuously, even when no events occur. PM 3570 has two separate memories; one for data and a second for time. If there is any change in one of the channels being examined between one sample and the next, the old data is loaded into the data memory, while at the same time the duration for which this data was valid is loaded into the time memory. PM 3570 therefore captures only the important transitions, even though it samples at constant intervals. Use of the transitional timing principle therefore enables PM 3570 to capture even the smallest pulses, without wasting valuable memory by repeatedly capturing unchanged data.

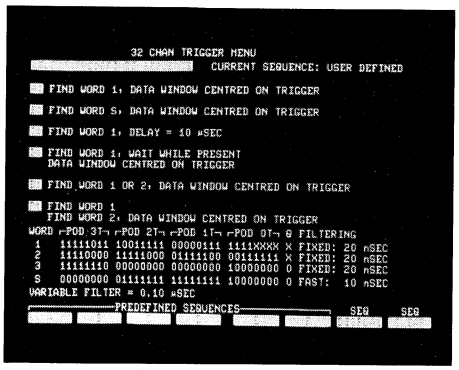
With a powerful, software-selectable choice of 32 transitional timing channels at 100 MHz, software-switchable to 16 channels at 200 MHz, 8 channels at 400 MHz, or combinations of these, PM 3570 has the capacity and versatility to handle every timing analysis requirement.

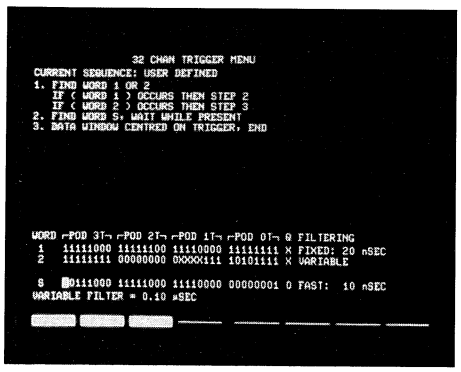
For example, a number of channels can be set to 100 MHz, while others are set to 200 or 400 MHz, giving a combination of these three sampling speeds at the same time. Working at 200 MHz allows detection of 7 ns pulses or glitches on 16 channels without any problem, while at sampling speeds of 400 MHz, pulses down to 5 ns or less can be captured on 8 channels. Powerful triggering is offered with four

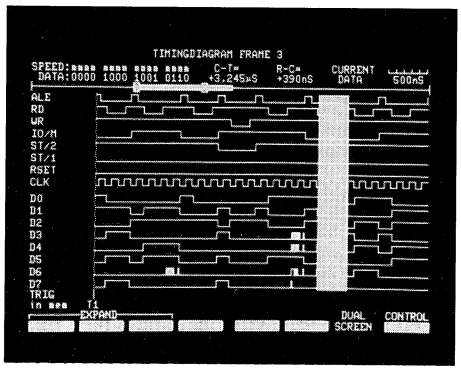
6

PM 3570

re-usable and independent trigger words of 32 bits each. Triggering is possible at any of the 3 available trigger levels at speeds of up to 400 MHz.







Timing Display Facilities

PM 3570's display facilities offer 4 available frames of any 16 timing channels to be displayed at the touch of a button for maximum user convenience. Of course, every timing channel can be preceded by a user-definable timing label, while a number of preset timing labels are also available. Timing reference measurements are easily carried out. All that is necessary is just to place the reference marker on desired edge, and move it to the next edge of interest. The measured time can then simply be read out to 5 decimal places! An important system attribute here is that a settable reference veil, indicating a specific time interval, can be moved right along the timing display. This allows quick searching of pulses of a specific length.

Cursor scrolling can be continuous or in discrete steps, such as edge-to-edge or page-by-page. The cursor can also be positioned immediately at a trigger word, as well as at the beginning or end of memory.

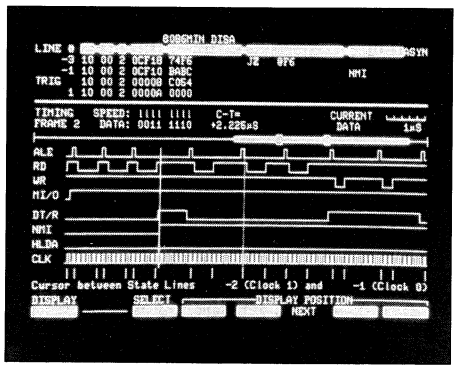
Time-Correlated Mode for Simultaneous State and Timing Analysis

As well as completely independent state and timing analysis sections, PM 3570 also allows both state and timing analysis sections to run together. This facility is particularly valuable in the hardware/software integration stage of a development project, when it is essential to check the interactions of system hardware and software, as well as for debugging and optimizing total-system performance.

In PM 3570's Combi mode, the state section can trigger the timing section, or vice versa; a powerful tool in determining true total-system behavior. It is also possible for one analyzer section to wait in its trigger sequence for the other analyzer section to proceed.

Analysis is extended even further in the selectable Time-Correlated mode in which the timing analyzer is running in synchronism with the state section. In this situation, state and timing displays are fully cross-referenced, so both state and timing conditions can be examined simultaneously at any specific moment in system operation.

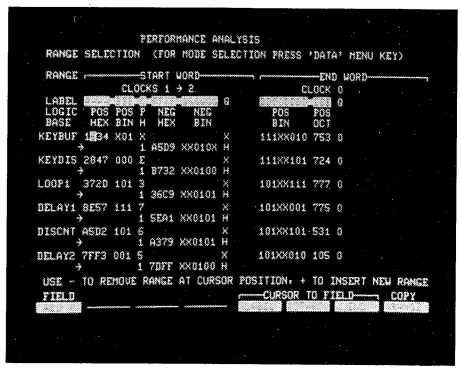
The availability of a dual-screen mode allows both state information (disassembled if required) and timing waveforms to be shown simultaneously but with full cross-coupling. This allows superfast detection of errors by searching for irregularities in one part of the display, for example timing, and studying their effect on program flow in the other part of the display.



Performance Analysis

The PM 3570's performance analysis mode is essential in the final development phase after functional system testing has been completed.

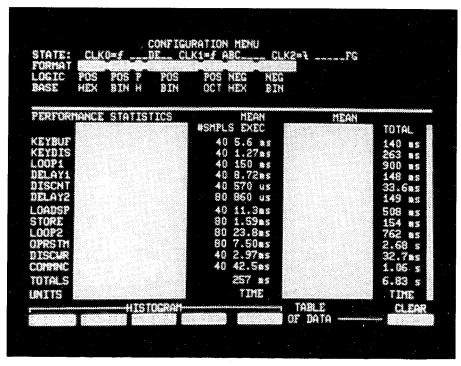
Performance analysis monitors 12 sections of your code and presents an analysis, complete with graphics, as to which section code takes the longest time or is called most frequently. This tool quickly isolates where code should be optimized for faster operation



Essential in Hardware/Software Integration

The task of the hardware development is to create hardware modules that match the electronics specification in terms of signal timing, levels, fan-in and fan-out etc. An important tool for the hardware team is a logic timing analyzer that offers at least 16 channels, and with sampling speeds of up to 400 MHz for high-resolution analysis.

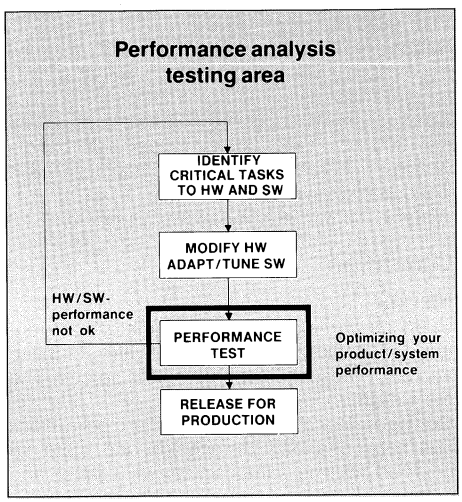
Concurrently, the software development team will be writing all the code modules and linking them together.



These separate activities are followed by the more difficult task of integrating hardware and software subsystems, either or both of which may then need further modification and testing. At this stage, an essential verification tool is the combined logic state and timing analyzer, offering sophisticated (synchronized) state and timing analysis, combined with full disassembly facilities.

Real finished-product software can be implemented after completion of the first working prototype with test software. Of course, it is essential to remove major system bugs, but this alone is not enough to ensure efficient and optimized system operation in accordance with the defined system tasks.

For example, it may be found that overall system run-times aims are not met, possibly due to the occurrence of long wait states caused by bottlenecks in the execution of system routines.



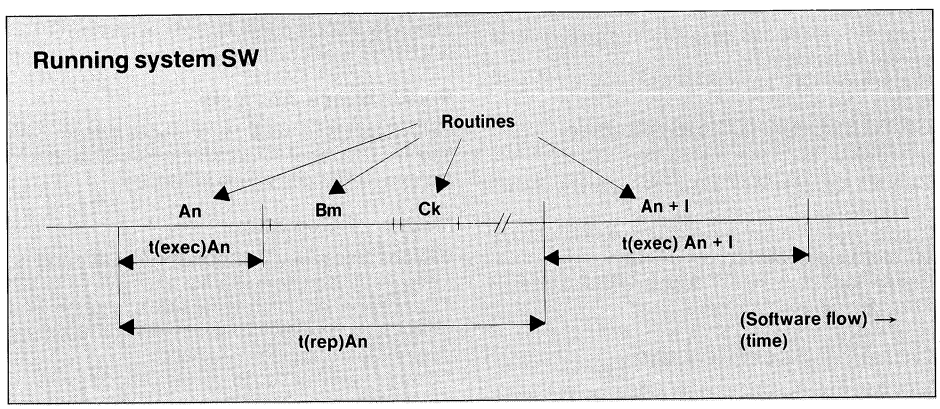
The diagram below shows a part of the program running in the system. Three routines are shown - A, B and C - together with an indication of execution time and repetition time for one of the routines. These execution and repetition times need not, of course, be constant. They can vary according to the level of system activity.

This allows a 'mean' execution time to be computed, giving a first indication of routine behavior. The mean is calculated by taking the average values of a selectable number of measured samples, for example 100, of either the execution or repetition time. Detailed measurements of execution/repetition periods of all 12 ranges can also be made, revealing important statistical information like minimum and maximum period values and standard deviations.

PM 3570's powerful combination of performance analysis facilities includes the following four operating modes:

- Event frequency, for measurement of the relative frequency of occurrence of a maximum of 12 address ranges
- Range period overview mode, for measurement of mean execution and repetition periods for a maximum of 12 ranges
- Range period overview mode, for measurement of individual execution and repetition periods for each range
- Complement period, for measurement of the time during which the system is active outside a maximum of four address ranges

Other special performance analysis features are 'ignore' and 'recursive routine' modes. Ignore mode allows an ignore word to be specified, which causes acquisitions passed through this word not to be merged with existing data. Measurements subject to interrupts can then be ignored, and the number of ignored events is also counted. The recursive routine mode enables repeatedly called routines to be recognized. This is not normally possible with other logic analyzers, which usually assume that a routine is ended after recognition of the END word. Up to 255 deep recursive routines can be recognized in this way, together with an indication of maximum and minimum values.



GPIB/IEEE-488* Bidirectional Control Interface

All logic analyzer functions are controllable at three distinct levels:

- Keyboard commands: all key operations can be simulated from a remote host
- Menu-level commands; complete sets of menu parameters can be set at once
- Instrument-level commands; all instrument parameters can be set at once

Of course, up- and downloading of instrument (reference) data are also possible via the GPIB/IEEE-488 interface.

All bus communications are handled in accordance with GPIB/IEEE-488 protocol, while service requests are handled by a complete, built-in control activated by the logic analyzer's operating system.

RS-232-C Bidirectional Control Interface

As with the GPIB/IEEE-488 interface, all analyzer functions are controllable at the same three distinct levels of operation. Here again, up- and downloading of measurement (reference) data are also possible. All link communications according to the RS-232 standard are built in, together with a complete service request control system.

RS-232-C Printer Interface

Both theGPIB/ IEEE-488 and RS-232-C cards contain an additional, independent, RS-232-C printer interface which is provided for print dump output.

Printout can be handled in a number of ways:

- Printout listing of listed data per page
- Printout complete data listing
- Printout of all instrument menus
- Printout (hard copy) of any analyzer screen on a dot-addressed graphics printer (dedicated to Epson LX80/FX80/85 graphic printer types)

IBM PC-AT Interconnection

Remote control and post-processing of data are vital attributes in today's research and development environment. These tasks can be handled highly effectively by connecting the PM 3570 to a PC or work station, thereby providing access to powerful and versatile data processing and storage capabilities.

A software communications package is available for this purpose supports connection to the IBM PC and PC-AT, and compatibles. The package runs under the computer's PC- DOS (or MS-DOS) operating system, and provides complete remote control of PM 3570 from the PC-AT plus file-oriented storage of settings and measurement data on floppy or hard disk.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 3570

Specifications

Technical Specifications

State Modules

Input: Via PM 8821 or PM 8825 multi-lead active pods
PM 8821: 4.7 MΩ//6 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 250 mV threshold overdrive
Threshold: Selectable TTL, ECL or variable per pod
TTL: +1.4V
ECL: -1.3V
VAR: -3v...+12V in 100 mV steps

Clocks and Qualifiers

Three External Clocks
Min. Repetition Time: 50 ns
Min. Clock Pulse Width: 15 ns
Up To Four Clock Qualifiers
Set-Up Time: 12 ns, with respect to active clock edge
Hold Time: 0 ns, with respect to active clock edge

Memory

Depth: 1023 words
Width: 35 bits or 59 bits or 83 bits. Reference memory of similar size

Triggering

Trigger Words: 7 words of 83 bits max.
No. of Trigger Levels: 7
Trigger Modes: Sequential, conditional, on-sequence-break
Trigger Source: From state, from timing, external

Selective Data Acquisition

Sections Between Trigger Words
Sections of Words A, B With/Without Delay
A, B Word Width: 83 bits max.

32-Channel Timing Module

Input: Via PM 8826 dual timing pods, 1 MΩ//5 pF
Max. Input Voltage: -50V...+50V
Max. Sensitivity: 200 mV threshold overdrive
Threshold: Selectable TTL, ECI, or variable
TTL: +1.4V
ECL: -1.3V
VAR: -3...+12V in 100 mV steps

Clock and Qualifiers

Clock Source: Internal, external or from state

Channel Speed Configurations With Internal Clock

32 Channels at 100 MHz: (Sample interval 10 ns)
16 Channels at 200 MHz: (Sample interval 5 ns)
8 Channels at 400 MHz: (Sample interval 2.5 ns) Plus 22 mixed 100/200/400 MHz channel/speed configurations
Storage Mechanism Transitional
Memory Depth: 256 to 512 x 10^6 samples, 1024 to 131 x 10^9 samples (optional)
Max. Recording Time: 5 min.; 22min. (optional)
Reference **Memory:** Same values
Glitch Capturing: 4.7 ns
Max. Undetected Pulse: 4.7 ns
Channel-to-Channel Skew: 2 ns
Triggering: 4 independent words of 32 bits + 1 external trigger bit
Trigger Levels: 3, either sequential or conditional
Trigger Source: From timing, from state, external
Glitch Triggering: Via timing triggering
Triggering Time Delay: From 0 ns to 335 ms
Final Trigger Delay: PRE, CENTER, POST

Channel Speed Configurations With External Clock

31 Channels at 50 MHz Max: Synchronously
Clock Qualifiers: 4
Memory Depth: 512 samples, 2048 samples optional

RS-232-C Printer Dump Interface

Prints alphanumeric data to any RS232-compatible printer. Prints graphic data to Epson FX80, or compatible printer
Format: 1start bit, 7 data bits, 1 parity (E), 1 stop bit
Speed: 110, 150, 300, 600, 1200, 2400, 4800, 9600 bits/s

RS-232-C Control Interface

Format and speed for RS-232 printer interface
Modes: Load and dump with PM 4202 cassette drive full control with any RS232 control unit, (host PC)
Control Levels: Key level, menu level, instrument level
Data transferred can be instrument settings and/or reference data
Separator: CR, NL, CRLF (default), EXT, ETB

GPIB/IEEE-488/IEC 625 Interface

Implements SH1, AH1, T6, L4, SR1, RL1, DC1, DT1
Control Levels: Key level, menu level, instrument level
Data transferred can be instrument settings and/or reference data
Separator: CRLF and EOI default, CR, LF, ETX, ETB
Transfer Speed: 1 KB/s

General Specifications

Video Output: Composite video output standard; 50 Hz refresh, BNC connector; 1 V peak-to-peak into 75Ω
Power Supply: 110, 127, 220 or 240V AC ±10%; 50/60 Hz ±10% (400 Hz on request). Conforms to IEC 348 safety class I and ECMA 57 requirements. Power Consumption 550 VA (max.)

Ambient Temperatures
Rated Range of Use: +5°C...+40°C
Operating: -10°C...+55°C
Storage and Transport: -40°C...+70°C

Altitude
Operating: <5,000m (16,400 ft.)
Not Operating: <15,000m (49,200 ft.)

Humidity
Operating: 20%...80% RH (non-condensing)
Not Operating: 5%...95%\
Electromagnetic Interference: Conforms to VDE 0871, Level N - 12 dB
Recovery Time: Operates within 30 minutes after - 10°C soak, going into 60% RH at + 20°C room conditions
Size: 237 mm H incl. feet, 450 mm W plus handle, 600 mm D incl. backstanders plus handle (9.3 in H incl feet, 17.7 in W plus handle, 23.6 in D incl backstanders plus handle
Weight: 18 kg (39.4 lb) approx.Operation

Operation

Menus

Upon menu selection, all parameters are entered by softkey and hex pad. User prompting and error messages appear on the screen. The menus are:
Configuration: The organization of clocks, clock qualifiers, channels, thresholds and state labels, as well as sampling speed (timing) and polarity
Triggering: The definition of the point at which data acquisition is to stop
Selective Data Acquisition: The definition of which data from the data stream is to be captured
Compare: The definition of which data is to be compared in the main and reference memories
Option: The selection of a required disassembler and parameter setting of the RS-232 printer interface, RS232 control interface and the GPIB/IEEE-488* control interface

Performance Analysis

Built-in as standard. Divides code (system SW) into max. 12 ranges, identifiable by start and end of word in Range Selection Menu

Modes of Operation

- Event frequency for occurrence of ranges; min. repetition time: 50 ns
- Range period for (averaged) execution and repetition times with minimum and maximum values plus standard deviation
- Complement period for range period of system activity outside max. four selectable ranges

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Special Features

Ignore: Exclusion of exceptional/spurious events
Continue: Recognition of recursive routines

Data Displays

List: Listing of state/timing captured data
Time: Displays a waveform diagram (timing diagram) representing the contents of the timing analyzer memories
Graph: XY-oriented display plotting memory contents against address values
Table: Tabular representation of event frequency, mean execution, repetition and total time period data (performance analysis)
Histogram: XY-oriented bar graph representing event frequency, execution (mean) period, repetition (mean) period, total time and complement period data. Histogram of recursion depth (performance analysis)

Data Display with Compare

List: Irregularities between current and reference memories are highlighted
Time: Irregularities between current and reference memories are underlined

Non-Volatile Memory Facilities

Stores up to four user settings; last setting always saved after power-down. Stores all available state/timing reference data, including performance analysis results.Built-in as standard.

Universal Disassembler Option

Universal disassembler package with four user-definable dissassemblers in case no particular disassembler from the above table applies. Useful for disassembly of military CPUs, bus systems, etc. User can specify e.g.:

- Disassembler name (9 characters per dissassembler name)
- PM 3570 configuration incl. clocks, qualifiers
- Translation table and mnemonics (max. 256 per disassembler)

Delivered as normal disaboard with one empty socket. All user-defined data to be stored in one 2764 which fits in socket. Two 2764s are supplied: one empty, another with example disassemblers (e.g. GPIB/IEEE-488 bus). Max. 4 disassemblers packs (EPROM boards) can be installed per instrument.

Personality Adapters

To allow easy target clip-on connection to PM 3570, compatible with PM 8821, PM 8825 and PM 8826 pods. Two hard-wired types are available:
PM 8817/40: 5 pods to 40-pin DIL clip
PM 8817/64: 8 pods to 64-pin DIL clip
Prewired personality adapters are available for many microprocessor types. See list above. All pluggable parts of PM 8817/XX can be ordered separately.

PM 8816/XX: Personality housing for
PM 8817/XX: same range as PM 8817/XX
PM 8815/40: 40-pin DIL-clip with flat cable and connector (to PM 8816/XX)
PM 8815/45: 40-pin DIL low-profile (12 mm height) with flat cable and connector (to PM 8816/XX)
PM 8815/48: 48-pin DIL-clip with flat cable and connector (to PM 8816/XX)
PM 8815/64: 64-pin DIL-clip with flat cable and connector (to PM 8816/XX)
PM 8815/65: 64-pin DIL-clip low profile with flat cable and connector (to PM 8816/XX)
PM 8815/68: 68-pin grid array front-end with flat cable and connector (to PM 8816/XX)
PM 8815/70: 68-pin grid array front-end with flat cable and connector (to PM 8816/XX) (Intel Version)
PM 8815/71: Pin grid to Lcc converter
PM 8815/72: 114-pin grid array front-end with flat cable and connector (to PM 8816/37)
PM 8815/00: five pod noses allowing connection of PM 8821 /25 /26 pod to PM 8816/XX (personality housing)

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Ordering Information

Models

PM 3570 Logic Analyzer

Options

PM 8853/60 Logic State Module 35 channel/ 20 MHz
PM 8853/50 Logic State Module 24 channel/ 20 MHz
PM 8853/70 Logic State Module 24 channel/ 20 MHz
PM 8853/30 High Speed Timing Module, 32 channels, 100/200/400 MHz, 1/2 kB mem.
PM 8853/90 High Speed Timing Module, 32 channels, 100/200/400 MHz, 2 kB mem.
PM 8856/20 RS232 Control
PM 8856/40 IEEE Control
PM 8821 8-Channel State Probe
PM 8825/10 8-Channel Fast Timing/State Pod
PM 8826 2 x 8-Channel Dual Timing Pod
PM 8827 32 Channel Single Probing Adapter

Accessories

PF 8701 General Purpose Software Communications Package
PM 8800 100 MHz Logic Analyzer Probe Set
PM 8892 Diagnostic Tool Kit
PM 8811 Serial Data Pod
PM 8819 Extension Kit
PM 8819/10 54 Colored Leads (26 cm)
PM 8819/20 35 Measuring Clips (black)
PM 8819/30 50 Mini Clips (red)
PM 8819/40 54 Colored Leads (12 cm)
PM 8819/50 54 Colored Leads (6 cm)
PM 8893 Protective Front Cover

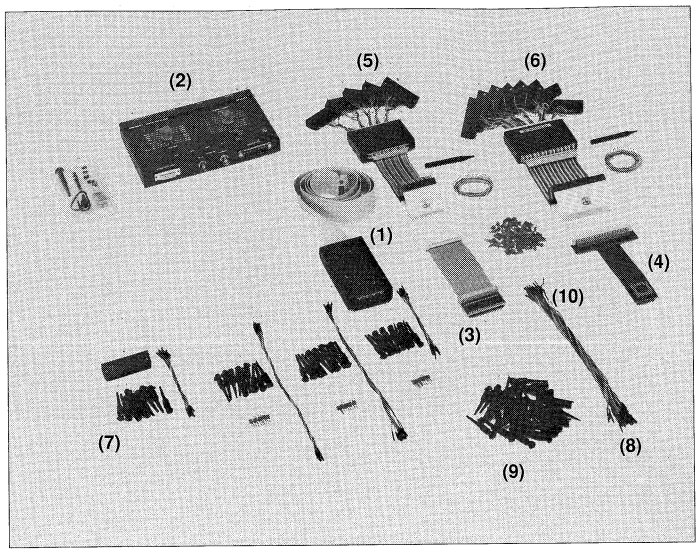
PM 3570

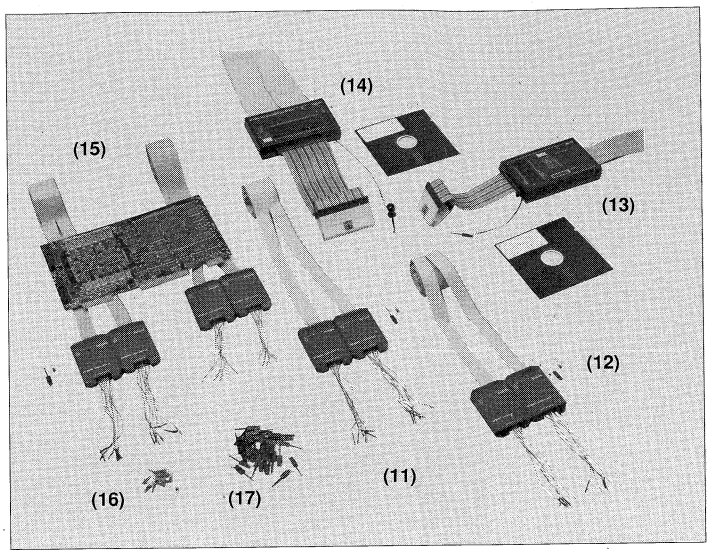
Microprocessor Support

Type		Disassembler package	Personality adapter	Front-end
Motorola	6800	PM 8858/00 (M1 pack)	PM 8817/10	40-pin DIL
	6802/6808	PM 8858/00 (M1 pack)	PM 8817/10	40-pin DIL
	6809	PM 8858/00 (M2 pack)	PM 8817/26	40-pin DIL
	6809E	PM 8858/00 (M1 pack)	PM 8817/26	40-pin LCC
	68000, 68010	PM 8858/10 (M2 pack)	PM 8817/19 PM 8817/36	64-pin DIL 64-pin grid array
	68008	PM 8858/20 (M3 pack)	PM 8817/32	48-pin DIL
	68020	PM 8858/30 (M4 pack)	PM 8817/37	114-pin grid array
	68HC11	PM 8858/90 (M5 pack)	PM 8817/68	52-pin PLCC
Intel	8080	PM 8858/40 (N1 pack)	PM 8817/28	40-pin DIL
	8085	PM 8858/40 (N1 pack)	PM 8817/20	40-pin DIL
	8031/51	PM 8858/40 (N1 pack)	PM 8817/30	40-pin DIL
	8048	PM 8859/40 (X pack)	PM 8817/40	40-pin DIL
	8086/8088 min./max.	PM 8858/50 (N2 pack)	PM 8817/27	40-pin DIL
	80186	PM 8858/60 (N3 pack)	PM 8817/31 PM 8817/34 PM 8817/38	68-pin LCC 68-pin grid array 68-pin LCC and 68-pin grid array
	80286	PM 8858/70 (N4 pack)	PM 8817/35 PM 8817/39	68-pin grid array 68-pin LCC
	80386	PM 8858/80 (N5 pack)	PM 8817/41	132-pin grid array
Zilog	Z80	PM 8859/20 (Z pack)	PM 8817/22	40-pin DIL
Rockwell	6502, 6512	PM 8859/30 (R pack)	PM 8817/24	40-pin DIL
NS	NSC 800	PM 8859/30 (R pack)	PM 8817/12	40-pin DIL
Universal adapter			PM 8817/64	64-pin DIL
Custom		PM 8859/10 (B pack)	User selectable	User selectable
disassembler [1]		PM 8859/00 (C pack)	User selectable	User selectable

[1] Universal disassembler package with four user-definable disassemblers in case no particular disassembler from the above table applies. Useful for disassembly of military CPUs, bus systems, etc.
User can specify e.g.:
- *disassembler name (9 characters per disassembler name)*
- *PM 3570 configuration incl. clocks, qualifiers*
- *translation table and mnemonics (max. 256 per disassembler)*

Delivered as normal disaboard with one empty socket. All user-defined data to be stored in one 2764 which fits in socket. Two 2764s are supplied: one empty, another with example disassemblers (e.g. IEEE-488 bus). Max. 4 disassembler packs (EPROM boards) can be installed per instrument.





PM 3565 & PM 3570

(1) **PM 8825/10** 8-Ch Fast Timing Probe Pod
PM 8826 16-Ch Dual Timing Probe Pod
PM 8827 132-Ch Single Probing Adapter

(2) **PM 8811/001** Serial Data Pod
PM 8815/40 Flat Cable & 40-pin DIL Clip *

(3) **PM 8815/45** Low Profile Connector to 40-pin DIL Connector
PM 8815/48 Flat Cable & 48-pin DIL Clip
PM 8815/64 Flat Cable & 64-pin DIL Clip
PM 8815/65 Low Profile Connector

(4) **PM 8815/68** Pin Gr Adapter (6800068010) 68-pin
PM 8815/70 Pin Grid Adapter for 80286
PM 8815/72 Pin Grid Adapter 68020/114 pin Grid Front End of 68020

(5) **PM 8817/40** Personality Adapter for 40-pin DIL

(6) **PM 8817/64** Personality Adapter for 64-pin DIL
PM 8817/xx Range of Personality Adapters for particular microprocessors

(7) **PM 8819/00** Extension Kit

(8) **PM 8819/10** 54 Colored Leads (for PM 8820/8810)

(9) **PM 8819/20** 35 Measuring Clips (black)
PM 8819/30 50 Mini Measuring Clips (red)

(10) **PM 8819/40** 54 Colored Leads (PM 8825 at 50 MHz, 15 cm)
PM 8819/50 54 Colored Leads (PM 8825 at 300 MHz, 6 cm)

*part of accessories 5 and 6

PM 3655

(11) **PF 8600** 12-Ch Logic Pod

(12) **PF 8601** Clock/Q Qualifier Pod

(13) **PF 8610** Personality Adapter & Disassembler 8085
PF 8611 Personality Adapter & Disassembler 6800
PF 8612 Personality Adapter & Disassembler 6809
PF 8613 Personality Adapter & Disassembler 6502

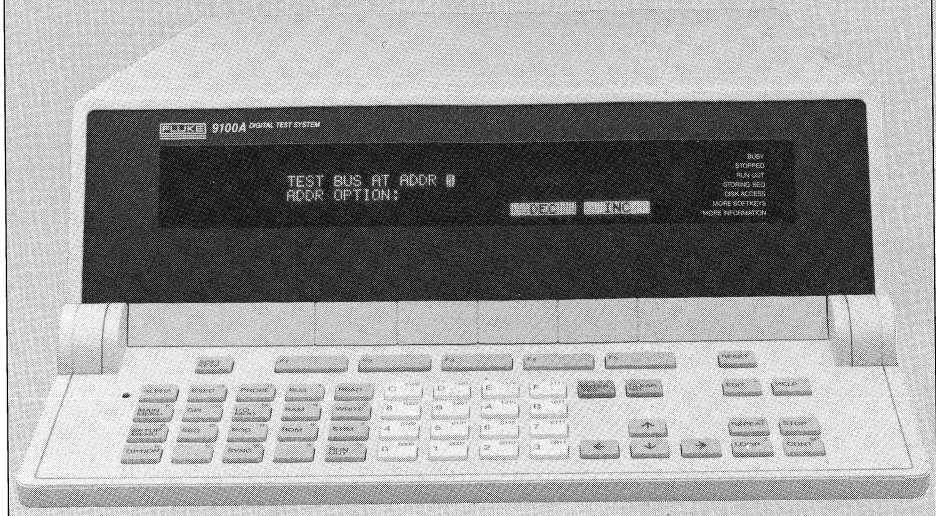
(14) **PF 8620** Personality Adapter & Disassembler 68000
PF 8624 Personality Adapter & Disassembler 8086/88

(15) **PF 8650** 24 Channel State/Timing Expansion Module

(16) **PM 8819/30** 50 Mini Measuring Clips (red)
PM 8819/90 30 Mini Measuring Clips (black)

(17) **PM 8819/91** Detachable leads, 8 data sets, 2 CK/qualifier sets

Board Testers & Troubleshooters



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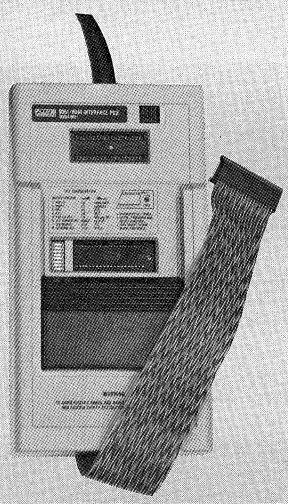
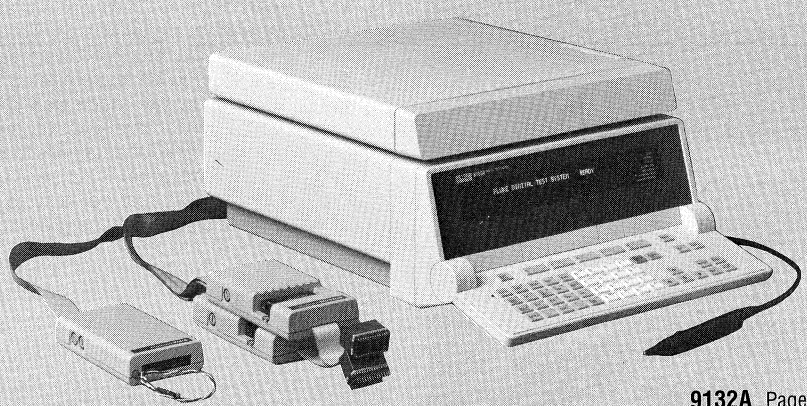


Interface Pods Page 188



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Most electronic equipment designed in recent years uses microprocessors. While this component makes it possible to design very sophisticated equipment at a low cost (such as personal computers), there are drawbacks in troubleshooting and repairing microprocessor-based circuit boards.

Astute manufacturers of electronic products know that the long-term success of their products depends on effective diagnostics in production testing, and fast, economical repair and service. That's why Fluke developed the innovative 9000 Series Micro-System Troubleshooter. It has proven to be a very cost-effective solution for hardware debugging, testing, and servicing of microprocessor-based equipment, using any one of over 50 different types of microprocessors.

For higher levels of automated testing and troubleshooting in production lines or in service depots, Fluke offers the 9100A Digital Test System, today's most sophisticated, most capable emulative board tester.

Fluke's solutions go further, too; the 900 Dynamic Troubleshooter provides quick and accurate fault isolation to the component level; anywhere on the Unit Under Test. No detailed UUT knowledge or documentation is required. It can be used to compliment any functional test or self test procedure to pinpoint the fault to a component.

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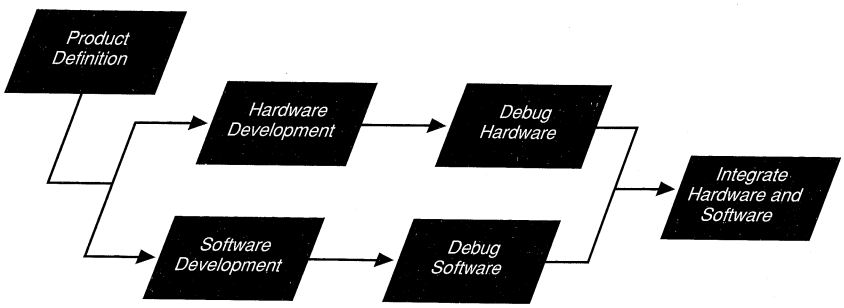
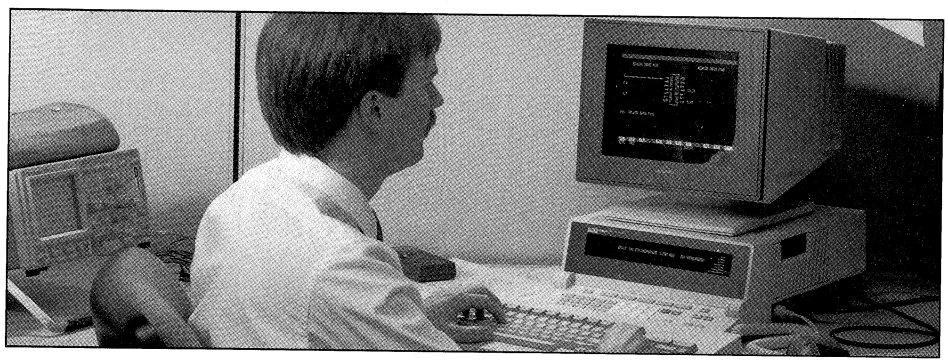
Board Testers & Troubleshooters Page 172
Interface Pods Page 188
Option Compatibility Page 190

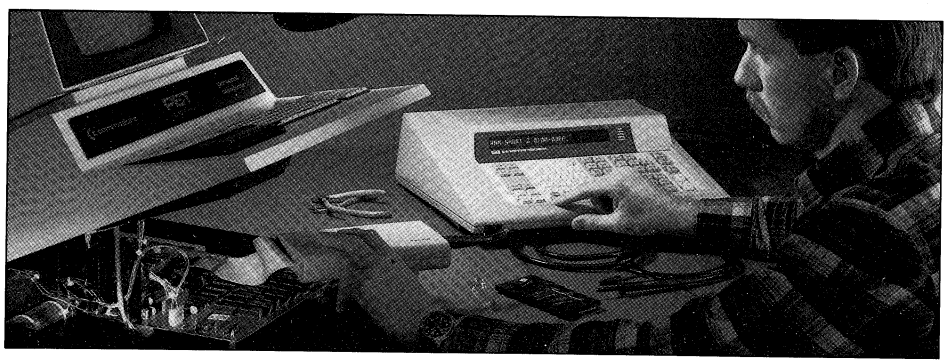
Product Development

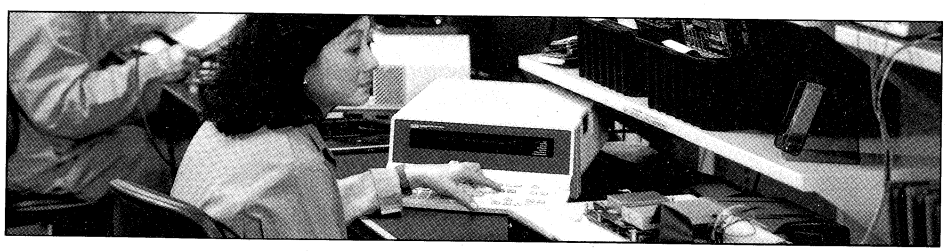


Prototype Debug

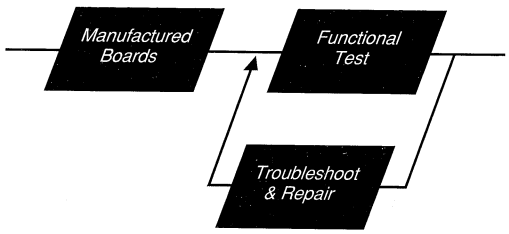
The **9010 Micro-System Troubleshooter** is the ideal tool for verifying hardware prototypes independent of system software. The low cost 9010A controls your board through the microprocessor kernel, allowing fast debugging without writing assembly code. Even with dead boards!







Manufacturing Board Test & Troubleshooting



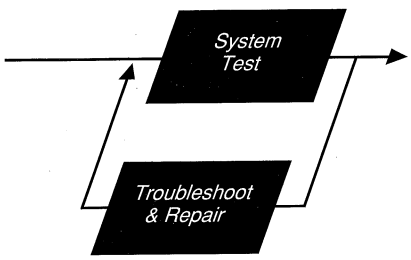
Functional Board Test

For medium and low volume board test, the **9100A Digital Test System** is the most productive, cost effective tester available. With its low capital cost, fast programming, and powerful test algorithms the 9100A offers test automation in an affordable, flexible package. Emulative Testing, at the heart of the 9100A, is the preferred technology for today's digital boards. The small size and low cost of the 9100A allows manufacturing test operations to be implemented in the most efficient manner, with dedicated product work cells, fast set-ups for small quantity production runs, and networking for data collection and process control. Software that is transportable to additional testers allows test capacity to grow incrementally as your test volume grows.

Fluke Board Testers

Highest Return For Your Test Investment. Fluke has been manufacturing electronic products for 40 years, and we are experts at testing and servicing our own high quality, high technology products. We offer this experience to you with innovative test equipment that is dramatically lower in price than traditional automated test equipment, while staying ahead of modern test requirements. Compare our board test products to any other, and you will find your highest R.O.I. comes from Fluke.

Plus, Common Test Philosophy for Product Development, Manufacturing, and Service. Fluke board testers break away from traditional techniques and limitations. For your products to compete, you require an integrated approach to design, manufacturing, and service. Fluke board testers offer test commonality between departments: tests designed in product development can be enhanced and used by production test, and then transferred to your service department. Advanced test software combined with lower cost hardware allows you to implement a corporate test strategy to meet your needs.



To Customer

Service
Board Test & Troubleshooting

To/From Customer



7

Troubleshooting

Fast, accurate board troubleshooting is where the **9100A Digital Test System** really stands apart from any other board tester. Sophisticated Guided Fault Isolation (GFI) algorithms speed even inexperienced technicians to faulty nodes. Faults that would take hours to locate using an oscilloscope or logic analyzer take just minutes with the 9100A. Advanced test development software lets you, the test engineer, concentrate on writing powerful test programs quickly.

For a non-programmed solution, the **9010A Micro-System Troubleshooter** offers the same powerful Emulative Test techniques as the 9100A in a keystroke controlled package. The 9010A is a tool for the experienced technician, who can combine his knowledge of the Unit Under Test with the direct control of the 9010A.

Emulative testers may be complemented with the **900 Dynamic Troubleshooter** which offers quick and accurate fault isolation to the component level. It tests a digital IC on the Unit Under Test (UUT) by comparing its performance to that of a known-good reference device and automatically analyzes the performance of the device under test as it operates in the circuit. It captures timing, intermittent, as well as static faults. It can test standard digital components from SSI to VLSI, (D)RAM and ROM, as well as custom parts like PALs, ASICs and gate arrays up to 28 pins.

When a stimulus is available for the unit under test, the 900 Dynamic Troubleshooter can troubleshoot non-microprocessor-based UUTs as well.

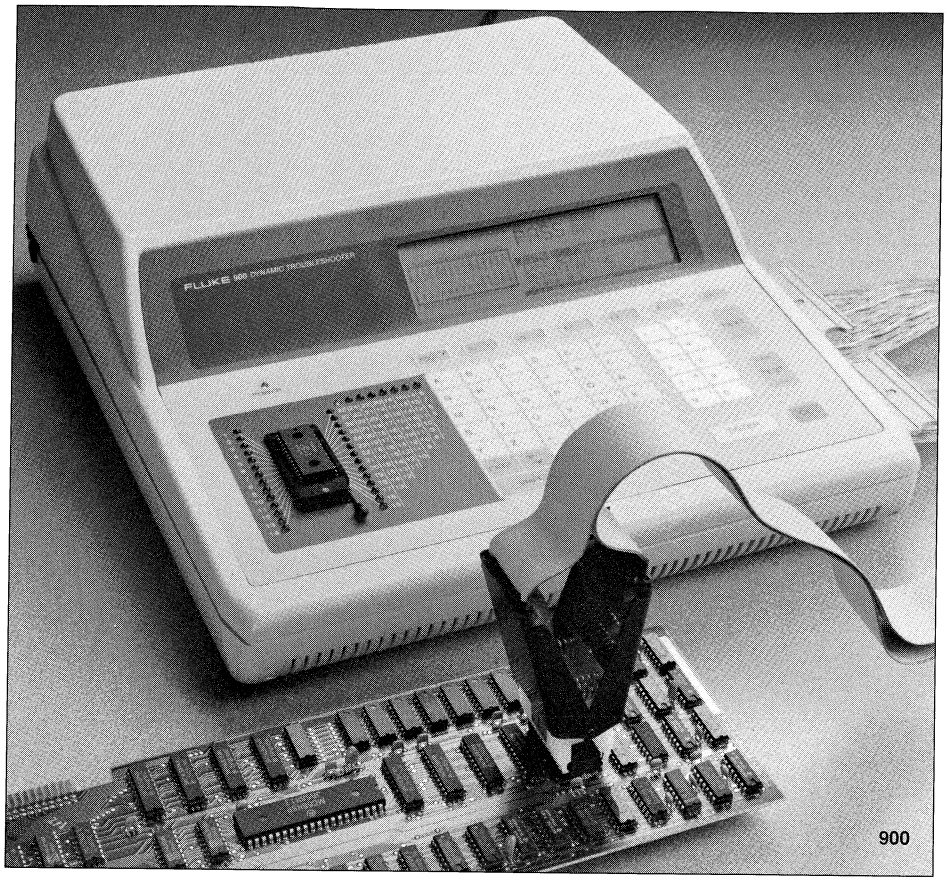
The Dynamic Reference Comparison technique can be applied anywhere on the UUT. It can isolate the bad component in a digital feedback loop, check drivers on a bus circuit, and pinpoint the failing PAL in a memory address decode circuit. The 900 can store the test parameters associated with each chip on a UUT such that this information is automatically recalled when testing suspect boards.

Centralized Repair

When repair is centralized , the **9100A Digital Test System** offers the same advantages to service as to manufacturing: cost effective automated test and troubleshooting for medium volume, large variety board test operations. If large board float inventories are a problem, consider using 9105As at your service centers as functional, Go/No-Go testers. The good boards swapped out of your customer's equipment can be identified and returned to use, while the bad boards are sent to your central site for repair.

Decentralized Repair

For fast customer response and minimal spare board inventory, board repair needs to be close to your customer site. The **9010A Micro-System Troubleshooter,** and the **900** offer the test and troubleshooting capabilities you need at prices you can afford to equip each service center. For an automated solution, programs written on the **9100A Digital Test System** can be implemented on the lower cost **9105A Digital Test Station.** Test software written at the factory or central service headquarters is distributed to the field on the execute only 9105A, offering the control and efficiency of centralized test programming with the low board float of decentralized repair.



900 Dynamic Troubleshooter

- Tests IC at speed while in circuit
- Supports standard and custom devices
- No test programs required
- Detects intermittent timing faults
- Softkey menu for easy operation

The Automated Troubleshooter for Dynamic Testing of ICs, at Speed, While Still in Circuit

The 900 Dynamic Troubleshooter is Fluke's newest addition to the board test product line. It's a powerful diagnostic tool for service and repair of digital circuits. The 900 provides you with a simple but effective means of testing ICs operating at speed, while still in circuit. Unlike other in-circuit testers, the 900 does not force any artificial signals into the UUT, nor does it try to backdrive devices or guard points. Yet with the 900, you can quickly isolate faults down to the individual component. No more "shotgun" attempts to repair a board! And because the 900 uses a proprietary comparison testing technique, you can pinpoint faults with little or no programming, and with minimal knowledge of the board under test or the individual components.

The Fluke 900 tests standard digital components, from SSI to VLSI, including (D)RAM and ROM, as well as custom parts such as PALs, ASICs, and gate arrays, up to 28 pins. Components can be tested both IN & OUT of circuit. But no special software, device descriptions or fixturing is required.

The 900 is not a universal solution, but rather a powerful tool that helps a technician isolate faults rapidly and accurately. A technician can begin using the 900 with very little training. And the 900 can be used as a stand-alone tool, or as a complement to testing with hot mock-ups or emulative testers, such as the Fluke 9010 and 9100 family of digital testers. One of these emulative testers can be used to quickly test the kernel of the UUT, and localize any fault to a subsection of the UUT. The 900 can then be used to isolate faults down to the defective component. A 9010A or 9100A can also be used to stimulate a board that is otherwise dead, so the 900 can then test ICs on the board while active.

A complete 900 tester includes:

- The main unit with graphic display, operator keypad, RS-232 interface port, and ZIF socket for a reference component.
- An interface buffer with high-speed signal conditioning to capture measurements from your board under test. No special pods or adapters are required.
- An assortment of DIP clips to attach to various sizes of ICs, from 8 to 28 pins. J-lead SO version SMD clips are also available.
- Nonvolatile memory cartridges for storing predefined board test sequences, plus patch leads and antistatic reference device tray.

The Power to Solve Even the Toughest Problems

With its combination of unique features, the Fluke 900 excels at diagnosing faults in a wide variety of applications. Among these are:

Real-Time Component Tests While In-Circuit

The 900 tests the Device Under Test (DUT) as it operates in-circuit, in real time, at data rates of up to 20 MHz. The 900 does not backdrive the DUT or guard points, nor force any artificial signals into the UUT. Rather, it unobtrusively monitors the DUT while operating, and compares the DUT's behavior with that of a known good part. The 900 will detect a failure if the response of the DUT differs by greater than 20 nsec from the response of the reference part. The timing tolerance can be adjusted with 10 nsec increments from 20 ns to 200 ns to compensate for normal circuit loading conditions.

Tests Without Software Programs

The 900 tests digital ICs by comparing a known good reference chip to the DUT on the board. Just plug in your reference chip and clip onto the DUT. Since the reference chip serves as a model for the test, the user does not have to write any device timing descriptions or test software. The user can optionally specify a test sequence which lists the preferred order in which ICs are to be tested on a board; any adjustments to the setup parameters for each IC can be added. These test sequences can be stored on non-volatile memory cartridges.

Automate the Reference Device

The RD simulation feature of the Enhanced Option Package provides a virtual reference device without the need to insert actual RD chips. Most standard IC types can be simulated at close to their normal speed. Reference devices are still used for high speed conditions and for new and custom devices.

Detects Intermittent & Thermal Faults

The 900 continuously monitors every pin on the DUT, asynchronously, without clocking or sampling. This insures that intermittent or one-shot faults will be captured, with the same 10 nsec resolution as timing and static faults. The user can choose the duration of a test, so the 900 can be set to capture elusive intermittent faults.

Tests Even When You Have No Documentation

Incomplete or even incorrect documentation is a common problem with today's constantly changing designs. But the 900 can still be applied when limited device descriptions or no detailed schematics are available: known good parts essentially define the tests for components in the UUT. And since reference parts define the test for each chip on the UUT, the 900 can readily test a private-labeled, or proprietary custom IC – even when extensive documentation is unavailable. Of course, a known good board will help determine if any timing resolution adjustments are necessary for individual ICs on the UUT.

Isolates Faults in "Untestable" Circuits

Some testers have difficulty with components in "untestable" circuits, such as ICs wired into loops, or ICs which have internal memory. The 900 readily handles many such common testing problems:

Hardwired Inputs or Outputs. The 900 tests ICs when input leads are tied together, or strapped to supply. Both the reference device and the DUT will see the same data on their respective input pins, and the 900 accepts that as a normal circuit condition.

Components with Internal Memory. (e.g. ICs with latches or counters). The 900 has built-in synchronization routines to put the reference device and the DUT in the same state when the test begins, even if the DUT's internal memory cannot be initialized because control pins are strapped in an inactive state.

Feedback Loops & Apparent Multiple Faults. The 900 breaks feedback loops – an extremely difficult task for most testers. Fast propagation times make the fault appear to be everywhere at once. The 900 analyzes the performance of a chip located in a loop by comparing the outputs of the DUT with those of a known-good reference device in the tester that receives the same input stimulus as the DUT in the loop. Working chips that simply have garbled inputs will pass. But faulty chips will have outputs that are different from the output signals generated by the known-good reference chip.

In addition, the 900 measures and displays the amount of time elapsed until a fault occurs, with 40 nsec accuracy. By identifying the earliest device to fail, the 900 can be used to isolate the defective IC(s) in a circuit with apparent multiple faults.

Bus Devices. The 900 readily tests bus devices, since the 29-channel Gate function can be used to insure that actual testing is performed only when the DUT is active on the bus.

Short Circuits and Open Circuits. The 900 monitors every pin on the DUT for any activity or for activity at a specifiable frequency, and flags any pin when there is no activity – whether due to a shorted node or an open lead. A conventional shorts finder could be used to pinpoint the actual physical location of a short.

Memory Testing. The 900 treats memory devices, even DRAM, like any other logic device. Since all data and timing signals are replicated, the 900 will perform full tests on memory chips. (RAM chips must have memory locations written before being read, so the DUT and reference device will have the same data.)

The Shadow RAM feature of the Enhanced Option verifies that each cell is initialized before comparing data.

Still More Capabilities

The Fluke 900 has several other features which make it an even more effective troubleshooting tool:

Built-in Frequency Counter. The 900 can measure signal activity on all of the DUT pins, plus one additional external node – at up to 25 MHz, accurate to within 0.5%.

User-definable Trigger. A two-word trigger function can be defined from a combination of 28 signals on the DUT's leads plus an external node, to start a test (similar to a conventional logic analyzer). Trigger event detection is a powerful diagnostic tool: it helps isolate the occurrence and then location of a fault.

User-definable Gate. Alternatively, a one-word gate function can also be defined from a combination of the DUT's pins plus an external node. This controls when comparisons are actually made between the DUT and the RD, such as in testing a bus driver. The Delayed Gate feature of the Enhanced Option is used to test such devices when contention is designed into the circuit.

User-definable Test Cycle. The 900 can be set to issue an automatic RESET signal to the UUT at the start of the test for each device. The user can also set the duration and timing of the reset pulse, relative to the comparison test, as well as the length of the overall test.

Nonvolatile RAM Cartridges. Memory modules, 32K bytes, can be used to hold test results, or predefined test sequences.

RS-232C Interface. This supports both software and hardware handshake protocols, and is programmable with data rates up to 19,200 baud.

Automatic Logging of Test Results. The 900 can be set to automatically save detailed test results on a memory pack, or to a device connected to one of the remote interfaces.

Friendly Operator Interface. The 900 has a softkey based menu-driven interface which supports operation of the unit, plus complete creation and editing of test sequences.

Complete Product Training and Support. So that you can get the maximum use out of your 900 right away, Fluke offers a hands-on in depth training course on troubleshooting with the 900. You are entitled to a free certificate for this two day course, with the purchase of a 900. Your account manager has the details.

Theory of Operation

The Fluke 900 operates on the principle of Dynamic Hardware Reference Comparison. This means that the real time operation of the DUT is compared to that of a known good Reference Device (RD). Comparisons are made while the DUT is operating at speed, for data rates up to 20 MHz (not clock rates).

The 900 continuously monitors the DUT and RD to determine which pins are inputs and which are outputs at any given moment; tri-state and bi-directional pins are handled automatically. The 900 is thus able to apply to the input pins of the RD the same signals as are on the input leads of the DUT while still operating in circuit. Simultaneously, the 900 checks for any differences in the outputs of the two chips, and flags these as errors; discrepancies down to 10 nsec are detected.

Some activity on the UUT is necessary in order for the 900 to test the performance of individual ICs. Since the 900 measures and displays the test time elapsed up to when a fault occurs, it can test even boards which crash after just a few machine cycles. In some cases, an emulative tester, such as the Fluke 9010 or 9100, or else a hot mock-up, can be used to stimulate activity on the UUT.

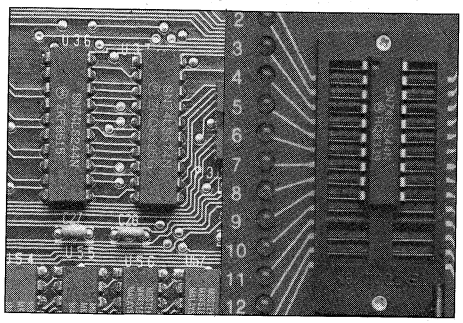
While the 900 isolates faulty components in circuit, it does not backdrive devices or guard points like other in-circuit testers. Instead, it monitors the signals coming into the DUT's pins, and replicates these on the RD; outputs are compared in real time, as the chips operate at normal clock speed.

Of course a RD will not experience the exact same loading as the DUT does in circuit. This can result is slight differences in the response times of the RD and the DUT. The 900 compensates for this by using a specifiable value for the acceptable difference (or fault window) in response times for the two chips – adjustable from 20 nsec on up, in 10 nsec steps, up to 200 ns.

Logic threshold levels can also be specified, at any level between 0 and 5 volts, with a resolution of 100 mV.

900

The fault window and logic threshold voltage levels together define a Performance Envelope against which the DUT is compared to the RD.



To determine the Performance Envelope for various DUTs, a known good board should first be examined. Any ICs on this good board for which the acceptable fault window and/or logic voltage levels differ from the regular setting should be noted. These test adjustments can be stored in non-volatile RAM cartridges, as part of a test sequence for the UUT.

Test sequences can be written for any UUT. Rather than complicated software programs, these test sequences are simply a list of the order in which to test the devices on the UUT, along with any adjustments to the Performance Envelope, and any user-specified trigger or gate words. Comments or instructions to the operator can be included here, for each step in the test sequence. The operator can work through the test sequence in the specified order, simply by pressing the NEXT key for each step, or can jump around within the sequence to a particular component, to take advantage of his experience.

Specifications

Power: 115/230V ac, 47 Hz to 63 Hz, 100W
Storage Temperature: -40°C to +70°C
Operating Temperature: 0°C to +50°C
Size: Main unit, 12 x 15 x 3.5 in (30.5 x 38.1 x 8.9 cm); interface buffer, 8 x 8 x 0.75 in (20.3 x 20.3 x 1.9 cm)
Cable Length: 48 in (122 cm)
Weight: 12 lb (5.44 kg)

Electronic Parameters

Devices Supported: Digital components up to 28 pins, SSI to VLSI capable of driving one LS load; N, S, F, LS, AS, ALS, HC, HCT, ACT, FACT, Open Collector TTL (4000, I4000 CMOS supported with 900-001 option)
Custom Components: PAL, HAL, PLA, FPLA, and Gate Arrays
Memory: Static and dynamc RAM, ROM, PROM, EPROM, FIFO
Fault Discrepancy Resolution: 20 nsec to 200 nsec (adjustable in 10 nsec increments)
Device Initialization and Synchronization: Times programmable from 10 msec to 9990 msec
Test Time: From 1 msec to 9999 msec, or cont
Frequency Counter Measurement: To 25 MHz, <.5% 20% min duty cycle for frequencies >20 MHz
DUT: Tested at data rate of up to 20 MHz
Minimum Pulse Width: 20 nsec
Minimum Slew Rate: 10V/µsec
Pin Loading on UUT: 10 KΩ @ 30 pf
Inputs Protected: To ±25V
Device Logic Levels: 0V to 5V, in 100 mV steps
Trigger Circuit: User-specifiable, two word of 28 pins on the DUT plus one external node; test cycle begins when trigger condition(s) met
Gate Circuit: User-specifiable, one word of 28 pins on the DUT plus one external node. Comparison test is performed only while gate condition is True.
Trigger or Gate: Can be used at any on time
Reset Circuit: Programmable to be positive or negative, is tri-stated when not active; position of reset pulse is programmable relative to test cycle, from ±32760 ms before/after start of comparison test, with 100 msec increments; pulse duration is 10 ms to 32760 ms
Can use either internal power or from the UUT
Internal: Supplied from 5V source; sink/source 50 mA @ .8/4.2V
External: Supplied from UUT (2V to 15V); sink/source 50 mA @ 0.8/V_{ext} -0.8V

Ordering Information

Model

900 Dynamic Troubleshooter
Includes: 900 Main Unit
Interface Buffer
Three Test Clips:
Y900-16D 16-pin, 0.3" Test Clip
Y900-24D 24-pin, 0.3" Test Clip
Y900-28D 28-pin, 0.6" Test Clip
Y900-001 Data Cartridge
Y900-005 Set of Patch Cords
Y900-003 RD Tray & Cartridge Holder
User's Manual
Power Cord

Options & Accessories

900-001 RD simulation option with Shadow RAM and Delayed Gate feature
Y900-001 Data Cartridge
Y900-002 Data Cartridges, set of 3 in Tray Y900-004
Y900-003 RD Tray & Cartridge Holder
Y900-004 Data Cartridge Tray, for 3 Cartridges
Y900-005 Patch Cords & Clips, set of 5
Y900-006 Carrying/Shipping Case
Y900-8D Test Clip, 8 Pin Dip, 0.3"
Y900-14D Test Clip, 14 Pin Dip, 0.3"
Y900-16D Test Clip, 16 Pin Dip, 0.3"
Y900-18D Test Clip, 18 Pin Dip, 0.3"
Y900-20D Test Clip, 20 Pin Dip, 0.3"
Y900-24D Test Clip, 24 Pin Dip, 0.3"
Y900-24DW Test Clip, 24 Pin Dip, 0.6"
Y900-28D Test Clip, 28 pin Dip, 0.6"
Y900-8S Test Clip, 8 Pin S.O.I.C.
Y900-14S Test Clip, 14 Pin S.O.I.C.
Y900-16S Test Clip, 16 Pin S.O.I.C.
Y900-16SW Test Clip, 16 Pin S.O.I.C.
Y900-20S Test Clip, 20 Pin S.O.I.C.
Y900-24S Test Clip, 24 Pin S.O.I.C.
Y900-28S Test Clip, 28 Pin S.O.I.C.

9100 Series

GPIB
IEEE-488



9100A

9100 Series Digital Test System

- Test and Troubleshoot digital circuitry with or without a microprocessor
- Interface with over 50 different microprocessors from 8 to 32 bits
- Pre-programmed functional tests for RAM ROM and the microprocessor bus
- Multi point or single point testing with I/O modules and a single point probe
- Integrated program development environment
- GPIB/IEEE-488 interface for use with analog instrumentation (Available early 1990)

The 9100 Series is Fluke's top of the line digital tester and troubleshooter. It is designed to functionally test and quickly isolate faults in digital circuits.

The 9100 Series is made up of two testers: the 9100A Digital Test System, and the 9105A Digital Test Station. Both have the same test and fault-finding capability and interface with the unit under test (UUT) through the following hardware components:

- Interface pods for connecting to and controlling the microprocessor kernel.
- Single point probe to measure UUT responses at any node within or beyond the microprocessor kernel; the probe can also provide stimulus at any node.
- I/O modules for measuring and stimulating up to 160 nodes simultaneously.
- GPIB/IEEE-488* interface for incorporating analog measurement capability.

Both the 9100A and 9105A can be used to test and troubleshoot digital circuitry using the front panel keyboard. In the hands of an experienced technician or engineer, the pre-programmed functional tests and stimulus functions can be used to isolate many faults without writing a single program.

In addition to the capabilities mentioned above, the 9100A can also be used for writing test and troubleshooting programs by adding an optional programming station. The programming software makes it possible to develop customized functional and troubleshooting programs for your UUT. Test program design is highly automated, guiding the test or service engineer through the development process. Combined with new state-of-the-art test hardware, complete digital board test and repair solutions can be implemented in record time.

The lower cost 9105A, an execute-only tester, was designed to provide an economical solution for customers desiring a multi-station production or service line. Except for programming, both testers have the same capabilities. Once programs are developed on a 9100A, they can be transported to the 9105A and executed. The 9100A and 9105A combine to offer unmatched power, flexibility, and economy to factory board test and service center repair.

Test Techniques for Every Part of the Board

The 9100 Series can detect and isolate faulty components within digital circuits – on or off the microprocessor bus, in both synchronous and asynchronous circuitry. The test techniques employed by the 9100A – signature analysis, logic level detection, frequency and event counting, pulsing, vector stimulus and emulative testing – have been standard in the test industry for many years. Fluke has put all these test techniques into one instrument and made the 9100A a powerful, as well as flexible, piece of test equipment.

Through the IEEE-488 interface the 9100 Series can control and retrieve information from external test equipment, such as DMMs, signal generators, and counter/timers. The IEEE-488 interface makes it possible for the 9100A to use analog measurements as well as digital measurements in testing and troubleshooting a UUT. The 9100 Series can also be controlled by an IEEE-488 controller, for use in an IEEE-488 test system.

Test connection. Connecting to the UUT can be accomplished through a number of techniques. Fluke's family of interface pods will provide a connection to the UUT's microprocessor kernel. Each interface pod is designed specifically for testing kernel circuitry, and cover a broad range of microprocessors. A single point probe and two types of I/O modules let you test digital circuitry beyond the kernel. Together, these capabilities let you test your products more thoroughly and with a higher degree of confidence than ever before.

Emulative Testing for the Kernel

At the heart of Fluke's approach is a technique which we developed known as emulative testing – so called because the tester emulates the microprocessor's action on the UUT. Technicians the world over prefer this technique for finding faults in kernel circuitry because it offers the quickest way to locate faults: by testing boards from the inside out.

The 9100 Series Testers use two different methods of interfacing with the kernel of a UUT: memory and microprocessor. Two different techniques with one common goal: bus control. Once the 9100 gains control of the microprocessor bus, it can emulate the microprocessor operation for the purpose of circuit stimulation or transfer of data. At this point, the 9100 Series testing capability can be brought to bear on the target UUT. For further information about these pods see the following interface pod section.

Pre-programmed BUS, RAM and ROM tests. Testing the microprocessor BUS, RAM and ROM circuitry is quick and simple with the 9100 Series' pre-programed tests. Because these circuits operate the same way on all microprocessor-based boards, Fluke designed the tests so they will run just by simply connecting to the UUT's kernel through an interface pod and providing address information when prompted through the display. The result is a series of tests that can be executed immediately. Each test uses an extensive set of fault messages to report test results to the operator through the 3-line display.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

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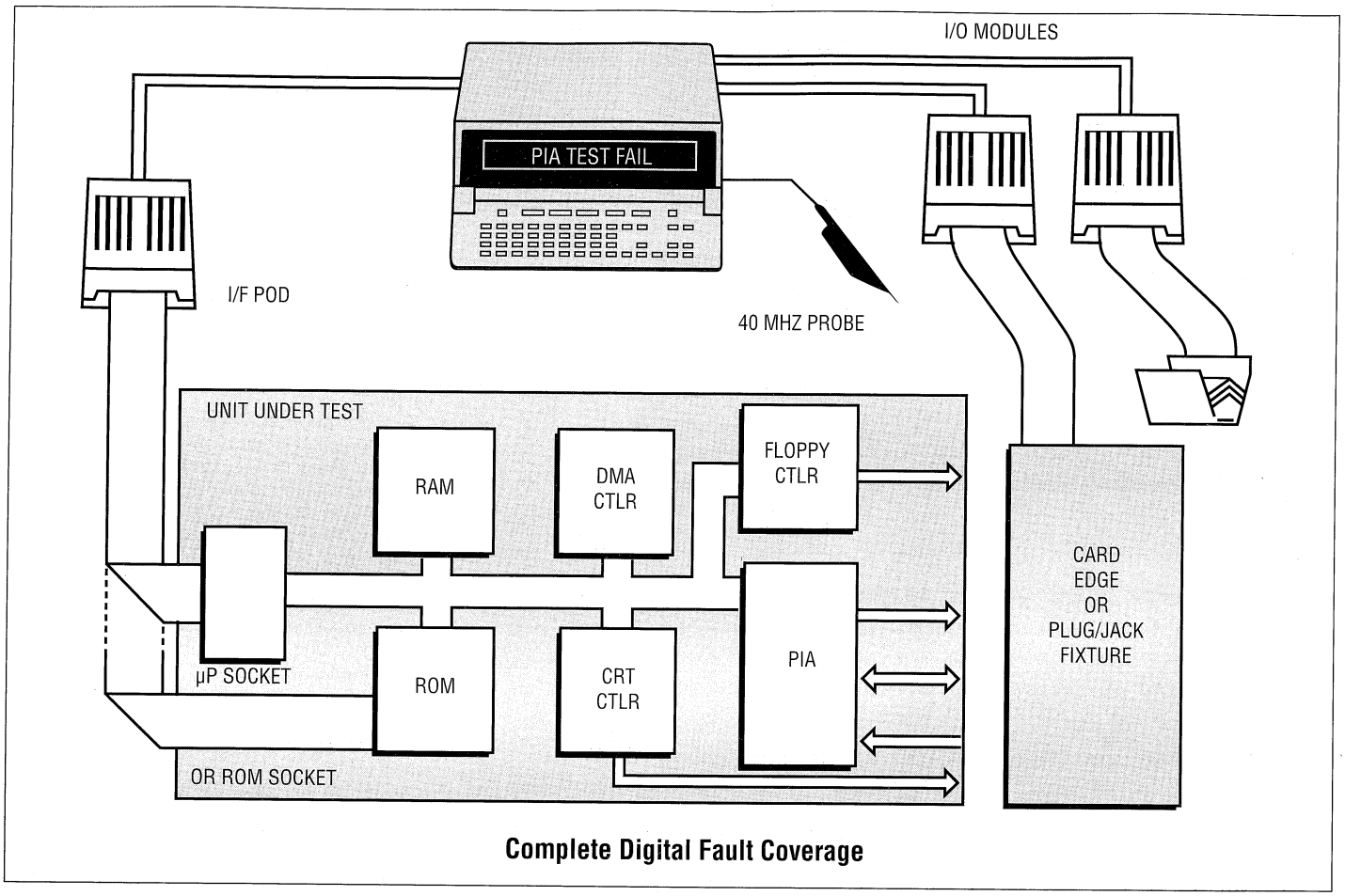
9100 Series



Complete Digital Fault Coverage

Testing Beyond the Kernel

To cover those areas of your UUT that are not tied to the microprocessor bus, we have added a single-point probe and two types of I/O modules. Both probe and I/O modules help facilitate testing of circuitry both on the microprocessor bus as well as those off the bus, such as video RAM, RS-232, PIAs and other peripheral circuitry.

I/O module for multiple-point testing. There are two types of I/O modules: Vector Output and Parallel. Each will connect up to 40 different points on a UUT at once. The 9100 Series accommodates up to four I/O modules at one time, allowing you to test as many as 160 pins simultaneously.

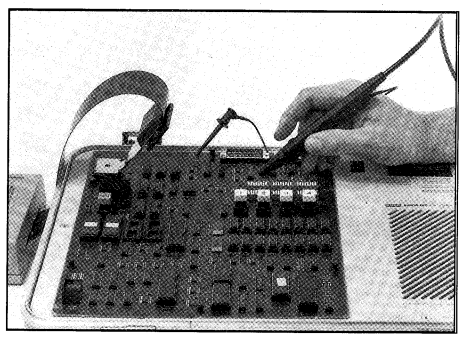
Both the Vector Output and Parallel I/O modules are identical as far as gathering data on a test point. Each of the 40 pins can take a signature, detect levels, and count events or frequency, all at one time. These measurements can be made in synchronization with microprocessor bus cycles as well as asynchronously through the modules external connections for CLOCK, START, STOP and ENABLE. Where these two modules differ is in their output characteristics.

The Vector Output I/O module has, as its main feature, the ability to output data on its pins at rates up to 25 MHz. Each pin of the I/O module has 8192 bits of RAM behind it, making it possible to generate test vectors (parallel patterns) for functional testing and troubleshooting. The stimulus can be clocked by an external source or an internal clock selectable to 1, 5, 10 or 20 MHz. The clocks can be qualified by the module's external START, STOP and ENABLE lines. The vectors can also be clocked synchronously with the microprocessor's control signals, such as read and write.

The high speed vector generation capability of the Vector Output I/O module can emulate many common buses. An external input, WAIT, synchronizes the output vectors to the bus cycle ready state. Separate drive and receive clocks allow the vectors to be driven independently of the data input sampling.

The higher speed Vector Output I/O module lends itself well toward applications where high speed parallel stimulus and bus emulation are needed.

The Parallel I/O Module adds overdrive capabilities at the expense of the higher stimulus speeds on the Vector Output I/O Module. Using the pulse feature of the Parallel I/O module, you can overdrive a node to a desired level, thereby testing a device while it is actively driving the circuit. Used with the 9100A's programming capability, the I/O module can emit a string of data patterns at a rate of about 35 kHz and can use up to 200 mA to overdrive a node.



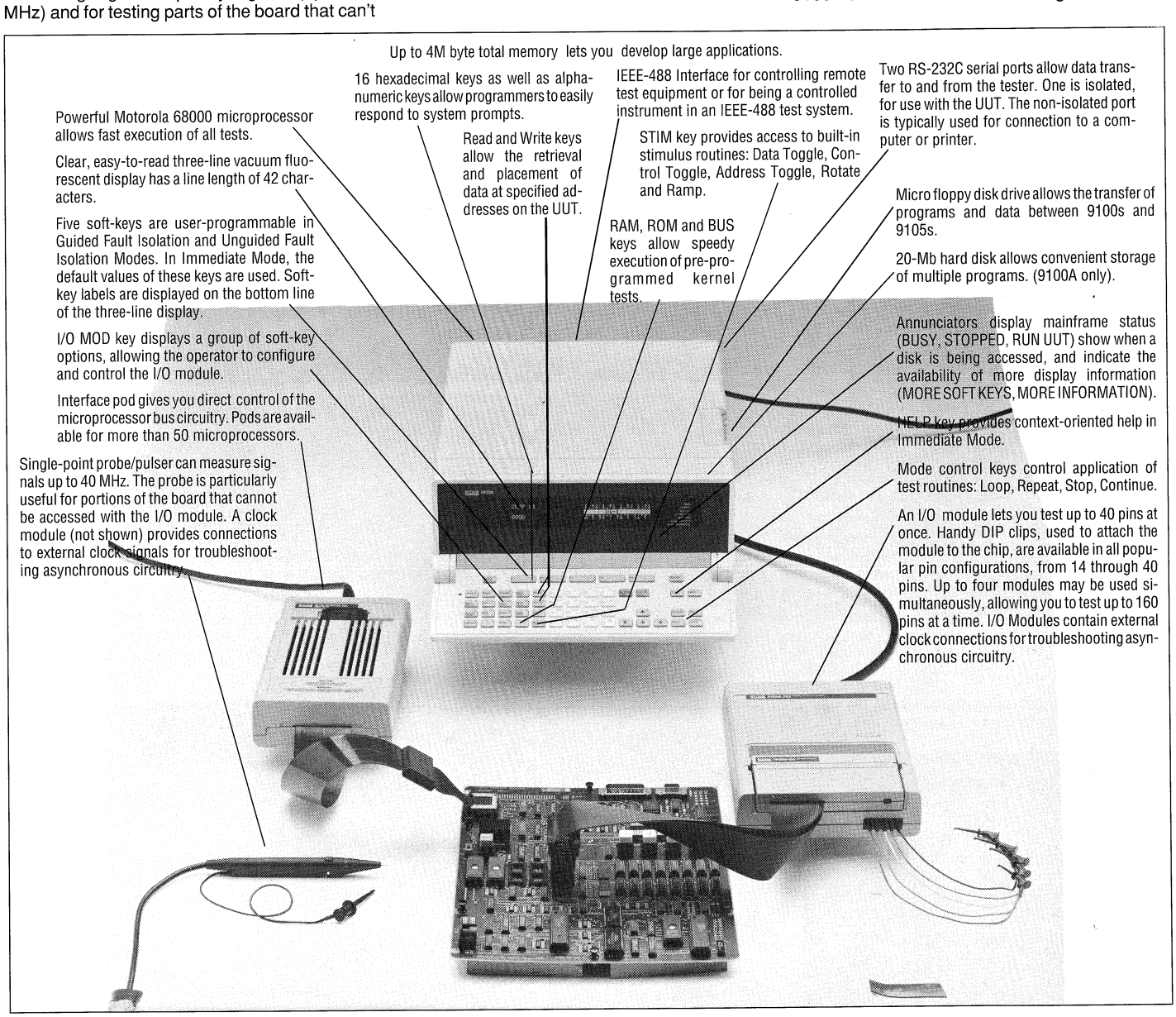
Flexible Board Connections. Several types of interface adapters are available to physically connect I/O modules to the UUT. A 20-flying lead adapter is supplied with each I/O module, allows you to make your own connections to the board edge, bed-of-nails fixture, or a customized test fixture. You can also use any of the various clip adapters for clipping the I/O module directly onto the chip being tested. A card edge fixture kit is also available for connecting the I/O modules to the UUT.

Single point probe for high-frequency signals. The single point probe has all the capabilities of the Parallel I/O module, except it is used to test only one point at a time. It's useful for measuring higher-frequency signals (up to 40 MHz) and for testing parts of the board that can't be accessed with an I/O module. Additionally, the probe's threshold levels for signatures, logic level detection and counting can be selected between TTL, CMOS or RS-232 logic.

Variable delay for fine tuning measurements. Both the I/O Modules and the Single Point Probe sense logic levels for all input measurements. A measurement taken at a circuit node on one UUT, may appear differently on the same circuit of another UUT, due to slight timing differences in the two circuits; even though both UUTs function perfectly. This difference is usually a result of trying to detect a level at or near a level transition point. Although these UUTs are good, the signature or level count computed will be different, causing ambiguity. To alleviate this ambiguity, the 9100 Series has a software controlled variable delay which can be used to adjust the actual measurement time to a more stable point in the waveform.

Ways to Use the 9100A

The 9100 Series was designed to fit in with whatever level of technical expertise you may have. Highly skilled technicians and engineers may find using the 9100A in the immediate mode most useful to them, while a less experienced technician may need some written programs to help them locate faults. A fully programmed 9100A will make your test operators as effective as your most experienced technician using the 9100A's Guided Fault Isolation algorithm.



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9100 Series

Manual operation lets you start testing immediately. The Immediate mode lets you begin using your 9100 Series tester the first day you get it, without having to write any program code at all. With the pod connected you can execute any of the pre-programmed tests (BUS, RAM & ROM). Then with your knowledge of the UUT and troubleshooting functions of the 9100A, you can isolate faulty components using the 9100 Series front panel.

If you find yourself keying in the same steps over and over again, you can use the Key Sequence function to store those steps and execute them using only a few keystrokes. This is a good technique for circuit setup commands and commonly used stimulus steps.

Unguided Fault Isolation (UFI) for the experienced troubleshooter. UFI is a semi-automatic troubleshooting process where the operator decides which nodes to test. After typing in the node through the keyboard, the 9100 Series will execute the appropriate stimulus programs and compare the measured response to that of a known good node. The operator is prompted, through the display, whether the node passed or failed the test. It is left up to the operator to decide what to do next.

This mode of operation takes the tedium out of having to make all the keystrokes necessary to execute a stimulus and the need to interpret each response. The operator can concentrate on the fault isolation process, thereby reducing the time needed to find the faulty component. For an experienced troubleshooter who wants some degree of automation, Unguided Fault Isolation is the preferred method.

Guided Fault Isolation (GFI) for the non-technical operator. For fully automated operation, the 9100A Series provides Guided Fault Isolation capability. In this mode, the operator enters no data and makes no decisions. All necessary data – stimulus routines, reference lists, parts lists, known-good responses, and interconnectivity information – are contained in the program. The system tells the operator what nodes to probe and interprets all response data.

The 9100A Programming Environment (With Options -004 and -005)

You'll find that programming the 9100A is simple and straightforward, whether you're writing a functional test or guided fault-isolation routine. Both hardware and software are designed to make the programmer's task easy.

Programming is performed through an 80-column, 24-line CRT and a standard computer-style (QWERTY) keyboard. The keyboard also includes nine soft keys with built-in functions to speed program development. The -005 includes the keyboard and a color video card to support a customer-supplied color monitor.

Special test language. The 9100A uses a programming language designed specifically for developing test and troubleshooting routines. Its command list incorporates all of the 9100 functions, program control constructs, and allowed variables, making it a well-rounded language for writing test programs.

Numerous features are designed into the programming software to make the programmer's job easier. Key among these are:

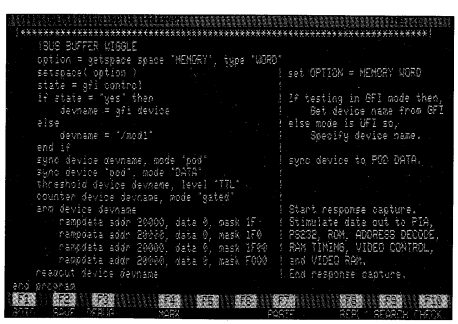
- Provision for default entries on most commands, simplifying the process of creating test routines
- Built-in fault handlers that you can incorporate in your routines. (You can also choose to override these built-in fault handlers with custom-created ones).

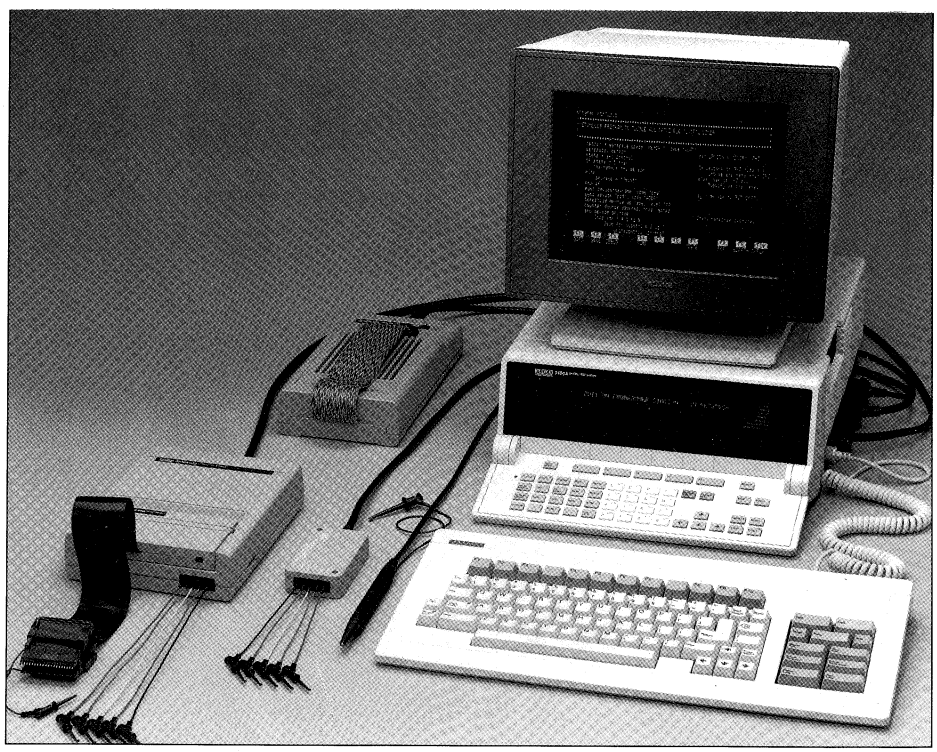
You can write functional tests incorporating the microprocessor interface pod, I/O modules, and probe. The 9100A programming software also includes a built-in debugger that tests program execution and identifies the location of any run-time errors it finds. The debugger is closely integrated with the program editor. With a single press of a soft-key, you will move from the editor right into the debugger without any need to compile your source code program. A number of soft-key selections for execution, displaying and changing variables, inserting break points as well as others are at your disposal while in the debugger. When you find a problem, you can jump right back into the source file and make your changes just by pressing one key.

Automated Response Gathering. The Task of gathering responses from a "known-good" UUT can be time consuming and tedious. The automated learn features of the 9100 Series can make gathering responses a lot easier and faster.

Individual nodes or a collection of nodes can be learned all at one time simply by listing the nodes and starting the learn function. Once the node(s) are probed or clipped the 9100 Series will run the appropriate program(s) and then display the results. Using the "Select" soft-key, you can indicate which measurement(s) you want to be used in determining if a node is good or bad. Once all the selections are made and you quit the learn mode, all selections are saved for later use when testing defective UUTs.

Off-Line Programming Tools. For those users who prefer to write test programs on a PC using their favorite editor, we have a series of options which make it easy to check and transfer programs between the 9100A and a PC. Communication between the 9100A and the PC can be accomplished either through an RS-232 or the higher speed Ethernet connection. Program development and file management are two key features of the Off-Line Programming Tools package.





Upward Migration from 9010A to 9100A. For 9010A users who require upward compatibility of their existing programs to the 9100A, there is a translator available for this purpose. The 9010A to 9100A Program Translator (9100A-030) will take a 9010 program listing and convert it to appropriate TL/1 commands for use on a 9100A or 9105A.

Customer Support Services

Fluke's support programs are designed to meet the needs of a wide variety of users.

Applications programming & fixturing. Authorized, factory trained Fluke Cooperative Service Partners are available to integrate the 9100A into your unique test system and write your test software. See Section 16 for details.

Training. Fluke offers training that will start you using your 9100A quickly and effectively. The 9100A training program is divided into two parts. The second part may be taken directly after the first, or you have the option of returning later. Certificates for both parts are included with every 9100A/SYS.

Part I: A four day class which teaches the basics of 9100A operation from immediate mode keystrokes to the development of functional tests. In this class you will learn to partition the UUT for more effective testing. You will learn to stimulate the UUT using built-in functions, microprocessor pod operations, and I/O modules, and then gather responses and find actual faults. Finally, you will gain an understanding of the TL/1 programming language, editor, and program debugger.

Part II: A four day class on writing sophisticated functional test and automated diagnostic programs. Emphasizes testing of difficult but common circuitry such as DUARTs, PIAs, DMA Controllers, Interupt Controllers, and video circuitry. In this class you will examine different test strategies and learn how to write functional tests, stimulus programs, and review the data base for Unguided Fault Isolation and Guided Fault Isolation. Test equipment includes 9100A options such as the 9132A Memory Interface Pod and the 9100A-017 Vector Output Module.

Worldwide Network of Technical Centers. Fluke's worldwide network of technical centers makes it easy for you to maintain and service your system, no matter where your operation is located.

Standard Warranty. The 9100A Series tester comes with a one-year warranty, including both time and materials. Warranty service is available at our U.S. Fluke Technical Centers, and worldwide.

Extended Warranty Agreement. All 9100A mainframes, options and accessories come with a one year warranty. A one year, renewable, cost-effective Extended Warranty, covering all repairs with performance testing, including parts, labor and return surface freight costs. This is guaranteed to keep your cost of ownership low. This warranty will be discounted 10% if purchased with the instrument or if purchased prior to expiration of product warranty.

On-Site Service. Even if you have an application where up-time is critical, Fluke can help with On-Site Service Agreements.

Software Support Agreement

A software support agreement is a renewable agreement that provides for automatic software updates during the covered period. Software releases which enhance the speed or performance of system and/or programmer's system software operating on the 9100A and 9105A will be made available to Software Support Subscribers at no additional cost. Manual revisions and updates are included.

In addition, Software Support subscribers have automatic membership in the 9100 Electronic Bulletin Board, an on-line users group. The Electronic Bulletin Board provides easy access to other 9100A users and experts at Fluke for the purpose of sharing information, TL/1 programs, papers, and more. Access to the Electronic Bulletin Board is available through a special toll-free 800 number (US only), using any terminal, including a 9100A connected through a modem.

9100 Features

Mainframe: 20M byte Hard Disk for program development and storage (9100A). Single Micro-Floppy drive with 640K byte capacity. Two (9105A) 640K byte formatted Micro-Floppy Drives standard for software loading, storage and copying. 4M bytes of internal RAM for program development and execution. Plug-in connectors for 1 pod and 4 I/O modules (both Parallel and Vector Output). Dual RS-232 Interfaces, one system reference, one earth referenced.
Display: 3 line, 42 character vacuum fluorescent dot matrix with graphics capability.
Keypad: User keyboard allows access to all functions. Seldom used functions are called with soft keys.

Pre-Programmed Tests

RAM: Allows selection of one of three possible tests for finding faults associated with RAM circuitry.
ROM: Reads ROM data and computes signatures and compares with know-good signature.
BUS: Checks the integrity of address, data and control bus lines.

Troubleshooting Functions

Read: Reads data from a specified location.
Write: Write data to a specified location.
Toggle: Toggles a specified data, address or control bit.
Ramp: Ramps the data or address bus over all possible values with a specified starting value and a mask of bits to be ramped.
Rotate: Rotates right a specified starting word through all possible bit positions.

Probe

Features: CRC signatures with external clock, start, stop, and enable; CRC signatures with external clock, start, and stop generated form a programmable number of clock pulses after start; CRC signatures with the clock from the pod sync; 24 bit transition counting using external start, stop, and enable; Frequency measurement to 40 MHz; Clocked 3-state logic level history using external clock, qualified with start, stop, and enable; Clocked 3-state logic level history using microprocessor pod sync clock; Asynchronous 3-state level history in all modes; Selectable thresholds for TTL, CMOS, and RS-232 levels; Three logic level indicators on the handheld probe body; Probe output drive for high, low or toggle synchronized to pod sync, external clock or free run; Probe response button to signal the mainframe to gather response data; Common lead fused for both the probe and clock module to provide ground fault protection, with blown fuse indication.

Software

Programming: The user creates and debugs test or troubleshooting procedures with the programmer's station option. This gives the user full access to a screen oriented editor and integrated procedure debugger. Test procedures generated on the 9100A can be transported and executed on other 9100A/9105A systems via the 3.5 inch micro-floppy media.
Language: The test language, called TL/1, is used by a test engineer to specify automatic test and troubleshooting procedures. TL/1 is an easily read high level language designed for complete control of the functional test and GFI test environment. The language includes the 9010A language testing concepts. Enhancements are provided in the area of fault handling, UUT initialization and interface to GFI procedures.
Edit/Debug: Procedure editing and debugging are integrated to present a unified means of testing and modifying procedures. The editor is screen oriented, and always provides the user with a current picture of the procedure being edited. The debugger provides many features such as breakpoint, tracing and access to variables by name.
Guided Probe/Clip Troubleshooting: A menu-driven software package makes it easy for a technician to specify node list information and accumulate signatures from a good UUT. During troubleshooting, this information is used to guide the operator. The operator is told where to place the probe or IC clip to track down the fault.
Executing: The procedure execution environment on the 9100A and the 9105A will also run on the 9105A. Procedures are transported from the 9100A to the 9105A on a 3.5 inch micro-floppy disk.

9100 Series

I/O Module Features

Both Parallel (9100-003) & Vector Output I/O (9100-017) Modules

Features: 40 channels per I/O module. Up to 4 I/O modules on one mainframe (160 channels). CRC signatures with Start, Stop, Enabled clocked to pod or external clock. CRC signatures with stop derived from a programmable number of clock pulses after Start (with TL/1). Enable can be derived from the external enable line, or from POD Sync, or can be forced true. Programmable slopes on clock, Start, Stop and Enable. CRC signatures can be taken while driving pin(s). Transition counter gated by external Start, Stop, and Enable. Frequency measurements to 10 MHz. Clocked level history using external clock; qualified with Start, Stop, and Enable. Asynchronous level history. Comparison of any arbitrary 40 bit pattern with a programmable 40 bit pattern of 0's and 1's. True comparison available as a fault within TL/1 programs or as a message during immediate mode operation. The hardware signal (DCE), is also available on the outside of the I/O module. Logic thresholds switchable between CMOS and TTL. Family of DIP and SMT logic clip modules with response button to start response gathering. Common lead fuse protection, for ground fault protection with blown fuse indication.

Vector Output I/O Module (9100A-017)

Features: High speed vector generation (parallel patterns). 8192 bit deep vector patterns. Bus emulation using WAIT signal for bus sychronization. Looping capability for repeating vector patterns up to 65,536 times. Internal or external clocking of vectors. Synchronization to microprocessor READ or WRITE cycle. External or internal 3-state control signal. Vector editor included with 9100A Programmer's System software.

Parallel I/O Module (9100A-003)

Features: 256 deep patterns. Latched or overdrive capability on each channel.

Manuals

Getting Started: A description of the parts of the 9100A/9105A, what they do, how to connect them, and how to power up.
Automated Operations Manual: How to run pre-programmed test or troubleshooting procedures.
Technical User's Manual: How to run built-in tests and manual or pre-programmed troubleshooting procedures.
Applications Manuals: How to write test or troubleshooting programs using the 9100A's TL/1 programming language.
Programmer's Manual: How to use the programming station with the 9100A to create automated test or troubleshooting procedures.
TL/1 Reference Manual: A description of all TL/1 commands arranged in alphabetical order for quick reference.
Supplemental Pod Information Manual: Provides information about the POD databases in the 9100A and how to use them when a specific pod is in use.

Specifications

9100A/9105A Electrical Specifications

Single Point Probe Input Thresholds

TTL	CMOS	RS-232	
5.0V	5.0V	30V	Guaranteed HIGH
2.6V	3.7V	3.2V	HIGH or INVALID
2.2V	3.3V	2.8V	Guaranteed INVALID
1.0V	1.2V	-2.8V	LOW or INVALID
0.6V	0.8V	-3.2V	Guaranteed LOW
0.0V	0.0V	-30V	

Input Impedance: 70 kΩ shunted by less than 33 pF

Data Timing for Synchronous Measurement
Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec
Minimum Pulse Width (tri-state): 20 nsec

Setup Times
Data to Clock: 5 nsec
Start, Stop or Enable to Clock: 10 nsec

Hold Time
Clock to Enable: 10 nsec
Clock to Start or Stop: 0 nsec

Data Timing for Asynchronous Measurements
Maximum Frequency: 40 MHz
Minimum Pulse Width (H or L): 12.5 nsec

Minimum Pulse Width Invalid (X)
TTL or CMOS: 100 nsec ±20 nsec
RS-232: 2000 nsec ±400 nsec

Transition Counting
Maximum Frequency: 40 MHz minimum
Maximum Count: 16777215 +overflow
Maximum Stop Count: 65535 clocks

Frequency Measurement
Maximum Frequency: 40 MHz minimum
Resolution: 20 Hz
Accuracy: ±250 ppm ±20 Hz

Output Pulser
High: >3.5V @ 200 mA for less than 10 µs; @ 1% duty cycle >4.5 @ 5 mA continuously
Low: <.8V @ 200 mA for less than 10 µs; @ 1% duty cycle <.4V @ 5 mA continuously

Clock Module Specifications
Input Threshold: 1.6V ±0.2V
Input Impedance: 50K shunted by less than 10 pF

Clock, Start, Stop, and Enable Input Speed
Maximum Repetition Rate: 40 MHz
Minimum Pulse Width: 12.5 nsec

RS-232 Interfaces
One isolated (system referenced); One non-isolated (earth referenced)
Baud Rates: 110, 134, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200
Parity: Odd, even or none
Data Bits: 5, 6, 7, or 8
Stop Bits: 1, 1.5, 2
XON/XOFF (Ctrl-S/Ctrl-Q): Disable/enable
Clear to Send: Disable/enable
New Line: Carriage Return/Line Feed or Carriage Return

General Specifications

Operating Temperature: 5°C to 27°C 95% RH maximum (non-condensing); 27°C to 40°C; RH decreasing linearly from 95% to 50% (non-condensing)
Storage/Shipping Temperature: -20°C to 60°C; 8% to 80% RH, non-condensing; micro-floppy media limited to 5°C to 60°C, 8 to 80% RH non-condensing
Line Voltage: 90V to 132V ac 47 Hz to 440 Hz; 180V to 264V ac 47 Hz to 63 Hz
Power Consumption: Mainframe, 150W max; monitor, 50W max
Safety: Designed to meet the following safety standards: ANSI/UL 478, IEC 348, IEC435, and CSA 5568

Size
Mainframe: 14.0 cm H x 34.3 cm W x 50.8 cm D (5.5 in H x 13.5 in W x 20.0 in D)
Monitor: 30.53 cm H x 33.53 cm W x 33.00 cm D (12.02 in H x 13.2 in W x 13 in D) ASCII
Keyboard: 5.02 cm H x 21.15 cm W x 47.2 cm D (2.0 in H x 8.33 in W x 18.51 in D)

Weight
Mainframe: 8.26 kg (18.2 lb)
Monitor: 8.44 kg (18.6 lb)
ASCII Keyboard: 1.59 kg (3.5 lb)

Options

9100A-017 Vector Output I/O Module Input Specifications

Input Impedance: 50 kΩ minimum, 90 kΩ typical; 100 pF maximum, 65 pF typical
Operating Voltage Range: -0.5V to +5.5V (all lines)
Input/Output Protection: +10V/-5V for one minute maximum, one line only

Input Thresholds

TTL	CMOS	
5.0V	5.0V	Guaranteed HIGH
2.6V	3.4V	HIGH or INVALID
2.1V	2.9V	Guaranteed INVALID
1.0V	1.2V	LOW or INVALID
0.6V	0.8V	Guaranteed LOW
0.0V	0.0V	

Clock, Start, Stop, and Enable Inputs

Thresholds
Logic Low: 0.8V maximum
Logic High: 2.0V minimum
Input Current: +1 µA, -125 µA
Input/Output Protection: +10V/-5V for one minute maximum, one line only

Transition Counter
Maximum Frequency: 10 MHz
Maximum Count (Transition Mode): 8,388,608 (23 bits) counts (+ overflow)
Frequency Accuracy (Frequency Mode): ±250 ppm ±2 Hz

Stop Counter
Maximum Frequency: 10 MHz
Maximum Count: 65,535 clocks

Clock
Maximum Frequency: 10 MHz
Minimum Pulse Width: 50 ns

Timing for Synchronous Measurements
Maximum Frequency of Clock: 10 MHz
Maximum Frequency of Data: 5 MHz
Data Setup Time: 30 ns
Data Hold Time: 30 ns
Minimum Pulse Width: 50 ns (Start, Stop, Enable, Clock)
Start Edge Setup Time: 0 ns (before clock edge, for clock edge to be recognized)
Stop Edge Hold Time: 5 ns (after clock edge, for clock edge to be recognized)
Enable Setup Time: 0 ns (before clock edge, for clock edge to be recognized)
Enable Hold Time: 10 ns (after clock edge, for clock edge to be recognized)

Data Timing for Asynchronous Measurements
Maximum Frequency: 10 MHz
Minimum Pulse Width: 50 ns (high or low)
Minimum Pulse Width: 150 ns (tri-state)

Data Compare Equal
Minimum Pulse Width of Data & Enable: 75 ns

Output Specifications

Output specifications were determined using a Fluke Y9100A-102 Card Edge Interface Module connected to 10 LS loads. Actual output results will vary depending on the impedance, length, and shielding of the connections used.

Vector Width (w/1 module): 40 channels
Vector Width (w/the max 4 modules): 160 channels
Vector Depth (without looping): 8,192 vectors
Vector Looping: Up to 65,536 repetitions of any one vector loop set. Each loop set must contain a minimum of two vectors.

Output Logic Levels
High: 3.7V minimum (6.0 mA source)
Low: 0.4V maximum (6.0 mA sink)

Drive Clock Sources
External Drive Clock (DR CLK): 25 MHz maximum (maximum may be exceeded in some cases, depending on the impedance, length, and shielding of the connection to the unit under test (UUT)); minimum pulse width: 4.5 ns high or low
Internal Drive Clock (INT CLK): 1 MHz, 5 MHz, 10 MHz, or 20 MHz, ±100 ppm
Pod Sync Clock: Available drive clock pod sync modes will depend on the interface pod type
Internal Soft Clock: Executed from a TL/1 program
Vector Out Time Delay From Clock Source: Delay (t_{del}) from DR CLK to vector out: 50 ±8 ns. Delay (t_{del}) from INT CLK to vector out: 37.5 ±7.5 ns
Handshake Line (WAIT) Setup Time (t_{wsu}): 42.5 ns maximum (35 ns typical) from WAIT edge until a clock cycle drives vector out. If the setup time is not met, the next clock will drive out the vector.
Single Module Channel to Channel Skew: 6 ns maximum; 1 ns typical
Multiple Module Channel to Channel Skew: 10 ns maximum; 1 ns typical

External Tri-State
Tri-State Activation Setup Time (t_{xout}): Output drive release 20 ±5 ns after $\overline{\text{TRISTATE}}$ goes low, minimum tri-state pulse width: 10 ns
Tri-State Recovery Setup Time (t_{xsu}): $\overline{\text{TRISTATE}}$ must go high within 5 ns after the rising edge of INT CLK, or within 10 ns after the selected edge of DR CLK. If the setup time is not met, the next vector is skipped over while the output remains tri-stated; the following clock will output the next vector.

Capture Clock Delay (t_{cap}): Delay from non-clocking edge of DR CLK: 55 ±10 ns. Delay from falling edge of INT CLK: 42.5 ±5 ns.

Start, Stop, and Enable Setup Times
Start Setup Time (t_{str}): 20 ns before DR CLK, 30 ns before INT CLK maximum
Stop Setup Time (t_{stp}): 20 ns before DR CLK, 30 ns before INT CLK maximum
Enable Setup Time (t_{en}): 15 ns before DR CLK, 25 ns before INT CLK maximum
Enable Hold Time (t_{enhld}): 35 ns after DR CLK, 20 ns after INT CLK maximum

Control Line Input Impedance
External Drive Clock (DR CLK): 40 kΩ minimum, 35 pF maximum
External Tri-State ($\overline{\text{TRISTATE}}$): 40 kΩ minimum, 80 pF maximum
Handshake (WAIT): 40 kΩ minimum, 50 pF maximum
Vector Output Series Termination: 33Ω

9100A-003 Parallel I/O Module Input Specifications

(Same as 9100A-017 Input Specifications)

Output Specifications

Current, Time >10 mS: ±200 mA ±10%
Current, <10 mS: ±2A ±10% (TL/1 write pattern only)
Pattern Rate, 1 Module Driven: 35 kHz
Pattern Depth, 1 Module Driven: 256 patterns
Min Pulse Width (tri-state): 150 nsec
Data Compare Equal (DCE): Min pulse width of
Data and Enable: 75 nsec

Y9100A-100 Card Edge Fixture Kit
Electrical Specifications: The electrical specifications of this fixture are defined by the electrical specifications of the 9100A I/O Modules and Interface Pods used with it. As long as the design guidelines outlined in the Card Edge Fixture Assembly Manual are followed, use of this fixture will not degrade the performance specifications of the I/O Modules or Interface Pods.

Mechancial Specifications
Size: 14.4 cm H x 38.6 cm W x 46.6 cm L (5.875 in H x 15.75 in W x 19.0 in L)

9100 Series

Ordering Information

Models

9100A/SYS Digital Test Programming System
Included in the 9100A/SYS are:
9100A Digital Test System
9100A-004 Programmer's Station
9100A-003 Parallel I/O Module (1 ea.)
Y9100A-DCS DIP Clip Set
8-day training course (for one person)
These individual items are described below.

9100A Digital Test System
Included in the 9100A are:
9100A Mainframe
Probe/Pulser
Clock Module
4M byte RAM
Manual Set
System Software Disks
Master User Disks
Y8091 Micro-Floppy Disks (10 ea.)
Software Support Agreement

9100A-004* Programmer's Station
Included in the 9100A-004 are:
Programmer's System Software Disk
Monochrome Monitor
Programmer's & TL/1 Reference Manuals
Programmer's Keyboard
Video Card (monochrome)
Software Support Agreement

9100A-005* Programmer's Station, Color Option
Programmer's System Software Disk
LESS Monochrome Monitor
Programmer's & TL/1 Reference Manuals
Programmer's Keyboard
Video Card (monochrome)
Software Support Agreement

9105A Digital Test Station
Included in the 9105A are:
9105A Mainframe
Probe/Pulser
Clock Module
Manual Set
System Software Disks
Master User Disk
Y8091 Micro-Floppy Disks (10 ea.)

If purchased separately for installation in a previously purchased unit, orders must be placed through a Customer Service Center. An additional installation charge will be added to the price.

Off-Line Programming Tools

9100A-020 Ethernet Interface
9100A-021 9100A Networking Software
9100A-022 9100 PC Toolkit Software
9100A-023 SUN PC-NFS
9100A-024 Western Digital Ethercard Plus™ (WD8003E)

9010A TO 9100A Program Translator

9100A-030 9010A to 9100A Program Translator

Software Support

910XA/SS Test Station Software Support
9100A/SYS/SS System Software Support

Only one of the Software Support Agreements need to be purchased per mainframe.

Software Upgrades

9100A-903 Software Upgrade Kit for Non-Programmable 9100A or 9105A Test Station
9100A-904 Software Upgrade Kit for 9100A with a Programming Station (including 9100A/SYS)

Ordering the 9100A-904 or 9100A-903 will provide the latest version of programming system software.

9100A/9105A Options

9100A-003 Parallel I/O Module
9100A-009 Video, Monochrome
The 9100A-009 includes:
Video Card with Cable
Monochrome Monitor
9100A-011 Color Video Card
9100A-016 Hard Disk Back-Up Utility
9100A-017 Vector Output I/O Module

9105A Options

910XA-015 IEEE-488 Interface Card
(Available early 1990)

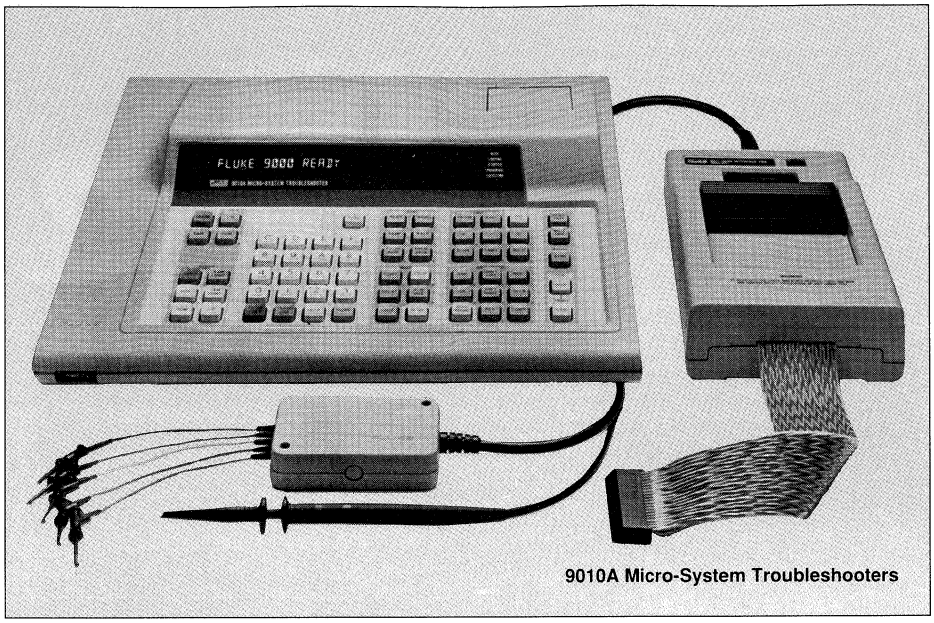
Accessories

Y8091 Micro-Floppy Diskettes, 3.5 inch (10 ea)
Y9100A-14D Dip Clip Module, 14 Pin
Y9100A-16D Dip Clip Module, 16 Pin
Y9100A-18D Dip Clip Module, 18 Pin
Y9100A-20D Dip Clip Module, 20 Pin
Y9100A-24D Dip Clip Module, 24 Pin
Y9100A-28D Dip Clip Module, 28 Pin
Y9100A-40D Dip Clip Module, 40 Pin
Y9100A-DCS Dip Clip Set
Y9100A-20L Flying Lead Set, 20 Leads
(includes packet of 25 clips)
Y9100A-20P PLCC Clip Module, 20 Pin
Y9100A-28P PLCC Clip Module, 28 Pin
Y9100A-14S Small Outline Clip Module, 14 Pin
Y9100A-16S Small Outline Clip Module, 16 Pin
Y9100A-20S Small Outline Clip Module, 20 Pin
Y9100A-24S Small Outline Clip Module, 24 Pin
Y9100A-28S Small Outline Clip module, 28 Pin
Y9100A-100 Card Edge Fixture Kit
Y9100A-101 Card Edge Fixture Base
Y9100A-102 Card Edge Interface Module
Y9100A-7201 Probe Accessory Kit
Included in the Y9100A-7201 are:
1 ea. Probe Tip
1 ea. Probe Tip Cable Assembly
1 ea. Ground Clip Hook (Large)
1 ea. Ground Cable Assembly
8 ea. Clock Module Clips (small)

9000 Series

GPIB IEEE-488

RS-232



9010A Micro-System Troubleshooters

9000 Series Micro-System Troubleshooters

- Preprogrammed kernel test routines
- Simple peripheral troubleshooting
- Keyboard data entry
- 32-digit display
- Power-up self-test
- Keystroke programming (9010A only)
- Language compiler optional (9005A and 9010A)
- Communications interface (RS-232C is optional for 9005A and 9010A; either RS-232 or GPIB/IEEE 488 is standard for 9020A)
- FREE Troubleshooting Course with purchase!

Special Functions

- Preprogrammed functional tests offer structured testing and troubleshooting of the µP's BUS, RAM, ROM and I/O Registers.
- TROUBLESHOOTING functions: simple READ and WRITE commands allow you to stimulate and observe responses from peripheral interphase adapters (PIAs, CTCs, and UARTs) and circuitry beyond the µP bus. Several special functions are available (RAMP, WALK) with preprogrammed stimulus sequences.
- Optional RS-232C: easy downloading of programs and test results to storage mediums, printers and other testers at remote locations. Optional GPIB/IEEE-488* for computer controller operation (9020A).
- TAPE deck controls for storing and reading programs and UUT memory maps on the minicassette.
- LEARN function which is used on a "known good" system, finds and maps RAM, ROM and read/writable I/O addresses.
- Hexadecimal entry of address descriptors.
- MODE control of tests and programs.
- TEST SEQUENCING and ARITHMETIC keys for creating unique user-generated test routines. (9010A only.)
- PROBE controls used for synchronizing the troubleshooting probe to µP cycles and to drive nodes high and/or low.
- Pod design provides for safe easy use – extensive input protection prevents damage to the pod from common accidental abuses such as plugging the pod into the socket backwards. Plug is inserted into socket on pod for self-test. Pins can be protected there when not in use.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Partial List of Processors Supported

Z80A	68010	8042	8344
Z80B	6802	8044	8741
Z8001	6802NS	8048	8741A
Z8002	6808	8049	8742
Z8003	6809	8050	8744
Z8004	6809E	8051	8748
1802	8031	8052	8749
1804	8032	8080	8751
1805	8035	8085A	9900
1806	8039	8085-2	80186
6502	8040	8086	80188
6800	8041	8088	80286
68000	8041A		

The 9000 Series Micro-System Troubleshooters – 9005A, 9010A, and 9020A – are among the most comprehensive troubleshooting instruments ever developed for locating faults on microprocessor-based systems. They include built-in preprogrammed test routines for checking the entire microprocessor kernel: bus, RAM, ROM, and I/O. Included is a troubleshooting probe that you can use either to monitor logic action on a node-by-node basis or to inject stimulus pulses.

The three troubleshooters differ primarily in their programming and system capabilities.

The 9010A is a self-contained, programmable model that lets you develop your own customized test programs. Using the 9010A, you can perform specialized guided fault-isolation routines on any portion of a board's digital circuitry.

The nonprogrammable 9005A includes the same built-in tests as the 9010A but cannot generate new test routines. It can, however, run test sequences developed on the 9010A and transferred from a mini-cassette tape. With the optional RS-232C interface, you can also download test sequences directly from the 9010A or a host computer. Typically, you would develop guided fault-isolation programs at a central location, using a 9010A, and then run the programs at remote sites on 9005As.

The 9020A, designed for systems use, runs test programs written and stored in a system controller or other computer. You can also combine the 9020A with other test instruments to troubleshoot complex microprocessor-based products with special measurement and control problems. The 9020A has no programming keys or cassette tape capability, so test sequences must be executed through the RS-232C or GPIB/IEEE-488 port.

Read/Write Emulation

The 9000 Series Micro-System Troubleshooters eliminate tedius, manual probing techniques. Instead, they take control of the unit under test by plugging into its microprocessor socket. They then emulate the actions of the microprocessor, both reading data from and writing data to the unit's RAM, ROM, and I/O addresses.

7

9000 Series

Built-in Tests

Fluke has taken the trouble out of verifying that the kernel – the heart of the microprocessor system – is operating properly, by including built-in kernel tests in all the 9000 Series Troubleshooters. These tests, initiated by a single keystroke, check the electrical integrity of the microprocessor bus, the read/write capability of the I/O registers, the data in ROM, and RAM operation. A fifth built-in test provides more extensive RAM tests when necessary, checking for pattern-sensitive failures.

The five tests, which cover more than 50% of the components on most boards, check for the problems that are often the most difficult to identify and isolate – including failures that lock up the microprocessor bus. Even if the troubleshooters had no other capabilities, the time saved by these built-in tests alone would more than justify their cost.

Of the five built-in tests, you should run the bus test first, since it verifies the integrity of the microprocessor's basic communication network. To test the remainder of the kernel, you need to enter the address range of RAM, ROM, and I/O for the unit under test, so the troubleshooter will know what addresses to read from and write to. You can enter this information manually through the front-panel keyboard or read it from a mini-cassette – or, if you have the RS-232C interface, you can download it from a host computer or system controller. If address information is not readily available from the unit's documentation, there is a LEARN algorithm to let you generate a memory map from a known-good board. Once entered, memory-map information can be stored on a mini-cassette for later use (9005A/9010A).

Beyond the Bus

The 9000 Series Troubleshooters aren't limited to finding kernel-related problems: they can also isolate failures in synchronous circuitry outside the bus. The troubleshooting probe that comes with the 9000 Series will help you track such off-the-bus failures to their source. This probe is a powerful fault-finding tool, useful both for monitoring logic action and for injecting stimulus pulses.

In monitoring, or response mode, the troubleshooting probe takes signatures, counts events, and shows high/low logic states in each node probed. In stimulus mode, it can inject high or low pulses to stimulate readouts, print heads, interfaces, or other devices. Driven by a sync pulse from the interface pod, the probe can be synchronized to various microprocessor events, such as valid address or data periods on the microprocessor bus. You can also choose to use it in "free run" mode, injecting 1 kHz pulses at the contacted nodes.

To further extend the capabilities of the troubleshooting probe, add the asynchronous signature option. This option lets you test asynchronous circuits located outside the microprocessor bus structure (such as DMA controllers, video controllers, and video-generation circuits) without using a logic analyzer or oscilloscope. Tests performed include signature gathering, waveform capture, and event counting. For more information, see the description of the Asynchronous Signature Probe Option.

Custom Test Programming on the Fluke 9010A

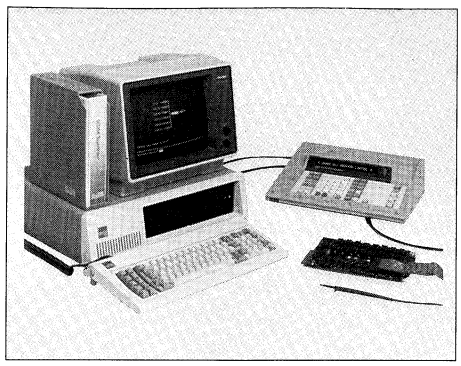
The 9010A lets you write your own comprehensive test routines tailored to the unique characteristics of the equipment you service. These programs can include prompting messages to help guide your technicians through the test procedures. Once written, your test programs can be stored on mini-cassettes for later use – or for downloading to a 9005A.

You can generate your own test software in two ways. First, you can develop short programs right on the 9010A's keyboard, in much the same way as with a scientific calculator. Second, for more extensive test routines, you can use the 9010A's Language Compiler, developing programs off-line on a personal computer and then downloading them to either a 9010A or 9005A. The compiler runs on a number of popular personal computers, including the IBM® PC and Kay Pro II® as well as on the Fluke 1720A and 1722A Instrument Controllers. For more information, see the description of the Language Compiler on the next page.

A Powerful Test System Using the Fluke 9020A

The combination of a Fluke 9020A Micro-System Troubleshooter with an IBM or IBM compatible personal computer and Fluke's TestWriter™ software gives you a powerful system for performing large-scale guided fault-isolation. In this system, the 9020A is used to stimulate and gather response information from the unit under test; the personal computer acts as both the system controller and the storage medium; and the TestWriter software minimizes programmer time through simplified data-entry procedures.

This test configuration makes developing test programs so easy that it opens the door to new types of tests – tests that previously would have required too much programming time to be cost-effective. And it makes performing the tests so simple that virtually any technician can immediately begin troubleshooting, without going through the extensive training required to use more traditional test techniques.



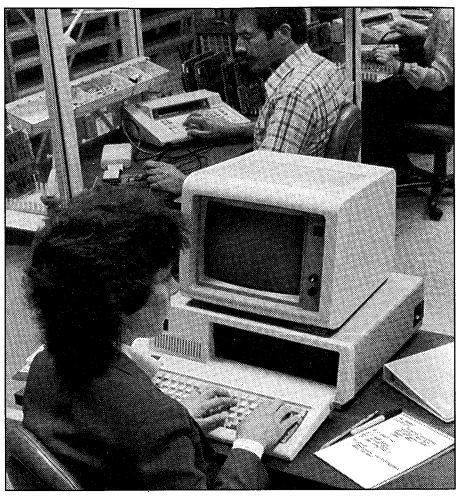
Options and Accessories

Utility Tape (9000A-910)

The 9000A-910 Utility Tape contains many programs designed to enhance the operation of the 9010A. These include:

- Merge Tape – Lets you read specific programs from a mini-cassette tape, renumbering them as desired and merging them with programs already in the 9010A. With this utility, you can combine programs from two or more tapes onto a single tape.
- Frequency Counter – Lets you use the troubleshooting probe to measure frequencies of up to 6 MHz.
- Setup – Lets the 9010A operator make changes in the setup menu while the system is under program control.
- Probe Pulser – Lets the 9010A operator change pulser status while the system is under program control.
- Register Addition and Subtraction – Allows for the addition or subtraction of the contents of two registers while the system is under program control.

The Utility Tape comes with a manual and one mini-cassette that describes how to use each of these programs.



Language Compiler (9010A)

If your test routines are short, you can develop them right at the keyboard of the 9010A. For more extensive test routines, you'll find it easier to work off-line on a personal computer, using the 9010A Language Compiler and downloading the results to the 9010A.

The language compiler lets you write extensive test and troubleshooting routines more quickly and conveniently. The compiler is avail- able in several versions, offering compatibility with the following computer systems:

- IBM® Personal Computer (9010A-923)
- Kay Pro® II (9010A-922)
- Fluke 1720A and 1722A Instrument Controllers (9010A-920)

Sophisticated development tools come with the Compiler to speed the program-development process. Using these features, you can:

- Share common test routines among multiple programs through a File Inclusion feature, linking them together automatically at compile time.
- Save time when entering code by using keyword abbreviations, optional command keywords, and shorthand notations.
- Assign symbolic names to your programs, labels, and registers, making it easier to understand and remember the purpose of the different program sections.
- Document programs with comments imbedded within the program listing, making them easier to follow should you later wish to revise them.

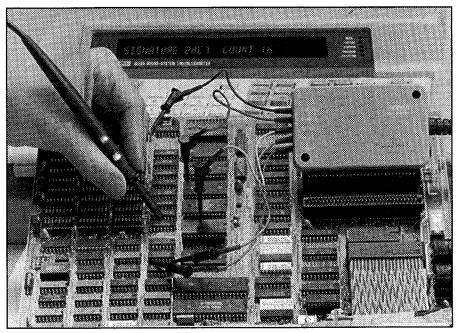
Asynchronous Signature Probe Option (9000A-006)

The 9000A-006 Asynchronous Signature Probe Option gives you high-powered fault isolation capabilities for asynchronous circuits located outside the microprocessor bus structure. With this option, you no longer need to augment your 9000 Series Troubleshooter with a logic analyzer.

By adding the asynchronous signature probe to the 9000 Series, you gain the ability to perform real-time measurement of such asynchronous circuits as:

- DMA controllers
- Video controllers
- Video-generation circuits
- Communication circuits
- Peripheral controllers

The asynchronous signature probe provides three distinct troubleshooting measurements:



- Signature gathering, using the cyclic redundancy check technique.
- Waveform capture, in which the probe-tip data stream is sampled every 20 nanoseconds for a total of up to 32 data samples. The results of this sampling are both displayed and stored.
- Event counting, a powerful tool for node characterization. Using this feature, you can count events from the probe tip, either continuously or through a measurement window. A 24-bit register allows you to record over 16 million events.

The asynchronous signature probe consists of a circuit board, installed in the 9000 Series mainframe; a clock module, which picks up timing and control signals from the unit under test; and a special set of operating programs contained on a mini-cassette tape.

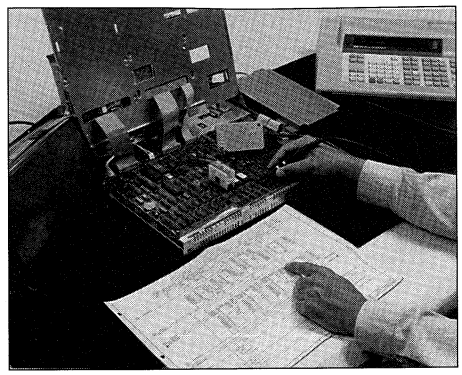
FREE Training Certificate Program

When you purchase any of the 9000 Series models, you will receive, upon request, a special certifcate entitling you to the 9010 Board Tester Troubleshooting course. You will enhance your troubleshooting proficiency and become productive even faster with this program.

Upward Migration from the 9010A to 9100A

For 9010A users who require upward compatibility of their existing programs to the 9100A, there is an outomated program available for this purpose. The 9010A to TL/1 Translator (9100A-030) converts 9010A programs into the 9100A TL/1 language.

TestWriter™ (9020A-925)



Fluke's TestWriter software, combined with the 9020A Micro-System Troubleshooter, an interface pod, and an IBM (or IBM-compatible) personal computer, makes it easy to develop Guided Fault-Isolation (GFI) or automated diagnostic programs for digital circuit testing. In this configuration, the personal computer, communicating with the 9020A-001 through its RS-232C interface, acts as both a system controller and a storage medium.

TestWriter offers the best of both worlds in regards to program generation and execution. Programmers will welcome TestWriter's time-saving and simplified data entry procedures. Operators will appreciate the use of menus in directing the testing process, as well as the easy-to-read graphic feedback of the testing process.

TestWriter's ability to automatically generate a fault tree eliminates the tedious time-consuming process of entering individual decision statements when structuring a program. The programmer simply enters UUT descriptive information: the component types and their interconnectivity. This time-saving feature, together with the increased memory capacity in the PC is what makes TestWriter extremely effective when generating large GFI programs.

The test engineer proceeds by developing a set of stimulus routines; one and, sometimes, several for each node on the UUT.

The last step in completing the GFI program is to gather responses on each node of a "known good" UUT while stimulated by the corresponding stimulus routine(s). These responses are stored in a separate file which will be used for comparison with responses from a defective board during the fault isolation process.

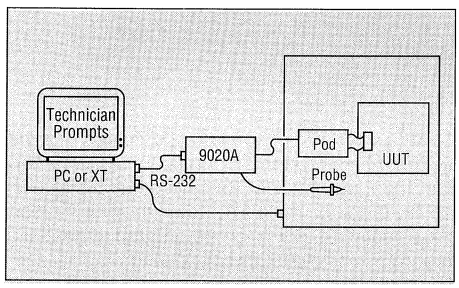
TestWriter also simplifies the process of troubleshooting defective units. The operator makes selections from menus, aided by prompts and graphic displays. The personal computer automatically sends the appropriate commands to the 9020A and records the responses. It also provides a graphic display of the node that the operator is probing, along with the other points that drive that node.

As each nodal measurement is taken, the display will show whether the response was

GOOD or BAD. The software will continue to ask for probe points until it can make a decision on the cause of the problem. Once made, this decision is displayed on the CRT.

For cases where the operator is experienced in troubleshooting a particular board, TestWriter also allows unguided fault isolation, in which the operator decides the order in which nodes are to be tested.

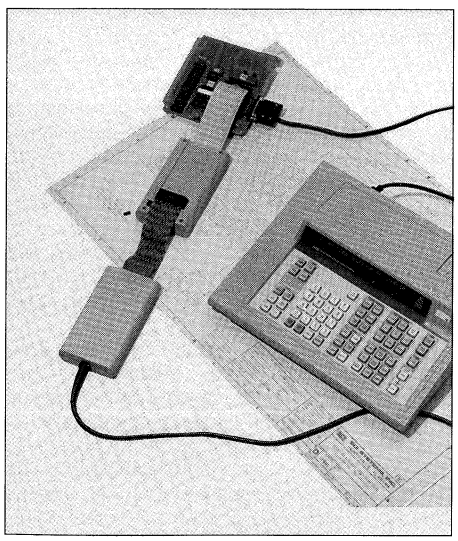
Test Station Configuration



Upgrade Kit (9010A/GF)

This kit, in conjunction with the 9010A-001 (RS-232C interface port), transforms a 9010A into a dual purpose unit: it will continue to function as a standard 9010A and, in addition, can function as a 9020A-001. As a 9020A, this unit can operate with the above described TestWriter software, which executes on an MS-DOS compatible personal computer.

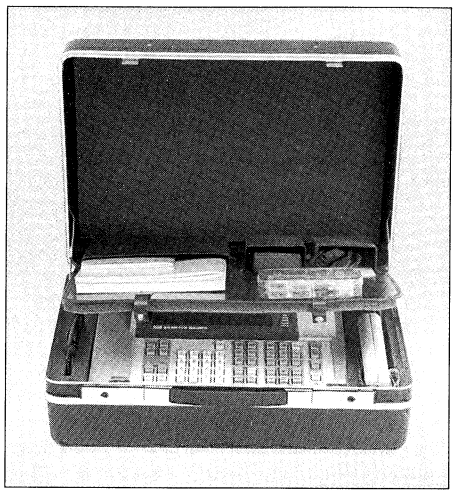
This upgrade kit allows you to execute all existing test procedures on the 9010A and expands its utility by offering you the ability to interface it with a PC and utilizing the power of the TestWriter software system.



The upgrade may be ordered as a kit for Fluke field service center installation in your unit or can be ordered factory installed for new units. The installation adds an internal module and a switch labeled GFI (Guided Fault Isolation) on the rear panel. In the GFI-ON mode the 9010A with 9010A/GF option behaves as a 9020A.

Transit Case (9000A-900)

Lockable hard case holds 9000 Series pod, probe, accessories, four mini-cassette tapes, and user's manual. Foam-lined, sturdy construction.



Specifications

Technical Specifications

Display: Vacuum fluorescent; displays up to thirty-two 14-segment alphanumeric characters at once

Self-Test: All 9000 Series units perform self-tests at each power-up, verifying proper operation of internal RAM, ROM, clock, power supply, display, and communications with interface pod. The pod has its own self-test socket to verify proper operation at microprocessor plug.

Test Speed: Tests run at full system speed, based on clock in unit under test

Keyboard Data Entry: Hexadecimal 0 through 9 and A through F

Mag Tape: (9005A and 9010A only). Mini-cassette tapes store all "learned" data plus test programs generated on-line for off-the-bus testing. One tape holds up to 12K bytes – the same as internal memory on the 9005A and 9010A. Both units come with a built-in tape drive.

Interface Pod: Plugs into 9000 Series mainframe; must match type of microprocessor used in circuits being tested. Pods available for 8-bit and 16-bit microprocessors. Special circuitry protects pods from damage even if plugged in backwards.

Troubleshooting Probe: Plugs into 9000 Series mainframe. In response mode, takes signatures, counts events, shows logic states; in stimulus mode, injects either clock-synchronized or 1 kHz pulses. Measurement thresholds are 0.8V (low), 2.4V (high). Stimulus pulses are <0.2V at 100 mA (low), >4V at 100 mA (high). Probe is protected to ±30V.

Automatic Functions Summary

Learn Mode: (9010A and 9020A only). Uses a known-good system of same type as unit under test to locate and determine size of RAM, ROM, and read/writeable I/O registers, and to compute signatures. Stores results in memory for immediate comparison to circuits being tested; data can also be saved on mini-cassette or (with RS-232C option) downloaded to another system or device.

Built-In Kernel Tests: Using data entered either automatically through Learn mode or manually through the keyboard, the 9000 Series Troubleshooters can perform the following tests of kernel circuitry (each initiated by a single keystroke):

- BUS – Checks electrical integrity of address, data, and control lines; isolates stuck nodes and adjacent-trace shorts.
- RAM SHORT – Checks each RAM location for ability to read and write; verifies address decoding; detects data-line shorts beyond bus buffers.
- ROM – Computes ROM signatures and compares them with those in the known-good unit.
- I/O – Checks each I/O register identified in the known-good system to make sure it is read/writeable.
- AUTO – Runs all the above tests; initiated by a single keystroke. (Typically requires several minutes, depending on size of memory being checked.)
- RAM LONG – A more complex RAM test, used to isolate "soft" or pattern-sensitive RAM faults.

In addition, 9000 Series Troubleshooters continually monitor the power supply of the unit under test for out-of-tolerance conditions as well as the UUT clock signal. An error message is displayed if they detect a defect.

Troubleshooting Functions Summary

The following function keys are available on the 9000 Series Micro-System Troubleshooters:

- READ – Displays data contents of specified address.
- WRITE – Writes specified data to any address location.
- WALK – Writes automatic walking pattern to specified address.
- RAMP – Writes automatic binary incrementing ramp to specified location.
- TOGGL DATA – Pulses specified data bit between high and low state.
- TOGGL ADDR – Pulses specified address bit between high and low state.
- TOGGL DATA, then STS/CTL – Pulses specified control bit between high and low state.
- READ PROBE – Displays probe measurements, including signatures, logic states and event counts.
- SYN – Allows probe measurements or stimulus to be either asynchronous or synched to valid address or data periods on the microprocessor bus.
- HIGH (Pulse) – Activates high-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- LOW (Pulse) – Activates low-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- HIGH and LOW toggle – Pulses alternate between high-going and low-going.

Also, a scope trigger-signal of about 100 mV amplitude can be synchronized with address or data sync pulses from the mainframe.

Test-programming Functions Summary (9010A)

(Not applicable to 9020A; available in execute-only mode on 9005A.) Users wishing to troubleshoot beyond the system kernel into peripheral devices can write and edit test programs tailored to the unique architecture of the systems they work with. The following keys are available for on-line programming:

- PROGM – Opens and closes test programs (both for development and for editing).
- EXEC – Runs selected test program.
- DISPL – Allows programs to include operator prompts (e.g., PROBE U6 PIN 7).
- Sequencing keys (IF, > =, GOTO, LABEL) available for comparison, branching, looping, and labeling steps in the test program.
- Arithmetic keys – Eight logical operations available for arithmetic control of mainframe registers that store user-specified address and data information during program writing.
- Editing keys – Allow the operator to scroll backwards or forwards through the programming steps.

Mode Control Summary

Mode control keys give operator control over all functions: automatic tests, programmed tests, and troubleshooting operations. The following mode control keys are available:

- STOP – Halts current test or operation.
- RPEAT – Causes test or operation to repeat once.
- CONT – Advances to next test step or continues last operation.
- LOOP – Continuously repeats a functional test, programmed test step, or troubleshooting command or loops on any fault.
- RUN UUT – Allows full exercise of both the self-diagnostics and normal run operation of the unit under test, with the pod microprocessor acting as the processor of the unit being tested.

General Specifications

Temperature: 0°C to +50°C operating temperature (+10°C to +40°C for mini-cassette); -40°C to +70°C non-operating temperature (+4°C to +50°C for mini-cassette)
Power: 100, 120, 220, 240V ac ±10%; 50 Hz, 60 Hz ±5%; 40W maximum
Size: 11.5 cm H x 35.5 cm W x 30.5 cm D (4.5 in H x 14 in W x 12 in D)
Weight: 6 kg (13 lb) mainframe; 0.7 kg (1.5 lb) per interface pod

Included with Instrument: Probe, probe accessories, two mini-cassettes (none with 9020A), manuals, power cord

Ordering Information

Models

9005A Micro-System Troubleshooter
9010A Micro-System Troubleshooter w/Program Functions
9020A-001* Micro-System Troubleshooter w/RS-232C Interface
9020A-002* Micro-System Troubleshooter w/IEEE-488 Interface

**A 9020A without interface is not available.*

Options* (For 9010A & 9005A)

-001 RS-232-C Interface
-910 Utility Program Tape
-920 Language Compiler, 1722A Instrument Controller
-922 Language Compiler for Kay Pro® II
-923 Language Compiler for IBM Personal Computer
9010A/GF Kit (field-installed)
9010A/GF Kit (factory-ordered)
9100A-030 A progam that converts 9010A programs to TL/1, which can be executed on a 9100A or 9105A

**See option compatibility chart on last page of this section.*

Options (For 9010A, 9005A & 9020A)

-006* Asynchronous Signature Probe

**Service Center installable only.*

Options (For 9020A and 9010A/GF)

-925 TestWriter Software

Accessories

9000A-200 Pod Adapter Packaging Kit
9000A-900 Transit Case
Y8007 Ten-Pack of Mini-cassettes

7

Interface Pods

Interface Pods

- Over 50 microprocessors directly supported
- Adapter kits available for other microprocessors
- Easy connection to unit under test
- Intelligent pods with built-in software*
- Quick memory tests*
- HyperTEST™ Test Algorithm*
- Built-in self-diagnostics

Available on some pod models only. See table below for a listing of pods offering these features

Microprocessors Supported by Fluke Interface Pods

System µP	Pod Model #	System µP	Pod Model #
Z80A	9000A-Z80QT*	8040	9000A-8048*
Z80B	9000A-Z80QT*	8041	9000A-8048*
Z8001	9000A-Z8000*	8041A	9000A-8048*
Z8002	9000A-Z8000*	8042	9000A-8048*
Z8003	9000A-Z8000*	8044	9000A-8051*
Z8004	9000A-Z8000*	8048	9000A-8048*
1802	9000A-1802*	8049	9000A-8048*
1804	9000A-1802*	8050	9000A-8048*
1805	9000A-1802*	8051	9000A-8051*
1806	9000A-1802*	8052	9000A-8051*
64180	9132A-64180*	8080	9000A-8080
6502	9000A-6502	8085A	9000A-8085
6800	9000A-6800	8085A-2	9000A-8085
68000	9000A-68000*	8086	9000A-8086*
68010	9000A-68000*	8088	9000A-8088*
6802	9000A-6802	8344	9000A-8051*
6802NS	9000A-6802	8741	9000A-8048*
68020	9132A-68020*	8742	9000A-8048*
68030	9132A-68030*	8744	9000A-8051*
6808	9000A-6802	8748	9000A-8048*
6809	9000A-6809	8749	9000A-8048*
6809E	9000A-6809	8751	9000A-8048*
7810	9132A-7810*	80186	9000A-80186*
8031	9000A-8051*	80188	9000A-80188*
8032	9000A-8051*	80286	9000A-80286H* (up to 10 MHz)
8035	9000A-8048*		
80386	9132A-80386*	80286	9132A-80286* (>10 MHz)
80386SX	9132A-80386S*		
8039	9000A-8048*	9900	9000A-9900

Incorporates one or more advanced features.
Note: The 9132A pods will work with the 9100A & 9105A only. For microprocessors not found in this table, contact your local area Sales Representative for a copy of Technical Data B0156, "User-Designed Interface Pod Adapters."

How the Interface Pod Works

The interface pod functions as the test interface between the suspect circuit board's microprocessor circuitry and the 9100 Series and 9000 Series mainframe. The pod adapts the general architecture of the mainframe to that of the specific microprocessor system under test. The mainframes simple language works the same with all pods, alleviating the need to program using the code of each different microprocessor.

Unlike emulators and development systems intended for software debugging, these pods are designed specifically for hardware troubleshooting. Once connected to the unit under test (UUT), the pre-programmed tests for BUS, RAM and ROM can be executed immediately without writing a single line of code. Some pods (see table) come with RAM and ROM tests that execute right out of the pod, providing a much quicker execution time without sacrificing fault coverage. A much faster test, HyperTEST™ (patented by Fluke), can also be found in some of the pods that cover microprocessors capable of addressing large amounts of memory.

Two different types of interface pods are available from Fluke: the Microprocessor interface pod and the Memory interface pod. Both give the mainframe the ability to access board and system components directly through the central control element of the entire system – the microprocessor. As a result, you get exceptionally high-confidence test results.

Microprocessor Interface Pods (9000A-XXXXX). Each Microprocessor interface pod has a self-contained system with its own microprocessor, RAM, ROM and I/O memory space. These pods are connected to the board by removing the UUT's microprocessor and plugging the pod into the microprocessor socket. The microprocessor inside the pod then has full control of all bus-related devices on the board. In addition, the board's clock circuit is channeled to the pod's microprocessor, allowing you to perform tests at the board's designed speed. Each pod has the capability of running board-resident programs as if the processor were on the board instead of in the pod. In this way, programs residing in the board's memory, such as initialization programs and diagnostics, can be executed to help you locate problems more rapidly.

Bus line monitoring takes place automatically when the pod accesses the UUT. This means that no probing is necessary to find bus faults. It also means that the pod can detect dynamic faults – those that come and go depending on the activity being performed – as well as static faults.

Memory Interface Pods (9132A) (for 9100A/9105A only). These pods connect to the UUT by removing the UUT's boot ROM(s) and plugging ROM module(s) into the vacant socket(s). By feeding instructions through the boot ROM socket(s), the UUT's microprocessor can be induced to perform bus accesses. The mainframe has full control of all bus-related devices on the board and can stimulate or transfer data across the bus. This method makes full use of the UUT's microprocessor and associated clock circuitry and, as a result, all tests are performed at the UUT's normal operating speed.

Like the microprocessor interface pods, the memory interface pod also contains tests for quickly testing RAM and ROM. The 9132A incorporates our patented high-speed HyperTEST RAM test algorithm. HyperTEST is immediately executable and can test one megabyte of UUT RAM in as little as one second.

In addition to the standard RAM and ROM tests available through the pod's WRITE and READ functions, each 9132A processor support package includes a microfloppy of 9100A programs and a sync module adapter. The programs provide advanced diagnostics for isolating bus faults, while the adapter provides a convenient connection to the UUT.

ROMs Supported

24 PIN: 2364A, 2366, 2716, 2732, 2732A, 5366
28 PIN: 23C1000, 23C128, 23C256, 23C64E, 23128, 23256, 2365, 27C128, 27C256, 27C512, 27C64, 27128, 27256, 27512, 2764, 38128, 38512, 3864, 531000, 53257
32 PIN: 27010

Support for many Microprocessors. Fluke makes a number of different pods that cover a wide range of microprocessors. Regardless of which method you employ, once you have control of the UUT's bus, you can perform the functional tests built into the 9100 Series or 9000 Series testers as well as those you design yourself.

Pod Intelligence. Many of the pods feature additional built-in software, enhancing the troubleshooting and test capabilities of the mainframe. With this software, the user need only send the test parameters to the pod from the troubleshooter mainframe. The pod will independently execute the specified function, providing much faster test results than is possible with mainframe execution.

Interrupt Features. Some of the pods have interrupt testing capabilities, allowing them to read information from received interrupts. The user can control the configuration of the pod's interrupt lines, enabling and disabling interrupts and forcing interrupt-acknowledge cycles.

Special Circuitry

Because pods are intended to be used with defective UUTs, Fluke designed them with special input protection circuitry. This circuitry provides overvoltage protection on each line to the UUT – even if a pod is plugged in backwards. A self test socket is included for verifying proper pod function.

Pod Adapter Packaging Kit

A special kit is available for adapting a Fluke pod to a microprocessor that we do not directly support. The kit consists of all the parts necessary to house the adapter circuitry, to connect the pod to the adapter, and to connect the adapter to the UUT. Information on designing a Pod adapter is contained in Applications Information note entitled "9000 Series User Designed Interface Pod Adapters."

Microprocessors for which Fluke has complete adapter design information:

2650	8094*
3870*	8095*
6503	8096*
6504	8097*
6507	8X300
6510	99000
6512	9995
68008	MAC-8
6801*	NSC800
6803*	V40*
78220*	V50*
80535	Z8*

**Fully assembled adapter available from Customer Support Services Ordering Information*

Ordering Information

Models

Microprocessor Interface Pods

9000A-Z80QT
9000A-Z8000
9000A-1802
9000A-6502
9000A-6800
9000A-6802
9000A-6809
9000A-68000
9000A-8048
9000A-8051
9000A-8080
9000A-8085
9000A-8086
9000A-8088
9000A-80186
9000A-80188
9000A-80286H
9000A-9900

Memory Interface Pods (9100A/9105A)

9132A Memory Interface Pod
9132A-64180 Processor Support Package*
9132A-68000 Processor Support Package
9132A-68020 Processor Support Package
9132A-68030 Processor Support Package
9132A-7810 Processor Support Package
9132A-80286 Processor Support Package
9132A-80386 Processor Support Package
9132A-80386SX Processor Support Package
9132A-024 ROM Module, 24 Pin**
9132A-028 ROM Module, 28 Pin**
9132A-032 ROM Module, 32 Pin**
9132A-100 RAM Module, (1 required for each ROM Module, up to 4 max)

** The 9132A-64180 comes with a Shrink-Dip style sync adapter.*

*** 1needed for each UUT Boot ROM.*

Minimum configuration is one 9132A Memory Interface Pod, one Processor Support Package, one ROM module and one RAM module. Check with your Sales Representative to assure accurate order configuration.

Accessories

9000A-200 Pod Adapter Packaging Kit
9000A-201 8051 Clip-on Adapter
Y9000A-80286-7202 PLCC Clip-on Adapter
9132A-64180-7201 PLCC Clip Sync Adapter
9132A-64180-7202 PLCC Plug Sync Adapter

Option Compatibility

9005A, 9010A, 9020A Option Compatibility

Option	Description	9005A	9010A	9020A-001	9020A-002
9000A-*	Interface Pods (all)	•	•	•	•
9010A-001	RS-232C Interface	1	1	#	–
9000A-006	Asynchronous Signature Probe	1	1	1	1
9000A-010	Demonstration and Training Package	2	2	2	2
9000A-200	Kit for customizing Interface Pods	3	3	3	3
9000A-201	Clip-on Adapter for -8051 Pod	•	•	•	•
9000A-900	Transit Case	•	•	•	•
9000A-901/AC	PCB for Troubleshooting Classes	•	•	•	•
9000A-910	Utility Tape	–	•	–	–
9010A-920	Language Compiler for 1722A or 1720A	–	4	–	–
9010A-922	Language Compiler for Kay Pro	–	5	–	–
9010A-923	Language Compiler for IBM PC	–	5	–	–
9020A-925	TestWriter, PC Software	6	6	7	–
9000A-9711	Tape for Troubleshooting 8520As	•	•	–	–
9010A/GF	For Guided Fault Testing w/Option -925	1	1	–	–
Other Items					
Y8007	Package of Ten Minicassette Tapes	•	•	–	–

Notes: All options are customer-installable except where noted.
† Compatible option
** Option suffix identifies Interface Pod type*
 # RS-232C capability included
1 Installed at Factory or, at extra charge later, order through Service Center
2 Requires 9000A-80286 Pod
3 Use only on 40-pin microprocessor adaptations
4 Option 9010A-001 is reqúired. E Disk Option 1720A-001 is required for 1720A
5 Option 9010A-001 is required
6 Requires IBM PC with RS-232C Interface, 9010A, and 9010A/GF
7 Requires IBM PC with RS-232C Interface

9100 Series Option Compatibility

Option	Description	9100A/SYS	9100A	9105A
9000A-*	Interface Pods (all)	•	•	•
9100A-003	Parallel I/O Module (four can be used)	#	•	•
9100A-004	Programmer's Station w/Monochrome Monitor	#	1	–
9100A-005	Programmer's Station w/o Monitor (for Color)	–	1	–
9105A-007	512K Byte Memory Expansion	–	–	1
9105A-008	Real-Time Clock	–	–	1
9100A-009	Monochrome Monitor	2	1	1
9000A-010	Demonstration and Training Package	4	4	4
9100A-011	Color Video Card	–	1	1
9100A-012	2M Byte Memory Expansion	1	1	–
9100A-013	Keyboard	#	•	•
Other Items				
Y8091	Package of Ten 3.5-inch Floppy Disks	#	#	#
Y9100A-DCS	DIP CLIP Set (-14D through -40D)	#	•	•

Notes: All options are customer-installable except where noted.
† Compatible option
** Option suffix identifies Interface Pod type*
 # One included
1 Installed at Factory or, at extra charge later, order through Service Center
2 Included as part of 9100A-004

Calibration Instruments



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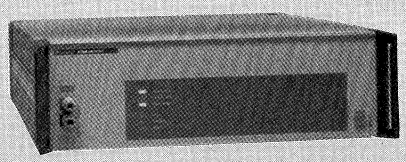

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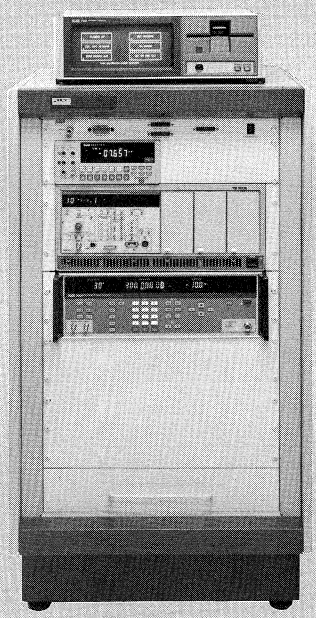

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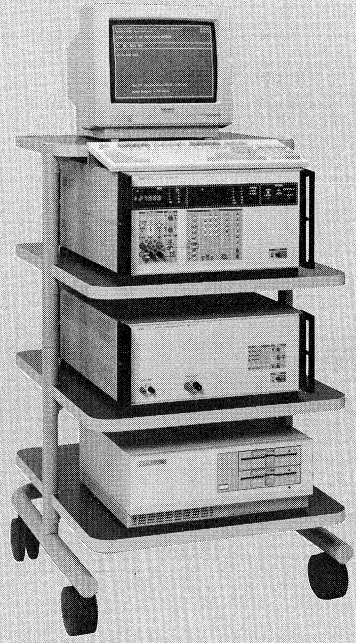

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NEW



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All electrical and electronic test and measurement instruments must be calibrated – when they are manufactured, and at regular intervals, to ensure accuracy and confidence in their measurements. Practically all instruments that measure voltage, current or resistance, can be calibrated with Fluke calibrators, standards, and auxiliary equipment.

Fluke is the leader in calibration equipment. This leadership applies to advancement in precision equipment and software and support services that greatly improves the productivity of calibration professionals. If you think it may be economical to calibrate your own voltmeters, ammeters, ohmmeters, multimeters, oscilloscopes, or other instruments of that kind, study Fluke's complete calibration solutions on the following pages.

Selection Guides	Page 192
Calibration Instruments	Page 195
Automated Metrology	Page 220
Standards Instruments	Page 239

What is Calibration?

Calibration is a special, highly-refined process in which you compare an instruments performance with standards of known uncertainty to detect or correct any variation from required performance. In other words, it is a process verifying the operational integrity of instruments.

All electrical and electronic test and measurement instruments must be calibrated, both at the time of manufacture and at regular intervals during use, to assure the accuracy of and confidence in the measurements you make. You will also find that in many instances certification of calibration is a legal requirement.

Calibration provides two major benefits. First, it allows you to use your instruments with confidence by minimizing the uncertainties associated with your measurements. Second, it fulfills the requirements for "traceability" to national standards demanded so frequently today.

Fluke is the leader in dc and low frequency calibration. Fluke provides a broad range of products, from calibration instrumens, to automated calibration systems, and the standards required to maintain them. If you calibrate voltmeters, ohmmeters, ammeters, multimeters, oscilloscopes, or other electronic test and measurement instruments, Fluke has the calibration solutions to match your workload.

The range of Fluke products includes high-accuracy single-function calibrators for calibrating your high end voltmeters. Fluke also provides multifunction manual and bus-controllable calibrators that can economically calibrate the bulk of your low- and mid-accuracy workload. These include a full line of accessories and auxiliary products.

Fluke also offers the next logical step in calibration, automated systems that will increase your productivity and repeatability, while easing your documentation process. You can start the automation process without replacing your existing instrument inventory. Instruments you purchase now can be integrated into systems as your workload expands. And what you need to add later will work with what you have now. Fluke provides the calibration software to meet your calibration workload.

Fluke's commitment to the calibration market includes the support services you require. Applications support, training, traceability programs, maintenance, repair, calibration services, and module exchange programs you expect are all available from Fluke.

Study the Fluke calibration solutions on the following pages. If you need assistance, contact your Local Sales Organisation.

Automated Calibration Systems Based on 7411 Calibration Software

Model	Oscilloscope Calibration	Multimeter Calibration	Measurement Cabability	Page
7457A	—	Yes	—	232
7451A	—	Yes	Yes	234
7409B	Yes	—	Yes	236
A123	Yes	Yes	Yes	238

AC/DC Transfer Standards

Model	Volts	Current	AC/DC Difference	Frequency Range	Page
540B	To 1000V	With A40 A40A	0.01%	5 Hz to 1 MHz	247
A55	0.5	—	0.05% to 0.5%	1 MHz to 50 MHz	249
A40	—	10 mA to 5A	0.02% with 540B	5 Hz to 100 kHz	248
A40A	—	10A to 20A	0.03% with 540B	5 Hz to 50 kHz	248

Calibrators

Model	Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Wideband Voltage	Basic Uncertainty	IEEE-488	Page
5700A	To 1100V	To 1100V	To 2.2A	To 2.2A	1.0Ω to 100 MΩ	Option	5 ppm	Yes	195
5100B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	40 ppm	Option	201
5101B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	40 ppm	Option	201
5440B	To 1100V	—	—	—	—	—	3 ppm	Yes	205
5442A	To 1100V	—	—	—	—	—	4 ppm	Yes	205
5200A	—	To 120V	—	—	—	—	200 ppm	Option	207
5450A	—	—	—	—	1.0Ω to 100 MΩ	—	8 ppm	Yes	210
335A	To 1110V	—	—	—	—	—	20 ppm	No	216
335D	To 1110V	—	—	—	—	—	10 ppm	No	216
343A	To 1110V	—	—	—	—	—	20 ppm	No	217
515A	To 100V	To 100V	—	—	10Ω to 100 MΩ	—	30 ppm	No	218

Amplifiers

Model	Output Range	Compatible Calibrator	Gain Transcond	Page
5725A	1100V 1 to 11A AC/DC	5700A	—	195
5205A	1200V rms 1600V dc	5100B 5101B 5102B 5200A 5440B	100	211
5215A	1200V rms	5100B 5101B 5102B 5200A	100	213
5220A	1 to 20A	5100B 5101B 5102B 5440B	1A/V	215

Reference Standards

Model	Amplitude Stability	Direct Voltage	Alternating Voltage	Resistance	Frequencies	DVMP*	Page
510A	±0.005 % in 30 Days	—	10V rms	—	50 Hz to 100 kHz	No	250
731B	10 ppm	10V 1V 1.018V ΔV	—	—	—	No	251
732A	0.5 ppm	10V 1V 1.018V	—	—	—	Yes	242
742A	5 ppm	—	—	1Ω and 10 kΩ	—	—	241
792A	X ppm	—	—	xΩ and xx kΩ	—	—	240

**Direct Voltage Maintenance Program. See page 244.*

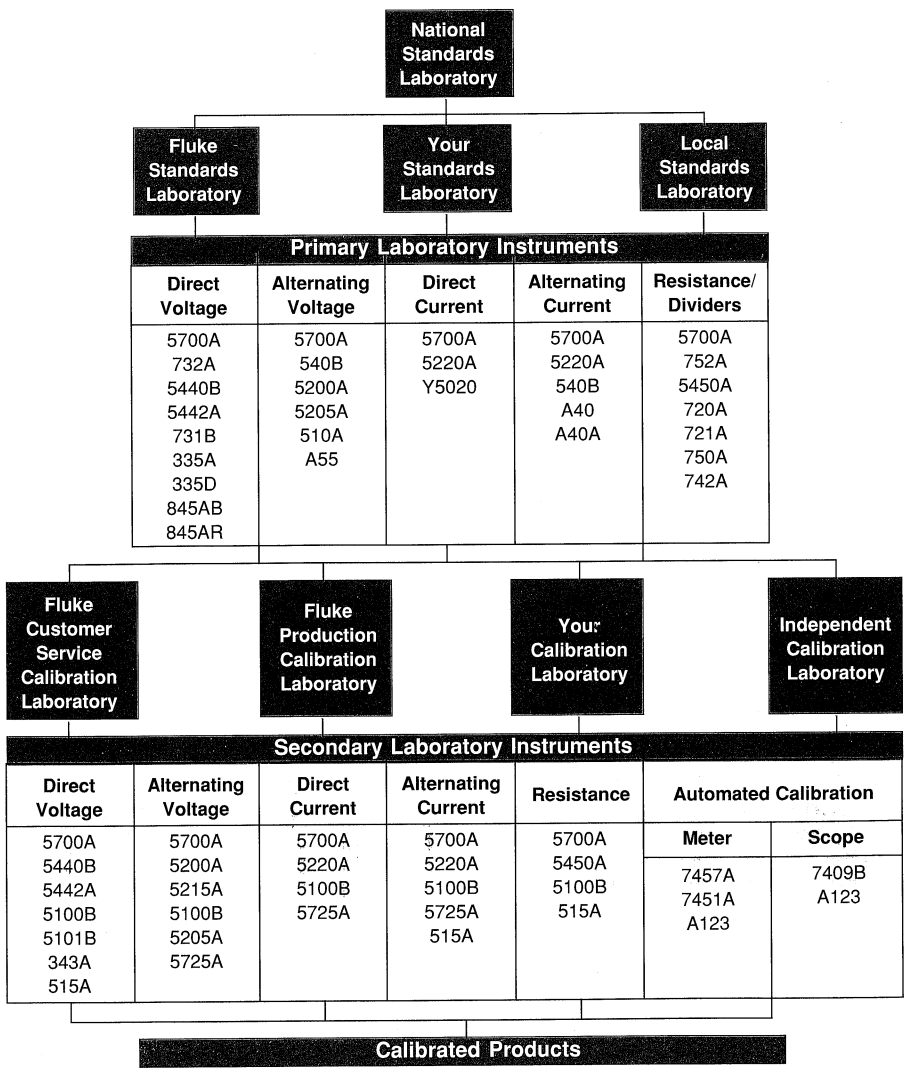
Dividers and Standards Equipment

Model	Basic Uncertainty	Stability	Input Range	Page
752A	0.2 ppm - 10:1 0.5 ppm - 100:1	—	1100V	246
Y5020	±0.01%	0.002% in 6 months	0 to 20A	219
720A	0.1 ppm	1.0 ppm/year	0 to 1100V	252
721A	—	—	4000:1 Ratio	251
750A	10 ppm	10 ppm/year	1.1 to 1100V	252
845AB	2%	0.15 μV/hr	1.0 μV to 1000V	253
845AR	3%	0.15 μV/hr	1.0 μV to 1000V	253

Using the Product/Applications Guide

The traceability chart shows you how Fluke calibration products cover your Calibration Lab and Standards Lab workload. This chart will help you select the instrumentation you need in your facility.

Find the position of your lab on the chart. Then refer to the box below for the appropriate products. Each product is fully described in the following pages. Your local Sales representative will be glad to assist you in matching Fluke instruments and systems to your requirements.



8

Cost-Effective Solutions for the Cal Lab Workload

While a calibrator's parts per million (ppm) specifications are important, focusing on specifications alone is not the best approach to selecting a calibration instrument. Other factors such as reliability, ease of use, expandability, service, and manufacturer service and responsiveness are equally as important as specifications. You need to consider the total cost of ownership.

Satisfying your calibration needs means far more than just buying some calibration hardware. Of course you need to look at the specifications, but make sure you are evaluating performance that fits your needs and not just paper promises.

The real challenge is how to get the most cost-effective workload coverage. Consider your population of instruments. Will you be calibrating ATE systems or handheld DMMs? How high is your volume?

To obtain sufficient workload coverage in the past, many different instruments were required to handle a single calibration task. Single instruments are now capable of multiple tasks. For example, when Fluke introduced the 5100 Series, it replaced the need for six different instruments and was dubbed the "cal lab in a box." With technology advances such as these, the expense of equipping a cal lab is decreasing. A new offering, the 5700A, provides still higher accuracy while maintaining compability with the 5100 Series.

You also need to keep the future in mind. Will you want to automate your calibration process at a later date? If so, consider calibration instruments that can be integrated into automated calibration systems. Expandability is an important factor in protecting your instrumentation investment.

A crucial aspect of achieving the best workload coverage is determining the level of accuracy required to calibrate instruments in your workload. For the most cost effective investment, concentrate on the instruments covering the greatest portion of your workload.

Selection Guide

Model	Multimeter Calibration	Direct Voltage Calibration	Alternating Voltage Calibration	Direct Current Calibration	Alternating Current Calibration	Resistance Calibration	Compatible Amplifiers
5700A	•	•	•	•	•	•	5725A, 5205A, 5215A, 5220A
5100B	•	•	•	•	•	•	5205A, 5215A, 5220A
5101B	•	•	•	•	•	•	5205A, 5215A, 5220A
5440B		•					5205A, 5220A
5442A		•					5205A, 5220A
5200A			•				5205A, 5215A
5450A						•	
335A		•					
335D		•					
343A		•					
515A	•	•	•			•	

For Further Information

To help you learn more about calibration and various related subjects, Fluke offers a wide variety of literature. Some specific terms of interest are listed below.

Traceability Chart: Derivation of Electrical Units

This full-color poster traces the derivation of electrical units from the basic world standards to the level of instrumentation in your calibration lab. It will be valuable for teaching new technicians derivation of units.

Technical Papers on Newest Technology

A number of technical papers presented at recent metrology conferences around the world are available, describing the latest advances in the field. Ask your Sales representative for a complete list of those available.

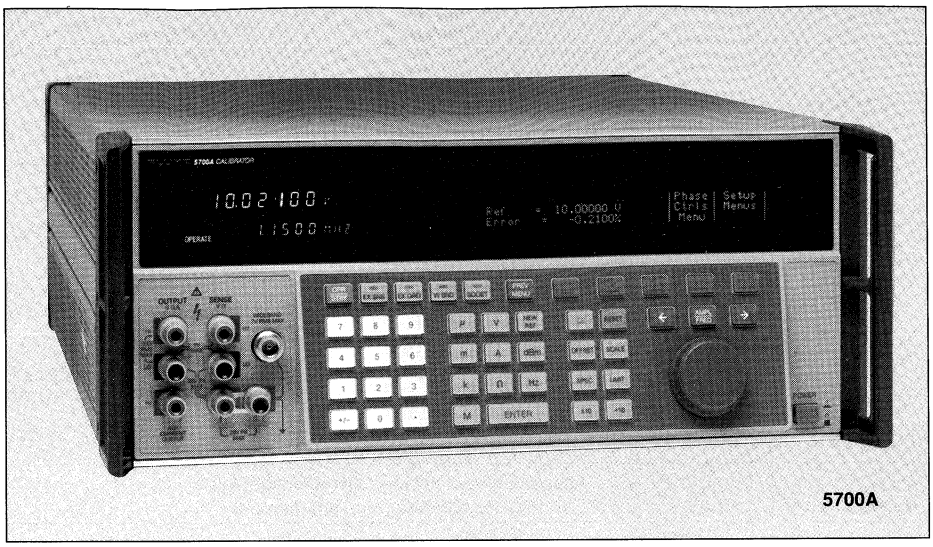
Calibration: Philosophy in Practice

This book, a "cal lab classic," describes various aspects of lab operation, types of instrumentation, and the theories underlying them.

Information is included on basic units and standards of measurement, and how traceability is maintained to guarantee the integrity of your measurements.

5700A

GPIB IEEE-488



5700A Calibrator

- Covers the complete DMM calibration workload
- Precision performance that is easy to use
- Simplified support with Artifact Calibration
- Compatible to protect your investment

Wide Workload Coverage

The Fluke 5700A is designed to cover the widest portion of today's calibration workload - a wide variety of DMMs from all manufacturers. It delivers direct voltage to 1100V and alternating voltage from 220 µV to 1100V at frequencies from 10 Hz to 1.2 MHz. Cardinal point resistances range from 1Ω to 100 MΩ in x1 and x1.9 decades, including a short. Direct and alternating current are provided to 2.2A, and frequencies for alternating current range from 10 Hz to 10 kHz.

One option is offered, wideband voltage (-03). It provides flat, low-noise alternating voltage output from 10 Hz to 30 MHz to extend workload coverage to include RF voltmeters. Output may be selected in volts or dBm referenced to 50Ω.

The companion 5725A Amplifier extends the 5700A's workload coverage still further. It increases maximum direct and alternating current to 11A for calibrating the high current ranges of popular low-cost and hand-held DMMs. And it extends the calibrator's alternating volt-hertz product to 1100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high-accuracy bench and system meters.

The 5700A is designed to be taken to the workload. In manufacturing applications, test instruments may be calibrated on-site, minimizing production line downtime due to calibration recall.

Low Cost of Ownership

The original purchase price is not the most significant cost associated with owning a high accuracy calibrator. Once the instrument is on the job, a wide range of calibration, maintenance, repair and training requirements increase its cost of ownership beyond the original purchase price many times over.

The 5700A Calibrator was designed to keep those traditional ownership costs down. Its powerful features are easy to use. Advanced internal metrology dramatically reduces support requirements while increasing your confidence in the instrument's performance. And its rugged, modular design increases reliability and makes problems easy to find and repair when they occur.

Simplified Calibration Support

Only three Artifact Standards, a 10V dc reference and 1Ω and 10 kΩ resistance references, are required to calibrate all 5700A ranges and functions to full specifications. The process, running under the control of the calibrator, takes about one hour. Instructions are displayed on the front panel in plain English to prompt the operator when to make various connections and inputs. For added confidence, Fluke recommends that a full verification of the 5700A be performed every two years or as required by your established procedures.

The 5700A does not need to be recalled to the standards laboratory for calibration. Due to its unique, environmentally tolerant design, the 5700A may be calibrated wherever it is used, at any temperature between 15°C and 35°C. Full performance is available for ±5°C of that temperature.

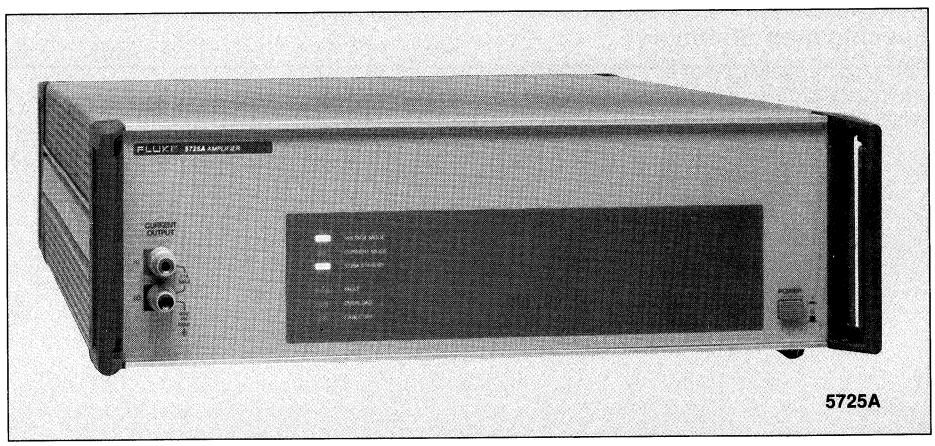
Complete Confidence

Between Artifact Calibrations, the 5700A's performance may be checked against its internal standards. Without adjusting the instrument, an automated procedure is available to check each range and function against internal check standards to increase your confidence that it is within performance tolerances. Should any range be shown to be out of specification, the operator is alerted. All results of this Cal Check process can be printed via RS-232 port. This data can be used to develop control charts to predict the long-term performance of the calibrator.

High Performance That's Easy to Use

In the past, calibration of precision DMMs required a host of complex, manually operated instruments and standards.

The 5700A combines the functions of these instruments to dramatically simplify DMM calibration. Values are entered on the simple numeric keyboard and displayed on the front panel.



The command is confirmed with the ENTER key. To verify the reading of the UUT, the operator simply adjusts the output knob and the error is displayed directly in ppm or %. Output values can be selected for editing using the arrow keys. Using the OFFSET and SCALE keys, the 5700A compensates for meter zero offset and scale errors and directly displays linearity errors at any scale level. The x10 and ÷10 keys simplify work on meters requiring calibration levels in even decade steps. Just multiply or divide any output value by pressing the corresponding key.

To protect the operator and UUT, limits on maximum output can be preset. For additional operator protection, the 5700A resets to standby mode when output is increased to more than 22V.

Compatibility

The 5700A is designed to protect your investment in existing Fluke instruments and procedures. For example, a Fluke 5205A or 5215A voltage amplifier, and a Fluke 5220A transconductance amplifier may be connected directly to the 5700A through dedicated ports. In automated systems, the 5700A may be configured to emulate a 5100B so that existing procedures can be run with minimal modification.

Designed for Reliability

Another important factor in keeping instrument cost of ownership low is product reliability. Throughout its design and manufacture, the 5700A has been engineered to be the most reliable instrument of its type. Statistical process control techniques assure that quality is maintained, from component test through final assembly. Every 5700A is subjected to more than 2g of random vibration to prevent subtle imperfections from causing failures later on. A stiff chassis permits the 5700A to be moved with minimal risk of damage. Internal DIN connectors seal out potential environmental problems while keeping circuit boards firmly connected. Internal diagnostics exercise both digital and analog functions and can isolate problems to the board level, so repair often requires nothing more than the replacement of a plug-in module.

Specification Summary*

To simplify evaluation of how the 5700A covers your calibration workload, use the 5700A absolute uncertainty specifications.

Specifications

DC Voltage

Range	Resolution	Absolute Uncertainty: ±5°C from Calibration Temperature			
		24 Hours	90 Days	180 Days	1 Year
		±(ppm output + μV)			
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8
2.2V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2
11V	1 μV	3.5 + 3	5 + 4	7 + 4	8 + 4
22V	1 μV	3.5 + 6	5 + 8	7 + 8	8 + 8
220V	10 μV	5 + 100	6 + 100	8 + 100	9 + 100
1100V	100 μV	7 + 600	8 + 600	10 + 600	11 + 600

Resistance

Nominal Value	Absolute Uncertainty of Characterized Value ±5°C from Calibration Temperature			
	24 Hours	90 Days	180 Days	1 Year
Ω	±ppm			
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ
1	85	95	100	110
1.9	85	95	100	110
10	26	28	30	33
19	24	26	28	31
100	15	17	18	20
190	15	17	18	20
1k	11	12	13	15
1.9k	11	12	13	15
10k	9	11	12	14
19k	9	11	12	14
100k	11	13	14	16
190k	11	13	14	16
1M	16	18	20	23
1.9M	17	19	21	24
10M	33	37	40	46
19M	43	47	50	55
100M	110	120	125	130

Absolute Uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and the traceability of external standards. You do not need to add anything to determine the ratios between 5700A uncertainties and the uncertainties of your calibration workload.

** Complete 5700A and 5725 specifications are available.*

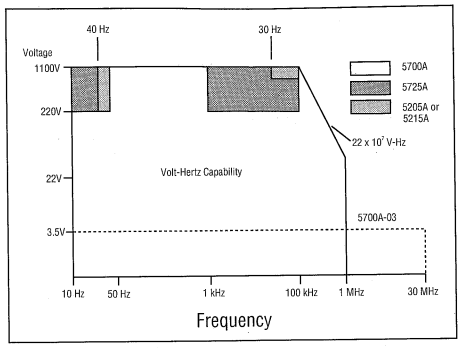
Resistance

Seventeen passive resistance values are supplied in x1.0 and x1.9 mutiples, plus a short to allow complete resistance calibration without moving test leads. Actual values assigned during calibration are displayed and used as reference points for error calculations.

For calibration of highter accuracy meters, 4-wire output connection is provided, with absolute uncertainties as shown in the table. Active 2-wire compensation is available for calibration of less accurate ohmmeters with 2-wire inputs. This feature substantially eliminates errors due to test lead resistance, and may be selected for resistance values up to 19 kΩ.

AC Voltage

Range	Resolution	Frequency	Absolute Uncertainty: ±5°C from Calibration Temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + μV)			
2.2 mV	1 nV	10-20	500 + 5	550 + 5	600 + 5	600 + 5
		20-40	200 + 5	220 + 5	230 + 5	240 + 5
		40-20k	100 + 5	110 + 5	120 + 5	120 + 5
		20k-50k	340 + 5	370 + 5	390 + 5	410 + 5
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
22 mV	10 nV	10-20	500 + 6	550 + 6	600 + 6	600 + 6
		20-40	200 + 6	220 + 6	230 + 6	240 + 6
		40-20k	100 + 6	110 + 6	120 + 6	120 + 6
		20k-50k	340 + 6	370 + 6	390 + 6	410 + 6
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30
220 mV	100 nV	10-20	500 + 16	550 + 16	600 + 16	600 + 16
		20-40	200 + 10	220 + 10	230 + 10	240 + 10
		40-20k	95 + 10	100 + 10	110 + 10	110 + 10
		20k-50k	300 + 10	330 + 10	350 + 10	360 + 10
		50k-100k	750 + 30	800 + 30	850 + 30	900 + 30
		100k-300k	940 + 30	.1% + 30	.11% + 30	.11% + 30
		300k-500k	.15% + 40	.17% + 40	.17% + 40	.18% + 40
		500k-1M	.30% + 100	.33% + 100	.35% + 100	.36% + 100
2.2V	1 μV	10-20	500 + 100	550 + 100	600 + 100	600 + 100
		20-40	150 + 30	170 + 30	170 + 30	180 + 30
		40-20k	70 + 7	75 + 7	80 + 7	85 + 7
		20k-50k	120 + 20	130 + 20	140 + 20	140 + 20
		50k-100k	230 + 80	250 + 80	270 + 80	280 + 80
		100k-300k	400 + 150	440 + 150	470 + 150	480 + 150
		300k-500k	.10% + 400	.11% + 400	.12% + 400	.12% + 400
		500k-1M	.20% + 1 mV	.22% + 1 mV	.23% + 1 mV	.24% + 1 mV
22V	10 μV	10-20	500 + 1 mV	550 + 1 mV	600 + 1 mV	600 + 1 mV
		20-40	150 + 300	170 + 300	170 + 300	180 + 300
		40-20k	70 + 70	75 + 70	80 + 70	85 + 70
		20k-50k	120 + 200	130 + 200	140 + 200	140 + 200
		50k-100k	230 + 400	250 + 400	270 + 400	280 + 400
		100k-300k	500 + 1.7 mV	550 + 1.7 mV	550 + 1.7 mV	600 + 1.7 mV
		300k-500k	.12% + 5 mV	.13% + 5 mV	.13% + 5 mV	.14% + 5 mV
		500k-1M	.26% + 9 mV	.28% + 9 mV	.29% + 9 mV	.30% + 9 mV
			±(ppm output + mV)			
220V	100 μV	10-20	500 + 10	550 + 10	600 + 10	600 + 10
		20-40	150 + 3	170 + 3	170 + 3	180 + 3
		40-20k	75 + 1	80 + 1	85 + 1	90 + 1
		20k-50k	200 + 4	220 + 4	240 + 4	250 + 4
		50k-100k	500 + 10	550 + 10	600 + 10	600 + 10
		100k-300k	.15% + 110	.15% + 110	.16% + 110	.16% + 110
		300k-500k	.50% + 110	.52% + 110	.53% + 110	.54% + 110
		500k-1M	1.20% + 220	1.25% + 220	1.25% + 220	1.30% + 220
1100V	1 mV	50-1k	75 + 4	80 + 4	85 + 4	90 + 4



AC Voltage, 5725A Amplifier

Range	Resolution	Frequency	Absolute Uncertainty: ±5°C from Calibration Temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + mV)			
1100V	1 mV	40-1k	75 + 4	80 + 4	85 + 4	90 + 4
		1k-20k	105 + 6	125 + 6	135 + 6	165 + 6
		20k-30k	230 + 11	360 + 11	440 + 11	600 + 11
750V		30k-50k	230 + 11	360 + 11	440 + 11	600 + 11
		50k-100k	600 + 45	.13% + 45	.16% + 45	.23% + 45

8

5700A

DC Current

Range	Resolution	Absolute Uncertainty: ±5°C from Calibration Temperature			
		24 Hours	90 Days	180 Days	1 Year
	nA	±(ppm output + nA)			
220 µA	.1	45 + 10	50 + 10	55 + 10	60 + 10
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100
	µA	±(ppm output + µA)			
220 mA	.1	55 + 1	60 + 1	65 + 1	70 + 1
2.2A	1	75 + 30	80 + 30	90 + 30	95 + 30
5725A Amplifier:					
11A	10	330 + 470	340 + 480	350 + 480	360 + 480

AC Current

Range	Resolution	Frequency	Absolute Uncertainty: ± 5°C from Calibration Temperature			
			24 Hours	90 Days	180 Days	1 Year
		Hz	±(ppm output + nA)			
220 µA	1 nA	10-20	650 + 30	700 + 30	750 + 30	800 + 30
		20-40	350 + 25	380 + 25	410 + 25	420 + 25
		40-1k	120 + 20	140 + 20	150 + 20	160 + 20
		1k-5k	500 + 1 µA	600 + 1 µA	650 + 1 µA	700 + 1 µA
		5k-10k	.15% + 4 µA	.16% + 4 µA	.17% + 4 µA	.18% + 4 µA
2.2 mA	10 nA	10-20	650 + 50	700 + 50	750 + 50	800 + 50
		20-40	350 + 40	380 + 40	410 + 40	420 + 40
		40-1k	120 + 40	140 + 40	150 + 40	160 + 40
		1k-5k	500 + 2 µA	600 + 2 µA	650 + 2 µA	700 + 2 µA
		5k-10k	.15% + 4 µA	.16% + 4 µA	.17% + 4 µA	.18% + 4 µA
22 mA	100 nA	10-20	650 + 500	700 + 500	750 + 500	800 + 500
		20-40	350 + 400	380 + 400	410 + 400	420 + 400
		40-1k	120 + 400	140 + 400	150 + 400	160 + 400
		1k-5k	500 + 10 µA	600 + 10 µA	650 + 10 µA	700 + 10 µA
		5k-10k	.15% + 20 µA	.16% + 20 µA	.17% + 20 µA	.18% + 20 µA
		Hz	±(ppm output + µA)			
220 mA	1 µA	10-20	650 + 5	700 + 5	750 + 5	800 + 5
		20-40	350 + 4	380 + 4	410 + 4	420 + 4
		40-1k	120 + 4	150 + 4	170 + 4	180 + 4
		1k-5k	500 + 50	600 + 50	650 + 50	700 + 50
		5k-10k	.15% + 100	.16% + 100	.17% + 100	.18% + 100
2.2A	10 µA	40-1k	600 + 40	650 + 40	700 + 40	750 + 40
		1k-5k	700 + 100	750 + 100	800 + 100	850 + 100
		5k-10k	.80% + 200	.90% + 200	.95% + 200	1.0% + 200
5725A Amplifier:						
11A	100 µA	40-1k	370 + 170	400 + 170	440 + 170	460 + 170
		1k-5k	800 + 380	850 + 380	900 + 380	950 + 380
		5k-10k	.3% + 750	.33% + 750	.35% + 750	.36% + 750

Current

The 5700A supplies direct alternating current to 2.2A, extended to 11A with the 5725A Amplifier or to 20A with the 5220A Transconductance Amplifier. 5700A current output is available on front or rear voltage output terminals. For convenience in calibrating meters with separate current terminals, 5700A outputs may also be directed either to an auxiliary front panel current terminal or to 5725A front or rear terminals. This allows automated meter calibration without moving test leads.

For system applications, a rear panel current guard provides a voltage follower output for guarding low level current through longer system cables.

Wideband AC Voltage (Option -03)

Specifications apply to the end of the cable and 50Ω termination used for calibration:

Range		Resolution	Absolute Uncertainty: ±5°C from Calibration Temperature 30 Hz-500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			±(% output + μV)			
1.1 mV	-46	10 nV	.4 + .4	.5 + .4	.6 + .4	.8 + 2
3 mV	-37	10 nV	.4 + 1	.45 + 1	.5 + 1	.7 + 3
11 mV	-26	100 nV	.2 + 4	.35 + 4	.5 + 4	.7 + 8
33 mV	-17	100 nV	.2 + 10	.3 + 10	.45 + 10	.6 + 16
110 mV	-6.2	1 μV	.2 + 40	.3 + 40	.45 + 40	.6 + 40
330 mV	+3.4	1 μV	.2 + 100	.25 + 100	.35 + 100	.5 + 100
1.1V	+14	10 μV	.2 + 400	.25 + 400	.35 + 400	.5 + 400
3.5V	+24	10 μV	.15 + 500	.2 + 500	.3 + 500	.4 + 500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference		
		Voltage Range		
		1.1 mV	3 mV	>3 mV
Hz	Hz	±%		
10-30	.01	.3	.3	.3
30-120	.01	.1	.1	.1
120-1.2k	.1	.1	.1	.1
1.2k-12k	1	.1	.1	.1
12k-120k	10	.1	.1	.1
120k-1.2M	100	.2 + 3 μV	.1 + 3 μV	.1 + 3 μV
1.2M-2M	100k	.2 + 3 μV	.1 + 3 μV	.1 + 3 μV
2M-10M	100k	.4 + 3 μV	.3 + 3 μV	.2 + 3 μV
10M-20M	1M	.6 + 3 μV	.5 + 3 μV	.4 + 3 μV
20M-30M	1M	1.5 + 15 μV	1.5 + 3 μV	1 + 3 μV

Additional Operating Information:
dBm reference = 50Ω
Range boundaries are at voltage points, dBm levels are approximate.

$$dBm = 10 \log \left(\frac{Power}{1\ mW} \right),$$

for 50Ω: 0 dBm = 1 mW across 50Ω = 0.22361V
Minimum Output: 300 μV (-57 dBm)
Frequency Uncertainty: ±0.01%
Overload Protection: A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

General Specifications

Warm-up Time: 2x the time since last warmed up, to a maximum of 30 minutes.
System Installation: Rear output configuration and rackmount kit available.
Standard Interfaces: IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).
Temperature Performance: Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: -40°C to 75°C.
Relative Humidity: Operating: <90% to 30°C, <70% to 40°C, <40% to 50°C. Storage <95%, non-condensing
Safety: Designed to comply with UL 1244 (1987); IEC 348-1978I IEC 66E (CO) 4; CSA 556B.
Guard Isolation: 20 volts

EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B.
Reliability: MIL-T-28800D, para. 3.13.3
Line Power: 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V.
Maximum Power: 5700A, 300VA; 5725A, 750VA.

Size
5700A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6in) for feet; width 43.2 cm (17 in), standard rack width; depth 63.0 cm (24.8), overall; 57.8 cm (22.7 in), rack depth.
5725A: Height 13.3 cm *5.25 in); width and depth same as 5700A; Both units project 5.1 cm (2 in) from rack front
Weight: 5700A: 27kg (62 lb); 5725A: 32kg (70 lb)

8

5700A



All ranges and functions of the 5700A, 5725A and Wideband Voltage option may be calibrated using just three Artifact Standards.

Calibration Requirements

Calibrating the 5700A to full specified absolute uncertainty requires only the following standards:

Fluke Standard	Traceable Quantity	Nominal Value	Uncertainty*
732A	Voltage	10V	±1.5 ppm
742A-1	Resistance	1Ω	±10 ppm
742A-10k	Resistance	10 kΩ	±4 ppm

**Relative to national standards*

The 5700A's simple, built-in, self-prompting calibration procedure is designed to use the portable Fluke standards to completely calibrated all of it functions.

Calibration may be done at any temperature from 15°C to 35°C without change to any specification except for resistance. Resistance specifications are modified by a small temperature coefficient when the 5700A is calibrated below 19°C or above 24°C.

You may use standards with different uncertainties than given in the table at left. Absolute uncertainty must then be modified by the algebraic difference between the uncertainty of the standard used and that in the table. For example if the dc voltage standard has an uncertainty of ±2.5 ppm, 5700A DC Voltage absolute uncertainty specifications will all be increased by ±1 ppm. Note that dc and ac current specifications include the uncertainties of both the dc voltage and resistance standards that are used.

Ordering Information

Models

5700A Calibrator
5700A-01 Calibrator, Rear Output Option*
5725A Amplifier
5725A-01 Amplifier, Rear Output Option*

**Factory installed only*

Option

5700A-03 Wideband AC Voltage

Accessories (Also see Section 20)

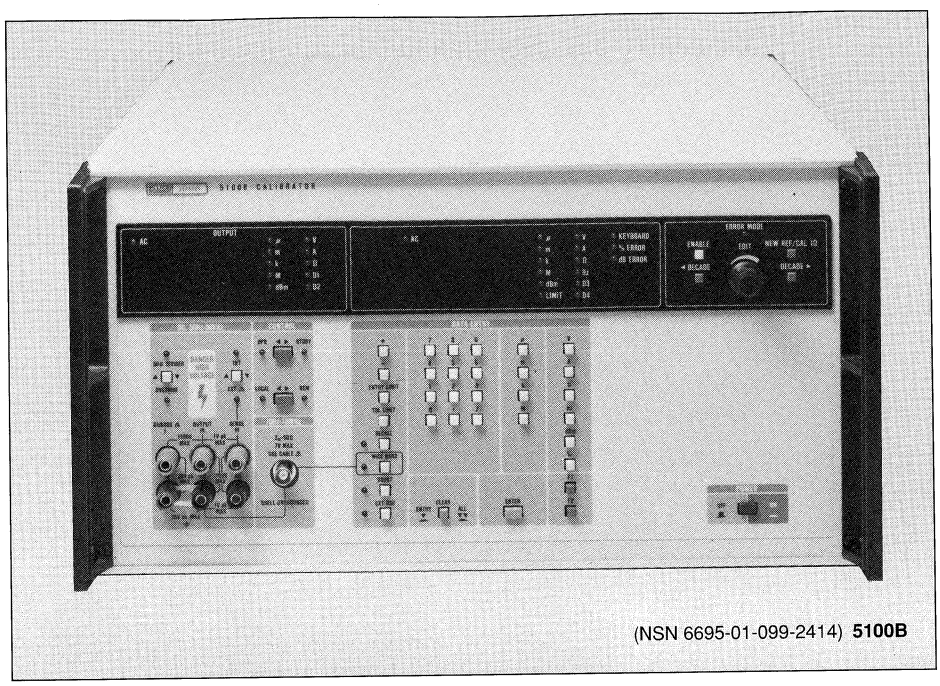
5440A-7002 Low Thermal Cable Set
732A DC Voltage Reference Standard
742A-1 1Ω Resistance Standard
742A-10k 10 kΩ Resistance Standard
Y5701 Cable for 5205A or 5215A
Y5702 Cable for 5220A
Y5737 Rackmount Kit with 24" slides for 5700A*
Y5735 Rackmount Kit with 24" slides for 5725A*
Y8021 Shielded IEEE-488 Cable, 1m
Y8022 Shielded IEEE-488 Cable, 2m
Y8023 Shielded IEEE-488 Cable, 4m

**Note: These rack slides allow for side ventilation.*

5100B Series

GPIB IEEE-488

RS-232



(NSN 6695-01-099-2414) **5100B**

5100B Series Calibrators

- Improved version of the world's most popular multifunction calibrator
- Cost-effective multimeter calibration to 4 1/2 digits
- Five functions: Direct or alternating voltage or current plus resistance
- New front panel, new output terminals, and updated control panel
- Modern production methods offer superior quality
- Unique cassette tape drive option available for storing procedures
- Compatible with Fluke 7411C and MET/CAL based systems, 5700A Calibrator, 5205A/5215A Power Amplifiers, and 5220A Transconductance Amplifier

The 5100B Series Calibrators are the world's leading calibrators for analog and digital multimeters to 4 1/2 digits. Dependability, five-function versatility and cost effectiveness have made the 5100B Series Calibrators basic equipment for nearly every calibration laboratory.

Now these calibrators offer even more value. DC voltage uncertainty is 40 ppm; Basic AC uncertainty is 350 ppm. The front panel includes high-voltage safety terminals together with control grouping optimized for user friendliness. Quality and reliability are also enhanced with modern manufacturing methods including statistical process control (SPC).

The versatility of the 5100B Series Calibrators is unmatched at any price. They are compatible with the popular Fluke 7411C and MET/CAL based Calibration Systems, the Navy's MECCA Systems and the new Fluke 5700A Multifunction Calibrator. Enhanced capability is also available with the 10 MHz Wideband Option and the capability to directly drive the Fluke 5220A 20A Transconductance Amplifier and the 5205A or 5215A High Voltage Amplifier.

5100B Series Increases Throughput

A large share of the workload of meter calibration laboratories and production lines consists of analog and digital meters with 4 1/2 digit or less resolution. There are hundreds of different meters in this category representing different manufacturers, with no standard format for meter specifications.

Operating the 5100B Series is simple, making it easy to train your operators. And all data is entered via a calculator-type keyboard. No need to convert volts to dBm or dBm to volts, for example. And the 5100B Series performs the mathematical computations associated with calculating the error of the unit-under-test (UUT) – in % or in dB. It then indicates to the operator whether the UUT passed or failed, according to its specified uncertainty and the magnitude of the error.

The 5100B Series calibrates meters quickly and efficiently. It is no longer necessary to gather together separate calibration instruments requiring complex interconnection and operation. A single 5100B Series does the whole job.

5101B Has System Features

The 5101B is designed for the user who needs the automated features of a large computer aided calibration system without the hardware and software costs of a large system.

A typical calibration procedure consists of forty or fifty separate steps. For most benchtop systems, each step must be loaded into the calibrator – an operation that is slow and prone to human error. The 5101B has a built-in cassette tape deck to store calibration procedures and step through them under microprocessor control.

Initially, the operator records the procedure on a mini-cassette. Once recorded, the procedure can be repeated in a fraction of the usual time. Preparing the calibration tape and operating the 5101B, requires no special knowledge of computers or computer languages. Using a printer and interface option with the 5101B, you can document both the calibration procedure and the test results with a hard-copy record.

5102B Has Rugged Case

The 5102B is similar to a 5100B but constructed in a rugged combination case with removable sealed end covers for military applications. It is not rackmountable.

Automated Calibration

The 5100B Series can be used in computer-aided calibration applications by adding a Fluke 1722A Instrument Controller and 7411B Calibration Software. Examples of calibration procedures are included in the software packages. Consult your local sales office for details.

Extended Power and Current Capabilities

The 5205A Precision Power Amplifier and the 5220A Transconductance Amplifier will operate as an integrated system with either a 5100B, 5101B, or 5102B. The purpose is to extend the voltage and current sourcing capabilities beyond the basic built-in capabilities of the 5100B Series Calibrators.

High voltage loading may be extended from 6 mA maximum to 100 mA maximum at 1100V for direct voltage. And alternating volt-Hertz limits may be extended from 20V at 50 kHz to 1100V at 50 kHz. Current sourcing may be extended from 2A to 20A.

A Y5000 Interface/Buffer is needed to integrate a 5205A and/or a 5220A with 5100B Series. It connects to the rear panels and preserves the advantage of single-point control of calibration,

automatic error calculation, entry limit protection, etc. The system is operated and controlled using only the front panel of the 5100B/5101B or procecures stored on a 5101B mini-cassette.

Specifications

Technical Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 µV	Limited by 50Ω output resistance or 25 mA using 50Ω overide	0.01 of setting +25 µV**
200 mV	1 µV		
2V	10 µV		
20V	100 µV	25 mA 1000 pF	0.02% of setting + 50 µV
200V	1 mV	10 mA/ 400 pF*	0.05% of setting (open to 20 kΩ) 0.1 of setting (20 kΩ to full load)
1100V	10 mV	6 mA/ 400 pF*	0.05% of setting

**100 mA/1500 pF with 5205A, Y5000 and Y5001*
***Double both terms for divider override mode*

Uncertainty: ±(0.004% of setting +0.001% of range +5 µV) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; ±(0.005% of setting +0.2 mV) for divider override mode
Temperature Coefficient: Above 30°C and below 20°C, ±(5 ppm of setting +1 ppm of range +1 µV)/°C to 200V, ±(5 ppm of setting +2 ppm of range)/°C, 200V to 1100V
Short Term Stability: (For 10 minutes from 0°C to 50°C) ±(10 ppm of setting +2 ppm of range +5 µV) to 500V; ±25 ppm of setting, 500V to 1100V
Load Regulation: (External Sense) ±10 ppm from 2V to 1100V, no-load to full-load. (Internal Sense) same as external except full-load is 400Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 µV	Limited by 50Ω output resistance	Bandwidth of 10 Hz to 200 kHz, Distortion, line interference + noise including random spikes **20V and Higher** 50 Hz to 10 kHz: 0.08% of output rms **Below 20V** 50 Hz to 10 kHz: (0.05% of output + 10 µV) rms 10 kHz to 50 kHz: (0.08% of output + 20 µV) rms
200 mV	1 µV		
2V	10 µV	2 kΩ/ 1000 pF	
20V	100 µV	25 mA/ 1000 pF	
200V	1 mV	10 mA/ 400 pF	
1100V	10 mV	6 mA/ 400 pF**	

** Can be set in dBm where 0 dBm + 1 mW in 6008 + 0.7746V*
***200 mA/1500 pF with 5205A, Y5000 and* Y5001

Uncertainty: ±(0.035% of setting +0.005% of range +50 µV) from 50 Hz to 10 kHz and ±(0.06% of setting +0.008% of range +50 µV) from 10 kHz to 50 kHz for 6 months, 20°C to 30°C ambient
Frequencies Available (Hz): 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, and 900 for all voltage ranges.

Frequencies Available (kHz):

Voltage Range	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	•	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	Δ	Δ	Δ
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Δ With 5205A, Y5000, and Y5001

Frequency Uncertainty: ±3%
Temperature Coefficient: Above 30°C and below 20°C ±(20 ppm of setting +2 ppm of range)/°C for amplitude, ±0.1%/°C for frequency
Short Term Stability: ±(0.01% of range +10 µV) for 10 minutes from 0°C to 50°C
Load Regulation: External Sense, ±200 ppm from 0.2V to 1100V, no-load to full-load; Internal Sense, same as external except regulation for voltages <0.2V is expressed as an output impedance of 50Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 µA	1 nA	0 to 10V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 2.1V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.015% of setting +0.002% of range +0.01 µA) for compliance voltage up to 1V. Add 0.002% of setting per volt above 1V rms. Applies for 6 months and 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(10 ppm of setting +2 ppm of range)/°C
Short Term Stability: ±(50 ppm of setting +5 ppm of range +0.002 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion & Noise
200 µA	1 nA	0 to 7V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 1.4V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.05% of setting +0.005% of range +0.02 µA) for compliance voltage up to 1V rms (50 Hz to 1 kHz). Add 0.005% of setting per volt above 1V rms. Applies for 6 months in 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(25 ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency
Short Term Stability: ±(0.014% of setting +0.002% of range +0.4 µA) for 10 minutes from 0°C to 50°C

Load Regulation: ±(50 ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1Ω to 10 MΩ in decade steps
Uncertainty: ±0.003%, except ±0.015% (1Ω), ±0.010% (10Ω and 1 MΩ), and ±0.030% (10 MΩ) assumes 4 terminal below 100 kΩ. 6 mo 20°-30°C
Power Dissipation: 1W maximum except 100 mW max (1 MΩ) and 10 mW max (10 MΩ)
Temperature Coefficient: Above 30°C and below 20°C, ±5 ppm/°C except ±10 ppm/°C (1Ω and 10Ω), ±10 ppm/°C up to 40°C (10 MΩ), and ±50 ppm/°C above 40°C (10 MΩ)

Extended Specifications

Direct Voltage (5205A)

Range: ±100V to ±1100V, with 10 mV resolution
Maximum Load: 100 mA; 1500 pF
Uncertainty: ±(0.07% of setting +20 mV), for 6 months, 20°C to 30°C ambient
Line-Related Noise: ≤50 mV rms
Random Noise: ≤100 mV rms, 1 MHz bandwidth

Alternating Voltage (5205A or 5215A)

Voltage Range: 100V to 1100V rms, with 10 mV resolution
Maximum Load: 200 mA, decreasing linearly to 140 mA from 100 Hz to 50 Hz; 1500 pF
Voltage Uncertainty: ±(0.08% of setting +0.1V) for 50 Hz to 10 kHz; ±(0.12% of setting + 0.15V) for 10 kHz to 50 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 50 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: 0.1% of setting from 50 Hz to 20 kHz, 0.2% of setting from 20 kHz to 50 kHz, for bandwidth of 10 Hz to 1 MHz

Direct Current (5220A)

Range: ±1A to ±19.9999A, with 100 µA resolution
Compliance Voltage: 0 to 4V
Uncertainty: ±(0.025% of setting +1 mA), for 6 months, 20°C to 30°C ambient
Ripple and Noise: 0.05% of setting +1 mA rms, 10 Hz to 3 kHz bandwidth

Alternating Current (5220A)

Current Range: 1A to 19.9999A rms, with 100 µA resolution
Compliance Voltage: 0 to 3V rms
Current Uncertainty: ±(0.07% of setting +1 mA) rms from 50 Hz to 1 kHz, ±(0.07% of setting +1 mA) x frequency (in kHz) from 1 kHz to 5 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 5 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: ±(0.07% of setting +1 mA) rms, for bandwidth of 10 Hz to 300 kHz

Option Specifications

Wideband aV Option (-03)

Option -03 is an accurate, low-noise, flat alternating voltage source that allows the 5100B Series to be used for calibrating wideband voltmeters. Frequency coverage expands to 10 Hz-10 MHz. A dedicated front panel BNC connector provides ac output from 300 µV (-57.5 dBm) to 3.1623V (+23 dBm) into 50Ω impedance. The output is programmable from the front panel or I/O interface in volts or in dBm (where 0 dBm equals 1 mW into 50Ω). Using a simple formula for calculation of a correction factor and the NEW REF feature, the wideband output can be directly programmed for dBm referenced to other impedances.

With the EDIT control the error of wideband meters can be calculated in % or in dB. With the EDIT control and NEW REF, you may test the frequency response of meters. This method provides a direct reading in percent or dB, ideal for making Bode plots.
Range: 10 Hz to 10 MHz

Amplitude Uncertainty, at 1 kHz, Terminated in 50Ω*

Voltage Range	Approx dBm Range	±(% of Setting + % of Range)
1V-3.1623V	+13 to +23	0.25 + 0.25
0.31624V-0.99999V	+3 to +13	0.5 + 0.25
0.1V-0.31623V	-7 to +3	0.75 + 0.25
31.624mV-99.999mV	-17 to -7	1.0 + 0.25
10mV-31.623mV	-27 to -17	1.25 + 0.25
3.1624mV-9.9999mV	-37 to -27	1.5 + 0.25
1mV-3.1623mV	-47 to -37	1.75 + 0.25
300µV-0.99999 mV	-57.5 to -47	2.0 + 0.25

**For 6 months, 20°C to 30°C ambient*

Amplitude Flatness*
10 Hz to 30 Hz: ±0.3%
30 Hz to 1 MHz: ±0.25%
1 MHz to 5 MHz: ±0.25% above 1 mV, ±0.6% ≤1 mV
5 MHz to 10 MHz: ±0.6%
**Using 1 foot of RG 58U cable terminated in 50Ω*

Temperature Coefficient: Above 30°C and below 20°C ±(0.1 times basic accuracy)/°C for amplitude; ±0.25%/°C for frequency
Harmonics: -40 dB or lower relative to fundamental for each frequency except -32 dB above 5 MHz
Spurious Outputs: -50 dB or lower relative to fundamental for each frequency
Frequency Resolution: 1 MSD
Frequency Uncertainty: ±3%

IEEE-488 Interface Option (-05)

This interface allows the 5100 Series B to be used in a system compatible with IEEE Std 488-1978. System control is via the Fluke 1722A or 1752A Instrument Controller or any host computer. Address coding is done using logic switches accessible on the rear panel. Data is transmitted bi-directionally in ASCII coded format. The following subsets are supported: SH1, AH1, T6, L4, SR1, RL1, DC1, and E2.

Bit Serial Interface Option (-06)

Provides compatibility with EIA Standard RS-232-C or 20 mA current loops. Thirteen baud rates are available from 50 to 9600 and either one or two stop-bits can be set up. Selection is made via rear panel logic switches.

General Specifications

Shock and Vibration: Meets requirements of MIL-T-28800 for Class 5, Style E equipment
Temperature
5100B and 5102B: 0°C to 50°C operating; -20°C to +65°C non-operating
5101B: (With mini-cassette tape) +10°C to +40°C operating; +4°C to +50°C, non-operating. Without mini-cassette: same as 5100B
Relative Humidity: 185% to 35°C, ≤70% to 40°C, ≤50% to 50°C
Power: 100, 110, 115, 120, 200, 220, 230, 240V ac, switch-selectable ±10%, 50 Hz to 60 Hz. 200VA (5100B) or 220VA (5101B) with all options
Size: 22.2 cm H x 60.3 cm W x 43.2 cm L (8.75 in H x 17 in W x 23.75 in L)
Weight
5100B: 30.4 kg (67 lb) basic, 32.7 kg (72 lb) with all options
5101B: 32.7 kg (72 lb) basic, 34.9 kg (77 lb) with all options
5102B: 35.8 kg (79 lb) basic, 38.1 kg (84 lb) with all options
Included with Instrument: Manual, power cord, serialized and dated calibration certificate. Also one mini-cassette tape with 5101B.

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5100B Series

Ordering Information

Models

5100B Calibrator
5101B Calibrator, w/procedure storage
5102B Calibrator in portable case
5205A* Power Amplifier
5220A* Transconductance Amplifier
** Y5001 or Y5002 cable and Y5000 interface required when used with 5100B Series Calibrator*

Options (for 5100B, 5101B, 5102B)

-03 Wideband AC Voltage
-05* IEEE-488 Compatible Interface
-06* EIA RS-232-C Interface
**Cannot have -05 and -06 together*

Accessories (Also see Section 20)

5100B-7003K* Fiberglass Carrying Case, for 5100B/5101B
5100B-7005K Extender Kit
M08-205-600 8 3/4" Rack Mount Kit, 5100B/5101B
M00-280-610** 24" Rack Slides
Y5000 Interface Buffer for 5205A, 5215A and 5220A
Y5001 Interface Cable for 5205A/5215A and Y5000
Y5002 Interface Cable for 5220A and Y5000
Y8021 Shielded IEEE-488 bus Cable, 1m
Y8022 Shielded IEEE-488 bus Cable, 2m
Y8023 Shielded IEEE-488 bus Cable, 4m
Y8004 Shielded RS-232-C Cable, 1.5m
Y8007 Mini-cassettes, 10-pack for 5101B
**Cannot be used as a shipping case.*
***Requires M08-205-600*

Percent and PPM

Calibrator and meter uncertainty specifications are usually given as either percent or parts per million (ppm). These are interchangeable concepts. We have chosen to use the term "ppm" for the most part, mainly to make the numbers more easily readable by reducing the number of zeros. This table will give you an idea of how they relate:

0.1% = 1000 ppm
0.01% = 100 ppm
0.001% = 10 ppm
0.0001% = 1 ppm

An easy memory aid to use is 0.01% and 100 ppm. Reverse the order of the numbers in 0.01% and it comes out as 100 ppm.

5440B & 5442A

GPIB IEEE-488

RS-232



NSN 6625-01-226-5448 **5440B**

5440B & 5442A Direct Voltage Calibrators

- Full accuracy over extended temperature range of 10°C
- Completely automatic internal calibration, no mechanical adjustments
- Simplified 5-minute external calibration to traceable standards
- Procedure Storage Module for single button test setup (5440B only)
- Completely programmable through the GPIB/IEEE-488 interface
- Serial printer output for calibration constants and instrument test results

The 5440B and 5442A are equipped with bright vacuum-fluorescent displays for clear visibility at any viewing angle. Even inexperienced operators find the 5440B and 5442A easy to use because the 40-character, alphanumeric display provided in addition to the numeric output display, makes operating instructions and error messages clear and readable in engineering units and English language messages instead of coded numerics. For semi-automated testing, the 5440B allows a complete test sequence of up to 60 steps to be stored in the internal Procedure Storage memory and recorded for later use in the interchangeable, plug-in Procedure Storage Modules. A test sequence is recalled and executed one step at a time with each touch of the NEXT STEP key.

The differences between the 5440B and the 5442A are in the operating features and specifications. The 5440B comes equipped with the Procedure Storage Module capability and boost capability for driving the 5205A Precision Power Amplifier and 5220A Transconductance Amplifier in system applications. The rear output terminals found on the 5440B as a standard feature are available for the 5442A as an option. Both instruments have outstanding accuracy specifications and the capability for operating at full rated accuracy over a temperature range of ±5°C from the calibration temperature, making them well-suited for operation in a production environment as well as in a standards lab. Both instruments are completely programmable via the GPIB/IEEE-488* interface which is included at no extra cost.

The outstanding accuracy specifications for the 5440B and 5442A are easily maintained in any lab by performing the simple, automatic calibration procedures which store the calibration constants in non-volatile solid-state memory. No hardware adjustments are required. The Fluke 732A Reference Standard combined with the Fluke Direct Volt Maintenance Program and the Fluke 752A Reference Divider, provide the highest accuracy reference standards available for this periodic calibration.

Specifications

Specifications apply to both the 5440B and 5442A unless otherwise noted.
Output Voltage: 0 to 1100V
Output Current: 0 to 60 mA up to 22V, except divided outputs; 0 to 25 mA up to 1100V

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

5440B:

Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	1.5 + 5 µV	2.0 + 5 µV
11V to 22V	1.5 + 8 µV	2.0 + 8 µV
22V to 275V	2.5 + 100 µV	3.5 + 100 µV
275V to 1100V	2.5 + 400 µV	3.5 + 400 µV
Divided Output		
0V to 220 mV	4 + 0.5 µV	5 + 0.5 µV
0.22V to 2.2V	3 + 1 µV	4.5 + 1.0 µV
Range	**180 Days**	**1 Year**
0V to 11V	2.5 + 5 µV	3.5 + 5 µV
11V to 22V	2.5 + 8 µV	3.5 + 8 µV
22V to 275V	4.5 + 100 µV	6.0 + 100 µV
275V to 1100V	4.5 + 400 µV	6.0 + 400 µV
Divided Output		
0V to 220 mV	6.5 + 0.5 µV	10 + 0.5 µV
0.22V to 2.2V	6 + 1.0 µV	8 + 1.0 µV

5442A:

Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)	
	30 Days	**90 Days**
0V to 11V	2.5 + 5 µV	3.0 + 5 µV
11V to 22V	2.5 + 8 µV	3.0 + 8 µV
22V to 275V	3.0 + 100 µV	3.5 + 100 µV
275V to 1100V	2.5 + 400 µV	3.5 + 400 µV
Divided Output		
0V to 220 mV	6 + 0.5 µV	7 + 0.5 µV
0.22V to 2.2V	4 + 1 µV	6 + 1.0 µV
Range	**180 Days**	**1 Year**
0V to 11V	4.5 + 5 µV	6.5 + 5 µV
11V to 22V	4.5 + 8 µV	6.5 + 8 µV
22V to 275V	5.0 + 100 µV	7.0 + 100 µV
275V to 1100V	4.5 + 400 µV	6.0 + 400 µV
Divided Output		
0V to 220 mV	9 + 0.5 µV	12 + 0.5 µV
0.22V to 2.2V	8 + 1.0 µV	11 + 1.0 µV

Uncertainty of Calibration Standards Compared to National Standards

Range	Uncertainty of Standards
0V to 11V	1.5 ppm
11V to 22V	1.5 ppm
22V to 275V	1.7 ppm
275V to 1100V	2.0 ppm
0V to 220 mV	4.0 ppm
0.22V to 2.2V	2.0 ppm

The output uncertainty compared to national standards for the 5440B and 5442A are defined as the algebraic sum for each range of the output uncertainty compared to calibration standards and the uncertainty of the calibration standards

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compared to national standards. The specifications for uncertainty of calibration standards listed above are those for the Fluke 732A and Fluke 752A. If other standards are used, the uncertainty of those standards must be substituted.

Output Stability

Specifications apply for initial stabilization of two hours, constant ambient temperature of ±1°C, constant line voltage, constant load, and measurement bandwidth of 0.1 Hz to 1 Hz.

Range	±(PPM of Output + Microvolts)		
	10 Minutes	24 Hours	30 Days*
0V-11V	0.2+2 µV	0.3+3 µV	0.5+3 µV
11V-22V	0.2+3 µV	0.4+4 µV	0.5+4.5 µV
22V-275V	0.3+40 µV	0.3+50 µV	1.0+60 µV
275V-1100V	0.3+200 µV	0.3+200 µV	1.0+300 µV
Divided Output			
0 mV-220 mV	0.5+0.2 µV	0.5+0.2 µV	2+0.3 µV
0.22V-2.2V	0.5+0.2 µV	0.5+0.5 µV	2+0.7 µV

** For best results, use internal calibration for periods exceeding one day.*

Temperature Coefficient of Output

These specifications apply for ambient temperatures outside the ±5°C range of the uncertainty specifications listed earlier.

Range	±(PPM of Output) Per °C	
	0-10°C	10-30°C
0V to 11V	0.15 ppm	0.1 ppm
11V to 22V	0.15 ppm	0.1 ppm
22V to 275V	0.2 ppm	0.2 ppm
275V to 1100V	0.2 ppm	0.2 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm
Range	**30-40°C**	**40-50°C**
0V to 11V	0.4 ppm	1.0 ppm
11V to 22V	0.4 ppm	1.0 ppm
22V to 275V	0.6 ppm	1.5 ppm
275V to 1100V	1.0 ppm	1.5 ppm
Divided Output		
0V to 220 mV	0.5 ppm	0.5 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm

Linearity

These specifications apply for the ambient temperature range of 15°C to 30°C within ±5°C of the external calibration temperature.

Range	±(PPM of Output + Microvolts)
0 mV to 220 mV	0.5 ppm + 0.2 µV
0.22V to 2.2V	0.7 ppm + 0.3 µV
0V to 11V	0.5 ppm + 1.5 µV
11V to 22V	0.5 ppm
22V to 275V	0.5 ppm + 40 µV
275V to 1100V	1.0 ppm

Resolution

Range	Resolution	Maximum Load or Output Resistance
0V to 11V	1 µV	25 mA
11V to 22V	1 µV	
22V to 275V	10 µV	
275V to 1100V	100 µV	
Divided Output		
0V to 220 mV	0.01 µV	495Ω
0.22V to 2.2V	0.1 µV	450Ω

Output Noise

Range	Bandwidth	
	0.1 Hz to 10 Hz	10 Hz to 10 kHz
0 mV to 220 mV	0.1 µV	5 µV
0.22V to 2.2V	0.2 µV	15 µV
0V to 11V	1.5 µV	30 µV
11V to 22V	3.0 µV	50 µV
22V to 275V	35 µV	150 µV
275V to 1100V	100 µV	300 µV

Output Settling Time

Time to settle within a given uncertainty band of final value, for a change in programmed output within a given range.

Range	±Parts Per Million of Change*		
	3 seconds	5 seconds	10 seconds
0 mV to 220 mV, 0.22V to 2.2V, 0V to 11V, and 11V to 22V	7 ppm	2 ppm	0.5 ppm
22V to 275V 275V to 1100V	–	–	3 ppm

** Add 0.5 seconds for any change in range up to 22V, 1.0 second for a change from 22V up, and 0.5 seconds for a change from STBY to OPER.*

Line Regulation: Changes less than ±0.1 ppm of range for ±10% change from nominal line voltage
Load Regulation: Less than ±0.1 ppm change of output for change from no-load to full-load or from full-load to no-load for output load impedances greater than 80 ohms
Common Mode Rejection: Greater than 140 dB for frequencies from dc to 400 Hz
Temperature: 0°C to 50°C, operating, except accuracy is degraded above 40°C due to loss of oven regulation; -40°C to +75°C non-operating
Relative Humidity: ≤90% to 30°C except accuracy is degraded above 80%, ≤70% to 40°C, ≤40% to 50°C

Vibration

Frequency	Force	Double Amplitude
5 Hz to 15 Hz	0.7G at 15 Hz	0.06 inches
15 Hz to 25 Hz	1.3G at 25 Hz	0.04 inches
25 Hz to 55 Hz	3G at 55 Hz	0.02 inches

Shock: Eighteen 20G 1/2-sinewave shocks
Compliance With External Standards: ANSI C39.5 Dec 1980 and IEC 348 Second Edition 1978
EMI/RFI Review Standards: FCC Rules Part 15, Subpart J; European Standard VDE 0871; MIL STD 461B
EMI/RFI Conducted Emissions: FCC Rules Part 15 Class J; European Standard VDE 0871; CISPR.11
Radiated EMI/RFI Emissions: Meets or exceeds all FCC and VDE requirements
Power: 100V, 110V, 115V, 120V ac ±10% or 200V, 220V, 230V, 240V ac ±10%, 50 to 60 Hz, 84W Standby, 145W nominal
Size: 61 cm L x 43 cm W x 24 cm H (24 in L x 17 in W x 9.4 in H)
Weight: 30.2 kg (66.4 lb)
Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use
Included with Instrument: Operator's and Service Manual, serialized and dated Calibration Certificate
5440B: Procedure Storage Module, IEEE-488 Interface, RS-232-C Printer Interface, Boost Interface, Rear Output
5442A: IEEE-488 Interface, RS-232-C Printer Interface

Ordering Information

Models

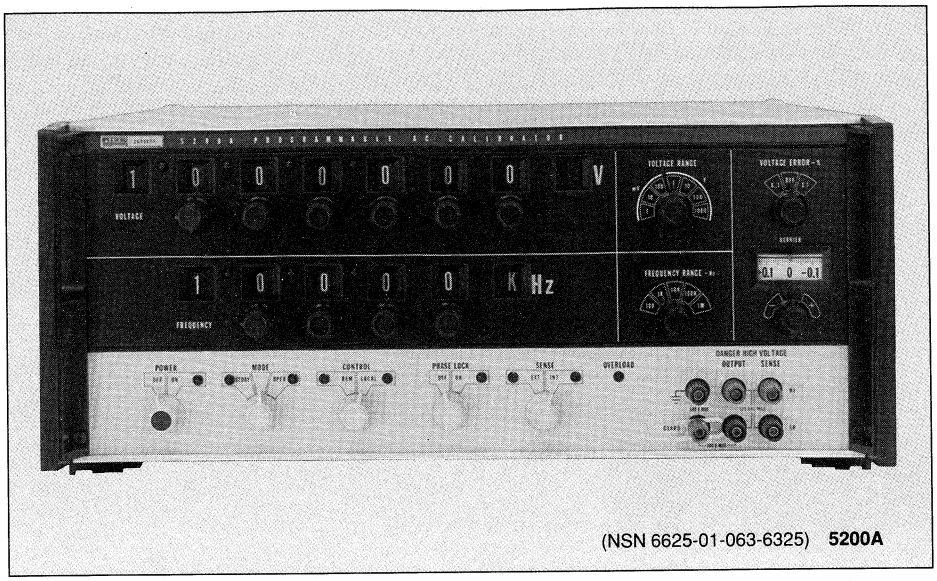
5440B Direct Voltage Calibrator
NSN 6625-01-226-5448
5442A Direct Voltage Calibrator
NSN 6625-01-224-9270

Accessories (Also see Section 20)

5440A-7001 Procedure Storage Module
5440A-7002 Low Thermal Copper EMF Plug-In Cables
732A DC Reference Standard
732A-000 w/Special Calibration, shipped hot
732A-100 w/Special Calibration and Drift Certification, shipped hot
752A Reference Divider
M08-205-600 8 3/4" Rack Mount Kit
M00-280-610 24" Rack Slide Kit
(Requires M08-205-600)
5442A-01 Rear Output Option

5200A

GPIB
IEEE-488



(NSN 6625-01-063-6325) **5200A**

5200A Precision Alternating Voltage Calibrator

- 120 ppm point uncertainty available
- Seven voltage ranges from 1 mV to 1000V
- 6½ digit resolution
- Output frequencies from 10 Hz to 1 MHz
- Automated characterized operation available
- GPIB/IEEE-488 system interface available
- Phase-lock input
- Completely guarded
- Short and overload protected

A Proven Performer

The Model 5200A Alternating Voltage Calibrator is a precision high-performance alternating voltage source with proven reliability and exceptional stability and accuracy over a broad frequency range. It is specified over a wide 0°C to 50°C operating range for use in both laboratory and manufacturing environments. Amplitude is controlled in six ranges from 1 mV to 100V. Resolution to 1,199,999 counts yields 20% overrange capability with 1 nanovolt steps on the 1 mV range, up to 0.1 mV steps on the 100V range. Outputs from 100 μV rms to 120V rms are provided, with up to 50 mA load current capability.

An additional 1000V range is included for front panel or remote interface control of a 5205A or 5215A Precision Power Amplifier.

Amplitude error measurement for voltmeter calibration is provided in two ranges, ±3% and ±0.3%. Error measurements can be resolved to 10 ppm.

Five frequency ranges are provided from 100 Hz to 1 MHz, with 119,999 count resolution for 20% overrange capability with 0.01 Hz steps on the 100 Hz range, up to 100 Hz steps on the 1 MHz range.

The oscillator of the 5200A may be phase locked to an external source to produce synchronous signals of precision amplitude and stability. Signal phase is locked within ±1° of phase angle, ±0.05°/kHz, over a ±2% band around the center frequency. This capability is essential for 60 Hz calibration.

A 3V pulse signal is provided for monitoring frequency with an external counter.

A quadrature output signal is provided which leads the fundamental signal phase by 90°. Amplitude varies from 1V to 10V rms, proportional to the fundamental signal output level on any range. This signal is useful for wattmeter calibration, and for research and development tasks that use the 5200A as a precision source.

External sensing may be selected, bringing rated accuracy to the load point bypassing losses in output leads.

Outputs are protected from overload by current limiting. Overload response time is typically 2 microseconds. When an overload is removed output recovers automatically to its previous level.

The 5200A is a fully guarded calibrator. This allows floating operation, and eliminates system ground loop problems. This is especially useful for calibrating non-guarded equipment.

Remote Programming (Opt -01 or -05)

The 5200A is remotely programmable in all functions except Power, Remote/Local, and Vernier Voltage Error. For any programmed amplitude, the output settles to its specified uncertainty within 0.5 seconds for frequencies above 100 Hz, and within 4 seconds for frequencies below 100 Hz. Program status flags are provided to indicate settling time and current limit conditions to the controller.

Either the 5200A-01 Parallel Remote Control Interface or the 5200A-05 GPIB/IEEE-488* System Interface may be installed in the 5200A, for complete remote control of both the 5200A Calibrator and a 5205A or 5215A Power Amplifier.

The 5200A-01 Parallel Remote Control Interface provides excellent isolation between external system logic and internal calibrator circuitry. This isolation is typically $10^9\Omega$ in parallel with 30 pf capacitance. This effectively attenuates external logic and ground noise better than 100:1 at 10 MHz.

Command data is segmented into 4-bit groups that can be programmed separately or simultaneously. Command data is stored both inside and outside the guard.

5200A-01 programming levels are compatible with TTL logic, and with contact closure:

Standard levels:
Logic 1 or true = 0V to +0.4 dV
Logic 0 or false = +2.8V to +5.0 dV
(For inverted logic levels, also order option 5200A-03.)

The 5200A-01 includes both standard and blank address matrix cards, and a mating connector.

The 5200A-05 IEEE-488 System Interface incorporates subsets SH1, AH1, T6, TEO, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. The 5200A-05 may be addressed for a 2-byte status response or serial polled for a 1-byte response. Status information includes Remote/Local, Standby/Operate, limits, settling time, and out-of-range instruction.

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

8

5200A

Automated Characterized Operation

The established excellent stability and performance history of the 5200A Alternating Voltage Calibrator offers an opportunity for further reducing calibration uncertainty while greatly simplifying use.

Characterization is a process of measuring a particular calibrator's uncertainties at selected points using traceable transfer standards and recording those uncertainties in a table. When the selected points are used, the portion of these uncertainties not due to the transfer standards or to the characterization process can then be added to (or subtracted from) the calibrator setting. In practice, this significantly reduces calibrator uncertainty.

Mathematical interpolation methods are used for points other than those selected for characterization. While this yields a significant improvement in uncertainty specifications, it can be complex and time consuming when done manually.

Option 5200A-800 is a software package that uses a Fluke 1722A or 1752A Instrument Controller to operate a 5200A Alternating Voltage Calibrator and a 5205A or 5215A Precision Power Amplifier. This software makes use of a stored characterization table and automatically interpolates for voltages and frequencies selected between characterization points.

The 5200A-800 controls all calibrator functions in a simplified manner with the touch-sensitive display of the 1722A or 1752A.

Calibration

The 5200A is originally calibrated at the factory by instrumentation traceable to the U.S. National Institute of Standards and Technology. Periodic traceable recalibration service is available through Fluke Technical Service Centers and Sales Representatives worldwide.

Fluke also offers 5200A characterization service as well as 540B characterization for customers doing their own 5200A characterization. The table of correction factors is supplied in written form, and on a disk compatible with the 5200A -800.

Specifications

Technical Specifications

Amplitude Uncertainty

Specified for 180 days. Characterized uncertainty requires optional 5200A-900 characterization. Both specifications are valid when operating in an ambient temperature between 18°C and 28°C after a 1-hour warmup.

Basic Instrument Absolute Uncertainty [1]			Characterized Uncertainty [2]		
Voltage Ranges	Frequency Hz	±(ppm setting + μV)	Frequency Hz	±(ppm setting + μV)	
				Relative	Absolute
1 mV [3]	10-30	1000+10			
10 mV	30-20K	200+10			
	20K-100K	500+20			
	100K-1M	3300+30			
100 mV	10-30	1000+10	50-100	130+10	150+10
	30-20K	200+10	100-20K	125+10	145+10
	20K-100K	500+20	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	200+20	470+20
		±(ppm setting + ppm range)		±(ppm setting+ppm range)	
1V	10-30	1000+50	50-100	130+20	150+20
10V	30-20K	200+20	100-20K	125+15	145+15
100V	20K-100K	500+50	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	300+30	470+30
1000V [4]	10-30	1200+50	50-100	190+20	210+20
	30-20k	400+40	100-10k	180+20	180+20
	20k-50k	800+50	10k-20k	200+20	200+20
	50k-100k	1000+100	20k-50k	310+30	310+30

[1] Valid for 180 days, between 18°C and 28°C, after 1-hour warm-up
[2] 180 days. Requires 5200A-900
[3] On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth.
[4] Output is through a 5205A or 5215A Power Amplifier

Characterized-Point Absolute Uncertainty, ±ppm*									
Voltage	Frequency, Hz								
	50	100	200	1k	2k	10k	20k	50k	100k
0.5	125	125	–	125	–	125	–	210	450
1	120	120	120	120	120	120	120	200	450
3	130	130		130	130	130		220	450
10	120	120	120	120	120	120	120	200	450
30	130	130		130	–	130	–	220	450
100	120	120	120	120	120	120	120	200	450
300	190	190	–	190	–	190	–	630	–
1000**	180	180	180	180	180	180	200	610	–

** 180 days. Requires 5200A-900. Traceable to U.S. NIST Standards. Includes transfer standards, dc reference source, and allowances for techniques*
*** Output is through a 5205A or 5215A Power Amplifier.*

Voltage Resolution

Range	Voltage Settings	Resolution
1 mV	0.100000 mV to 1.199999 mV	1 nV
10 mV	1.00000 mV to 11.99999 mV	10 nV
100 mV	10.0000 mV to 119.9999 mV	100 nV
1V	0.100000V to 1.199999V	1 μV
10V	1.00000V to 11.99999V	10 μV
100V	10.0000V to 119.9999V	100 μV
1000*	100.000V to 1199.999V	1 mV

** Output is through a 5205A or 5215A Power Amplifier*

Stability

Voltage Ranges	Frequency Hz	Stability [1] (ppm setting + ppm range) [2]	
		10 Minutes	180 Days
1 mV	10-30	70+40	300+60
10 mV	30-20k	70+3 [3]	100+30
	20k-100k	70+3	130+40
100 mV	10-30	70+40	300+60
	30-1k	70+3 [3]	70+40
	1k-20k	70+3	100+30
	20k-50k	70+3	120+50
	50k-100k	70+3	100+130
1V	10-30	70+40	200+20
10V	30-20k	35+5 [3]	45+5
100V	20k-50k	55+5	65+5
	50k-100k	70+3	220+20
1000V [4]	10-100	0+50	200+0
	100-20k	70+5	200+0
	20k-100k	70+5	400+0

[1] Constant line, load, and temperature.
[2] Total peak to peak random change in rms value.
[3] For frequencies below 50 Hz, floor is 40 ppm of range.
[4] Output is through a 5205A or 5215A Power Amplifier.

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C; for the 1000V range add ±(0.03 x uncertainty) per °C
Maximum Load: 1 mV, 10 mV, 100 mV ranges: minimum 6000Ω load impedance; 1V,* 10V, 100V ranges: maximum load current 50 mA; 1000V range: maximum load current 200 mA
**Minimum load impedance 50Ω above 0.1 MHz*

Voltage Error Control: Switch selectable OFF, on two ranges: 0 to ±0.3% with 10 ppm resolution; 0 to ±3% with 100 ppm resolution

Settling Time

Frequency Hz	Settling Time,* Seconds
10 - 30	4 to 15
30 - 100	4
100 - 400	2
400 - 1M	1**

** To within 100 ppm of change*
*** Typically less than 0.5 second, except frequency range changes*

External Sense: Switch selectable, internal or external, available on 1V, 10V, and 100V ranges.* Output rises to less than 2.0V rms above selected level when sense lines are disconnected in external sense mode
** Output impedance on 1 mV, 10 mV, and 100 mV ranges is less than 1.5Ω in series with 15 μH*

Frequency Performance*

Range	Frequency Settings	Resolution Hz**	Uncertainty ±(% of input + % of Range)
100 Hz	10.00 Hz to 119.99 Hz	0.01	1.0 + 0.1
1 kHz	.1000 kHz to 1.1999 kHz	0.1	
10 kHz	1.000 kHz to 11.999 kHz	1	
100 kHz	10.00 kHz to 119.99 kHz	10	
1 MHz	.1000 MHz to 1.999 MHz	100	3.0 + 0.3

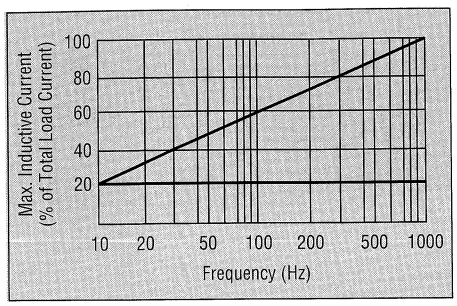
** 180 days, 18°C to 28°C, after 1-hour warm-up*
***100 ppm of range*

Total Harmonic Distortion and Line-Related Noise*

Frequency Hz	±(% of setting + μV rms)
10k - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

** Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A or 5215A specifications*
*** 1V range is ±0.08% from 10 Hz to 15 Hz*

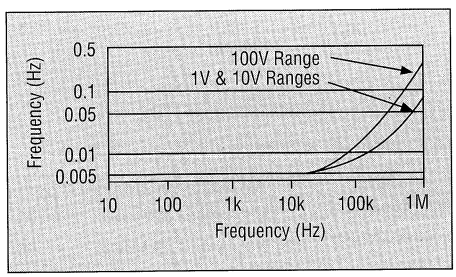
Maximum Capacitive Load: 1000 pF on 1 mV-100V ranges, 1500 pF on 1000V range
Maximum Inductive Load Current: (Except 1000V range)



Phase Lock Input: 1V to 10V rms, useable down to 100 mV rms
Phase Lock Accuracy: ±3° below 30 Hz, and ±(1° + 0.05° per kHz) over a ±2% band around center frequency

Quadrature Output

Amplitude: 1V to 10V rms, ±10%, proportional to selected output voltage
Phase: 10 Hz-40 Hz, 90° ±3°; 40 Hz to 1.2 MHz, 90° ±(1° + 0.03° per kHz)
Minimum Load: 3 kΩ impedance
Current Limit: Typical transition time, 2 μs. Recovery within specified settling time
Volt-Hertz Product: Output voltage x frequency ≤10^7. Full 120V rms output is maintained up to 83.33 kHz. Maximum output voltage at 1.2 MHz is 8.33V rms
Load Regulation: 50 ppm of range, no load to full load, up to 10 kHz



General Specifications

Maximum Isolation Voltages: (dc or peak ac) 500V, GUARD to chassis; 100V, LO to GUARD
Temperature: 0°C to +50°C operating, -40°C to +75°C storage
Input Power: Switch selectable, 100V, 115V, 200V, 230V ac, 100W
Size: 17.8 cm H x 43.2 cm W x 53.3 cm D (7 in H x 17 in W x 22.5 in D)
Weight: 24.1 kg (53 lb)

Included with Instrument: Instruction manual, mating connectors, power cord, serialized and dated calibration certificate

Ordering Information

Models

5200A AC Calibrator
5205A Precision Power Amplifier w/remote control
5215A Precision Calibrator Amplifier
5200A/5215A Precision AC Calibration System
1722A Instrument Controller

Options (for 5200A)

-01* Parallel Remote Control Interface
-03 Logic Inversion (for 5200A-01)
-05** IEEE-488 Compatible Interface
-800*** Automated Characterized Operation Software
-900 Characterization of New-Purchase 5200A and 5215A
-902 Characterization of New-Purchase 5200A
** Cannot be used with 5200A-05*
*** Cannot be used with 5200A-01*
**** Requires 1722A, or 1752A, and 5200A-900 or 5200A-902*

Accessories (Also see Section 20)

M07-205-600 7" Rack Mount Kit for 5200A
M10-205-600 10½" Rack Mount Kit for 5205A and 5215A
M00-280-610 24" Rack Slides for rack mount kit
Y1790 5¼" Rack Mount Kit w/24" Slides for 1722A
5200A-7015K Extender Board Kit

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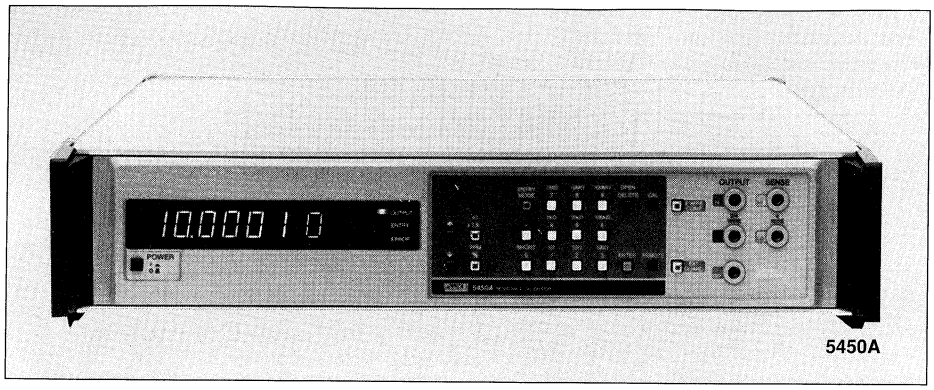
5450A



5450A Resistance Calibrator

- 17 standard resistors in one enclosure
- Decade values from 1.0Ω to 100 MΩ
- 1.9 multiples from 1.9Ω to 19 MΩ
- True passive resistors for low noise and offset
- Midband accuracy of 8 ppm over 18°C to 28°C
- 4-wire or 2-wire operation
- Easy data entry for test lead compensation
- Automatic meter error calculation
- GPIB IEEE-488 programmable

The 5450A Resistance Calibrator is designed to verify the resistance-measuring accuracy of precision multimeters, either manually or as part of an automated calibration process. It complements the 5440A and 5442A Direct Voltage Calibrators.

The 5450A provides cardinal point resistance values in decade steps from 1Ω through 100 MΩ and decade steps from 1.9Ω through 19 MΩ.

The known value of each resistance is stored internally and used for calibration purposes. Each value is displayed to 1 ppm resolution.

Four-wire connections eliminate the effects of lead resistance or, for 2-wire operation, you may measure and store the lead resistance value and automatically subtract it from the value of each resistor. Connections to the instrument being calibrated may be made to the front panel terminals or to special rear panel binding posts that contribute very low thermal offset voltage errors.

Calibrating the 5450A consists of storing the right values of each resistor. Recalibration can be accomplished without removing the instrument covers, and may even be done remotely over the GPIB IEEE-488* bus. A rear panel switch insures integrity of calibration.

The 5450A displays the precise value of each selected resistor and can show the error of the instrument being calibrated either in percent or in parts per million. All functions that can be controlled from the front panel may be controlled remotely via an IEEE-488 bus. No options are required to make the 5450A compatible with the bus; interface circuits are built in.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Analog Specifications

Uncertainty, For Rated Current, 4-Wire Connections

Nominal Resistance	Absolute Uncertainty (±ppm unless indicated)				Normal Current Ranges	
	23°C ±1°C, ≤70% RH		23°C ±5°C, ≤70% RH			
	24 Hours	90 Days	90 Days	1 Year	Lower	Upper
Short	.1 mΩ	.1 mΩ	.1 mΩ	.1 mΩ	10 mA	500 mA
1Ω	50	62	75	110	10 mA	100 mA
1.9Ω	40	52	65	100	10 mA	75 mA
10Ω	18	20.5	25	33	10 mA	25 mA
19Ω	16	18.5	23	31	10 mA	25 mA
100Ω	7.5	9	11	16	10 mA	15 mA
190Ω	7	8.5	10.5	15.5	10 mA	15 mA
1 kΩ	5.5	7	8.5	13.5	700 µA	2.5 mA
1.9 kΩ	5	6.5	8	13	500 µA	2.5 mA
10 kΩ	5	6.5	8	13	50 µA	1 mA
19 kΩ	4.5	6	7.5	12.5	50 µA	1 mA
100 kΩ	6	7.5	9	14	5 µA	250 µA
190 kΩ	5.5	7	8.5	13.5	5 µA	250 µA
1 MΩ	7.5	10	11.5	19	5 µA	50 µA
1.9 MΩ	7.7	10	11.5	19	5 µA	25 µA
10 MΩ	16	24	26	50	.5 µA	5 µA
19 MΩ	20	28	30	56	.25 µA	2.5 µA
100 MΩ	65	90	120	200	.05 µA	.5 µA

Relative to National Standards such as U.S. National Institute of Standards and Technology

Specifications

The analog specifications apply when the 5450A is calibrated using a 10 kΩ standard resistor, the absolute value of which is known within ±2 ppm or better and using the ratio calibration method for calibrating resistor values from 10Ω through 100 MΩ. The 1.0Ω and 1.9Ω value must be calibrated by comparison to a 1Ω standard whose absolute value is known within ±5 ppm.

General Specifications

Temperature: 0°C to 50°C, operating
Relative Humidity: ≤70% for rated accuracy
Power: 100, 120, 220, or 240 aV ±10%, 50 to 60 Hz ±5%, ≤50W
Size: 8.9 cm H x 43.2 cm W x 55.4 cm L (3.5 in H x 17 in W x 21.8 in L)
Weight: 9.3 kg (20.4 lb)

Included with Instrument: Instruction manual, line cord, serialized and dated calibration certificate

Ordering Information

Model

5450A Resistance Calibrator

Accessories (Also see Section 20)

Y8021 Shielded IEEE-488 Cable, 1m
Y8022 Shielded IEEE-488 Cable, 2m
Y8023 Shielded IEEE-488 Cable, 4m
M00-260-610* 18" Rack Slide Kit
M00-270-610* 20" Rack Slide Kit
M00-280-610* 24" Rack Slide Kit
Y8598 3½" Rack Mount Kit w/ 22" Slides
Y8599 3½" Rack Mount Kit
**Requires Y8599*



(NSN 6625-01-068-6762) **5205A**

5205A Precision Power Amplifier

- Extends range of 5700A, 5100 Series B, 5200A, 5440B, or 5442A Calibrators
- Output voltages to 1100V rms, ±1500V dc
- Maximum output power 220 watts
- DC to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable

The 5205A Precision Power Amplifier is a dc coupled programmable inverting amplifer with a fixed gain of 100. Designed as a precision calibration amplifer, the 5205A is also useful as a general-purpose amplifier for a wide range of waveforms from dc to 100 kHz. Alternating voltage output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode. Direct voltage output level is specified to ±1500V at up to 100 mA, with a typical upper trip limit of 1600V.

The 5205A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5205A trips and locks into standby mode and displays a fault indicator.

A calibrator interface is standard, including an independent input signal line. When used with a 5700A, 5100 Series B, 5200A, 5440B, or 5442A Calibrator, the 5205A is controlled by the calibrator as an extension of its capabilities.

A remote control interface is also standard, and independent of the calibrator interface. This allows remote switching between the calibrator and an alternate signal input source through a front panel BNC connector.

Amplifier features of the 5205A include a gain uncertainty of as little as 0.04%, and a slew rate as high as 800 volts per microsecond.

The 5205A includes a 1-meter output cable with a protective shrouded connector. When used with a 5200A AC Calibrator, remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5205 -07, for system applications, moves this cable and the BNC amplifier input connector to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5205A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Institute of Standards and Technology. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5205A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Technical Specifications

Calibrator Mode

Amplitude Uncertainty with 5100 Series B Calibrator

Absolute Uncertainty*	
Frequency Hz	**±(ppm setting + mV)**
dc	700+30
50-10k	800+100
10k-50k	1200+150

** Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 20°C to 30°C, after 1-hour warm-up*

Amplitude Uncertainty with 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	**±(ppm setting + ppm range)**	**Freq Hz**	**±(ppm setting + ppm range)**	
			Relative	**Absolute**
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

** Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

*** 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Characterized-Point Absolute Uncertainty with 5200A:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

**Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

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5205A

Amplitude Uncertainty with 5700A,5440B, or 5442A Calibrator: Use amplifier-mode gain uncertainty specifications
Output Voltage Range: 100V to 1099.999V, ±dV or rms aV
Output Voltage Resolution: 1 mV with 5200A, 5440B, or 5442A; 10 mV with 5100 Series B
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

Stability with 5100 Series B, 5440B, or 5442A Calibrator: Use amplifier-mode gain stability specifications

Stability with 5200A Calibrator*

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

**Constant line, load, and temperature, total peak to peak random change in rms value*

Amplifier Mode

Maximum Output Voltage: 1100V rms aV, ±1500V dV
Typical Overload Trip Voltage: 1200V rms aV, ±1600V dV
Maximum Input Voltage: 50V, dV or rms aV (without damage)
Frequency Range: 0 to 100 kHz
Typical Upper Trip Frequency: 120 kHz
Gain: X100, inverting

Gain Uncertainty

Maximum Load	DC to 20 kHz	20 kHz to 100 kHz
500Ω, 100 pF	±0.05%	±0.2%
5000Ω, 100 pF	±0.05%*	±0.15%
1 MΩ, 200 pF	±0.05%	±0.2%
1 MΩ, 500 pF	±0.06%	±0.4%
1 MΩ, 1000 pF	±0.08%	±0.8%
1 MΩ, 1500 pF	±0.1%	±1.2%

**±0.04%, dc to 10 kHz*

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add per °C below 18°C or above 28°C: dc to 20 kHz: ±(0.03 x uncertainty); 20 kHz to 100 kHz: ±(0.06 x uncertainty)

Gain Stability

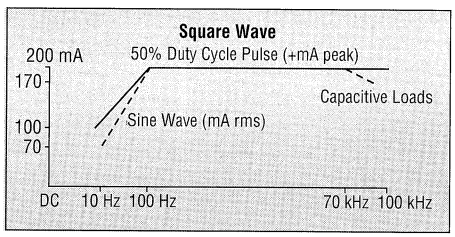
Frequency Range	Max Capacitive Load	24 Hours	6 Months
dc to 20 kHz	1500 pF	0.02%	0.06%
20 to 100 kHz	100 pF	0.08%	0.2%
20 to 100 kHz	1500 pF	0.4%	0.8%

Maximum Slew Rates:*

Maximum Load	Max Input Slew Rates	Max Output Slew Rates
200 mA Resistive	8.0V/µs	800V/µs
100 pF Capacitive	8.0V/µs	800V/µs
200 pF Capacitive	5.0V/µs	500V/µs
500 pF Capacitive	3.0V/µs	300V/µs
1000 pF Capacitive	2.0V/µs	200V/µs
1500 pF Capacitive	1.0V/µs	100V/µs

** Greater than 1000V output swing. Higher rates may trigger protection circuitry.*

Maximum Output Overshoot: Less than 4% of amplitude, with less than maximum input slew rate, and with greater than 1000V output swing
Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors
Input Impedance: 10 kΩ in parallel with less than 120 pF
Input Connector: BNC, located on front panel. (Located on rear panel with Option -07)
Maximum Input Voltage: 50V dV or rms aV
Maximum Input Bias Current: 100 nA
Maximum Load Current: Bipolar symmetrical waveforms



Unipolar Rectangular Waveform:* ±200 mA peak with pulse width less than 5 msec; period greater than 10 msec.
Linearly Derating To: ±100 mA peak with pulse width greater than 50 msec; period less than 100 msec

** Referenced to zero volts. Under all circumstances, output current capability is at least ±100 mA peak*

Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF
DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.
Random Noise: Less than 100 mV rms, 1 MHz bandwidth
Line-Related Noise: Less than 50 mV rms
Line Regulation: ±10 ppm of setting for 10% change in line voltage

General Specifications

Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power
Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)
Weight: 54.5 kg (120 lb)

Included with Instrument: Instruction manual, interface cable to 5200A, serialized and dated calibration certificate

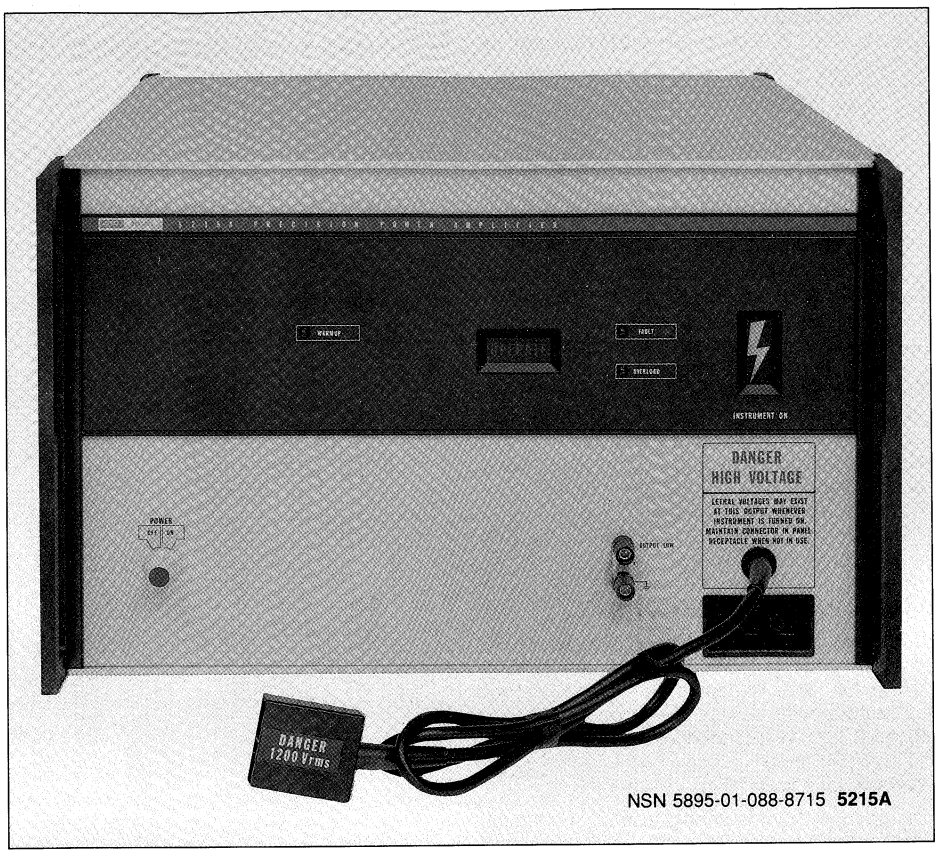
Ordering Information

Models

5205A Precision Power Amplifier
5205A-07 With Rear Input/Output

Accessories (Also see Section 20)

Y5000 Interface Buffer for 5100 Series
Y5001 Interface Cable for 5100 Series
Y5701 Cable, 5700A to 5205A or 5215A
Y5001 Interface Cable for 5100 Series
M10-205-600 10½" Rack Mount Kit
M00-280-610 24" Rack Slides for rack adapter



NSN 5895-01-088-8715 **5215A**

5215A Precision Power Amplifier

- Designed for use with 5700A, 5200A, or 5100B Calibrators
- Output voltages to 1100V rms
- Maximum output power 220 watts
- 10 Hz to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable
- Short and overload protected

The 5215A Precision Power Amplifier is an ac coupled programmable inverting amplifer with a fixed gain of 100. Output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode.

The 5215A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5215A trips and locks into standby mode and displays a fault indicator.

An interface for a 5200A Alternating Voltage Calibrator is standard, allowing the 5215A to be controlled by the calibrator as an extension of its capabilities.

The 5215A includes a 1-meter output cable with a protective shrouded connector. Remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5215-07, for system applications, moves this cable to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5215A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Institute of Standards and Technology. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5215A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Technical Specifications

Amplitude Uncertainty with 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Freq Hz	±(ppm setting + ppm range)	Freq Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

** Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

*** 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Characterized-Point Absolute Uncertainty:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

**Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Output Voltage Range: 100V to 1099.999V rms
Output Voltage Resolution: 1 mV with 5200A; 10 mV with 5100 Series, ac output only
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

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5215A

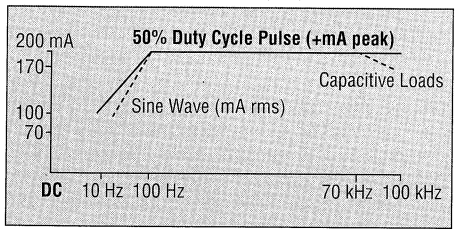
Stability*

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10-100	0 + 50	100 + 0	200 + 0
100-20k	70 + 5	100 + 0	200 + 0
20k-100k	70 + 5	200 + 0	400 + 0

**Constant line, load, and temperature, total peak to peak random change in rms value*

Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors

Maximum Load Current:



Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF

DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output over loads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.

Random Noise: Less than 50 mV rms

Line Regulation: ±10 ppm of setting for 10% change in line voltage

General Specifications

Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power

Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)

Weight: 54.5 kg (120 lb)

Included with Instrument: Instruction manual, interface cable to 5200A, power cords, serialized and dated calibration certificate

Ordering Information

Models

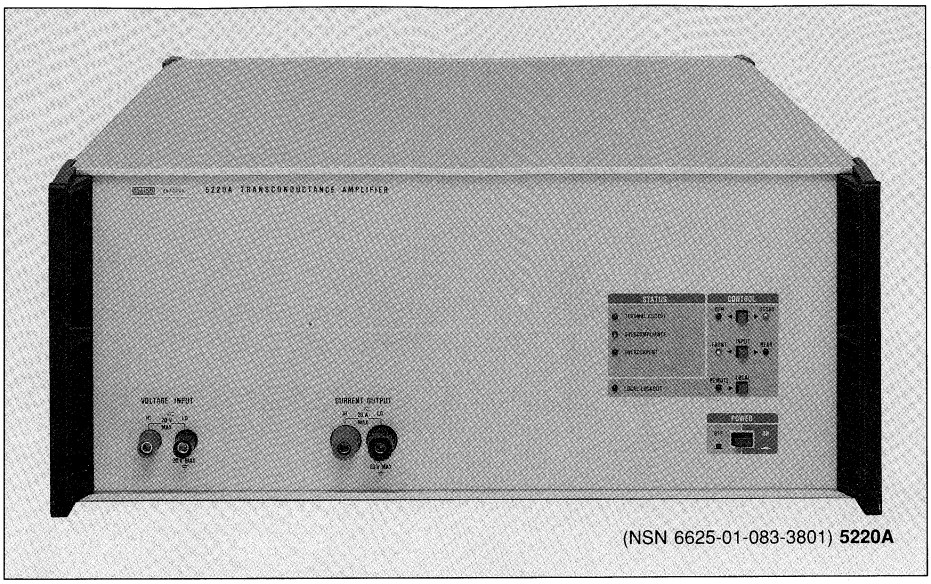
5215A Precision Power Amplifier
5215A-07 With Rear Output

Accessories (Also see Section 20)

Y5000 Interface Buffer for 5100 Series
Y5001 Interface Cable for 5100 Series
Y5701 Cable, 5700A to 5205A or 5215A
M10-205-600 10½" Rack Mount Kit
M00-280-610 24" Rack Slide Kit

5220A

GPIB IEEE-488



(NSN 6625-01-083-3801) **5220A**

5220A Transconductance Amplifier

- 20 amps output dc or rms ac
- 0.025% basic dc accuracy
- Over-voltage and over-current protection
- Over-temperature protection
- May be programmed through a 5700A or 5100B

The 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters that measure up to 20A. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20A.

The 5220A is designed to be controlled by a 5700A or 5100 Series B calibrator but may be driven by another voltage source such as the 5200A. When used with a 5100 Series B, the current range of those instruments is extended by a factor of 10 to 1. Options are available for the 5100 Series B that make the system GPIB/IEEE-488* and RS-232-C compatible.

Built-in Protection

Protection is designed in to eliminate problems caused by excessive inputs, open inputs, and overcompliance. Indicators on the front panel tell the user about any of these conditions. Automatic shut down occurs should the internal temperature rise excessively.

Remote Operation

Drive voltage to the 5220A may be introduced through the front panel or the rear panel. The connector on the rear, however, allows the 5220A to become an extension to the current range of a 5700A or 5100 Series B Calibrator.

The two instruments operate as one integrated calibration system with all the advantages of single control-point calibration; automatic error calculation, entry limit protection, etc.

A 5100 Series B Calibrator requires a Y5000 Interface/Buffer to control a 5220A. A single Y5000 Interface/Buffer may also be used to control a 5205A Power Amplifier.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

The specifications below apply for 180 days for instruments operated between 20°C and 30°C in a relative humidity of 70% or less.

Transconductance: 1 siemens (1 ampere per volt)
Output Range: 0 to 20A dc or rms ac (28.3A peak)
Maximum Compliance Voltage: ≥±4V dc, or 3V rms ac (4.25V peak)
DC Accuracy: ±(0.025% of output +1 mA)
AC Accuracy: ±(0.05% of output +1 mA) from 30 Hz to 1 kHz, and ±(0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz
Short Term DC Stability: Output changes less than ±(0.005% + 200 μA) in 10 minutes, with constant line, load, and temperature
Short Term AC Stability: Output changes less than ±(0.01% + 500 μA) in 10 minutes, with constant line, load, and temperature
Harmonic Distortion and Noise: ±(0.05% of output ±1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, ±0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz
Temperature Coefficient: ±(0.0025% of output +100 μA) per degree C, above 30°C or below 20°C
Transient Recovery: Output will settle to within 0.01% of final value within 2 seconds following a programmed change in output current or frequency (10 ms for 5220A alone)
Load Capability: Drives all resistive and capacitive loads consistent with current and compliance voltage capability. Drives inductive loads (with reduced accuracy) up to 200 microhenries, consistent with current and compliance voltage capability
Maximum Isolation Voltage: ±20V dc or 20V ac rms
Temperature Range: 0°C to 50°C (operating) and -20°C to 65°C non-operating
Relative Humidity: ≤50% to 50°C, ≤75% to 40°C, ≤95% to 25°C
Altitude: 0 to 10,000 feet (operating) and 0 to 40,000 feet (non-operating)
Vibration: 2G maximum, 5 Hz to 55 Hz for 15 minutes
Shock: 15G maximum, half sinewaves
Power: 100, 110, 115, 120, 200, 220, 230, or 240V ac +10%, switch-selectable, 50 Hz to 60 Hz, 300 watts
Size: 17.8 cm H x 43.2 cm W x 55.9 cm D (7 in H x 17 in W x 22 in D), case only
Weight: 227 kg (50 lb)

Included with Instrument: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

5220A Transconductance Amplifier

Accessories (Also see Section 20)

Y5020 Current Shunt
Y5000* Interface/Buffer
Y5002* Cable (Y5000 to 5220A)
Y5702 Cable (5700A to 5220A)
M07-205-600 7" Rack Mount Kit
M00-270-610 20" Slides for Rack Mount Kit
M00-280-610 24" Slides for Rack Mount Kit
**Required when controlled from 5100B or 5101B*

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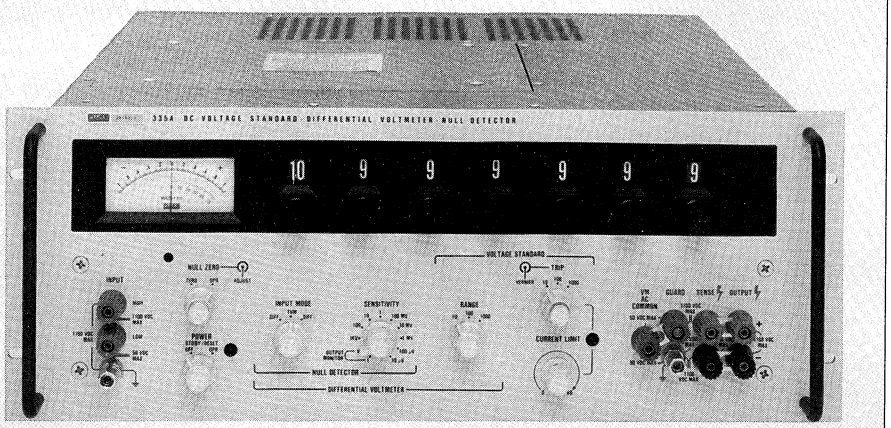
335A & 335D



(NSN 6625-00-445-3328) **335A**

335A & 335D DC Voltage Calibrators/Null Detectors

- 0 to 1100V output, 0 to 50 mA
- 0.1 ppm resolution, seven decades
- Built-in null detector for differential voltage measurements
- 10 ppm basic accuracy (335D)
- 5 ppm basic stability per month (335D)
- Overvoltage and overcurrent protection

Combining accuracy with versatility, Models 335A and 335D provide the functions of a precision dc voltage standard with those of a differential voltmeter and high impedance null detector. The only practical difference between the 335A and the 335D is their accuracy and stability.

Both instruments provide 0.1 ppm resolution, using seven in-line decade switches.

Specifications

Voltage Ranges: 10, 100, and 1000V with outputs as follows: 0 to 11.111110 (1 μV steps), 0 to 111.111110 (10 μV steps), 0 to 1111.1110 (100 μV steps)

Output Current: 0 to 50 mA

Accuracy of Output:* ±(% of Setting + μV)

Range	335A, 90 Days	335D, 60 Days
10V	0.002 + 10	0.001 + 10
100V	0.002 + 20	0.001 + 20
1000V	0.002 + 200	0.0015 + 200

**Also measurement accuracy of 335A and 335D used as a differential voltmeter*
NOTE: Accuracy is absolute, relative to NIST standards, and include effects of stability, line regulation, and calibration uncertainties under standard reference conditions of 23°C ± 1°C and up to 70% relative humidity.

Stability of Output: ±(% of Setting + μV)

Range	335A	335D
10V	±(0.001 + 10)/mo ±(0.002 + 20)/yr	±(0.0005 + 7)/mo —
100V & 1000V	±(0.001 + 20)/mo ±(0.002 + 40)/yr	±(0.0005 + 30)/mo —

Temperature Coefficient: (0.0002% of setting +1 μV)/°C from 22°C to 0°C or 24°C to 50°C
Overcurrent Protection: Limits current at 1 mA to 60 mA via continuously variable front panel control
Overvoltage Protection: Trips output if voltage level exceeds setting of front panel controls. Continuously variable from 10% to 110% of each range
Ripple and Noise: 10V range, ≤20 μV rms; 100V range, ≤30 μV rms; 1000V range, ≤40 μV rms
Settling Time: Typically within 10 ppm of final output less than 20s after a range change
Regulation: 0.0002% of setting or 10 μV for a 10% line voltage change or a full load change
Common Mode Noise Rejection: ≥140 dB from dc to 400 Hz, up to 700V rms or 1000 dV
Isolation: Either output terminal may be floated up to 1000 dV from chassis ground

Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 40 to 60 Hz, approximately 130 VA fully loaded
Size: 17.8 cm H x 48.2 cm W x 45.7 cm D (7 in H x 19 in W x 18 in D)
Weight: 23 kg (50 lb)
Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use

Included with Instrument: Manual, power cord, serialized and dated calibration certificate

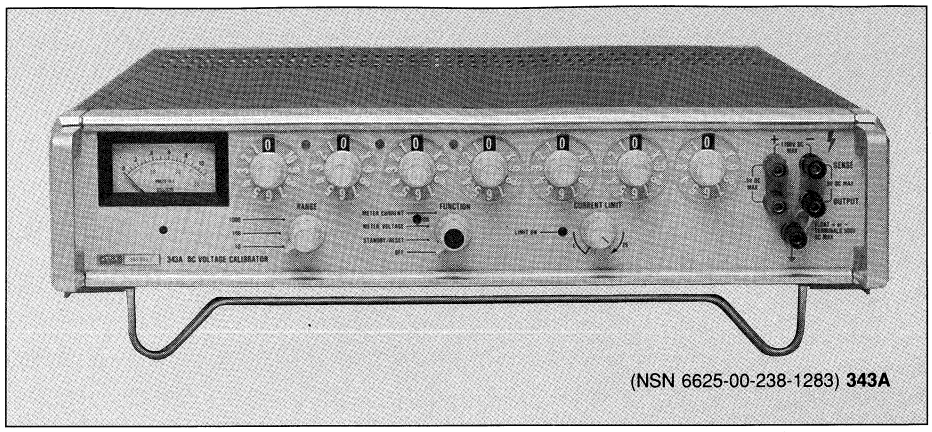
Ordering Information

Models

335A DC Voltage Calibrator/Null Detector
335D DC Voltage Calibrator/Null Detector (NSN 6625-00-361-5246)

Accessories (Also see Section 20)

A60-01 17-20" Rack Slides



(NSN 6625-00-238-1283) **343A**

343A DC Voltage Calibrator

0 to 1100V output, 0 to 25 mA

0.1 ppm resolution, seven decades

20 ppm basic accuracy

Stability better than 5 ppm/hour, 15 ppm/month

The 343A is a 7-digit instrument with a basic accuracy of 20 ppm and a resolution of 1 μV on the 10 μV range.

Cleanliness of the dc output is evident in the combined ripple and noise specifications of 50 μV rms from the 343A. Short term jitter and other random excursions are almost non-existent, less than 1 ppm.

A simple amplifier/comparator circuit is utilized to establish a convenient, variable, current limiter. Any maximum current output from 1 to 30 mA may be set via a front panel control. In addition to providing for current protection to the load, a failsafe "crowbar" protects the series-pass elements from damage should the total voltage across the elements exceed a safe level.

Specifications

Output Voltage: 0 to 1100 dV
Resolution: 1 μV on 10V range, 10 μV on 100V range, 100 μV on 1000V range

Accuracy, 90 Days
10V Range: ±0.002% of setting
or ±0.0002% of range*
100V Range: ±0.002% of setting
or ±0.0001% of range*
1000V Range: Same as 100V range

**Whichever is greater*
NOTE: The above accuracies are absolute, relative to NIST standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C ±1°C and up to 70% relative humidity after 30 minute warm-up. Apply for 90 days.

Stability: ±% of Setting or ±Microvolts*

Time	10V Range	100V Range	1000V Range
Per Hour	0.005% or 5 μV	0.0005% or 10 μV	0.0005% or 20 μV
Per Month	0.0015% or 15 μV	0.0015% or 25 μV	0.0015% or 50 μV
Per 6 Months	0.0025% or 30 μV	0.0025% or 40 μV	0.0025% or 60 μV

**Whichever is greater*

Temperature Coefficient: ±(3 ppm of setting +0.1 ppm of range +2 μV) per degree Celsius from 24°C to 15°C or 25°C to 35°C
Regulation: <0.0005% of setting +25 μV for a 10% line voltage change or a full-load to no-load change
Isolation: May be floated 500 dV from chassis
Settling Time: Within 15 ppm of final output in 5 seconds
Overcurrent Protection: Automatically limits output current at any preset level between 1 mA and 30 mA via continuously variable front panel control. Panel lamp illuminates during limiting.
Meter: Switch-selectable to full range voltage or full range current
Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 50 to 440 Hz, approximately 60 VA fully loaded
Size: 8.9 cm H x 43.2 cm W x 45.7 cm D (3.5 in H x 17 in W x 18 in D)
Weight: 10.43 kg (23 lb)

Included with Instrument: Instruction Manual, power cord, serialized and dated calibration certificate

Ordering Information

Model

343A DC Voltage Calibrator

Accessories (Also see Section 20)

MEE-7001 3½" Rack Mount Kit
MEE-8078 24" Rack Slide for rack mount kit
MEE-8079 18" Rack Slide for rack mount kit

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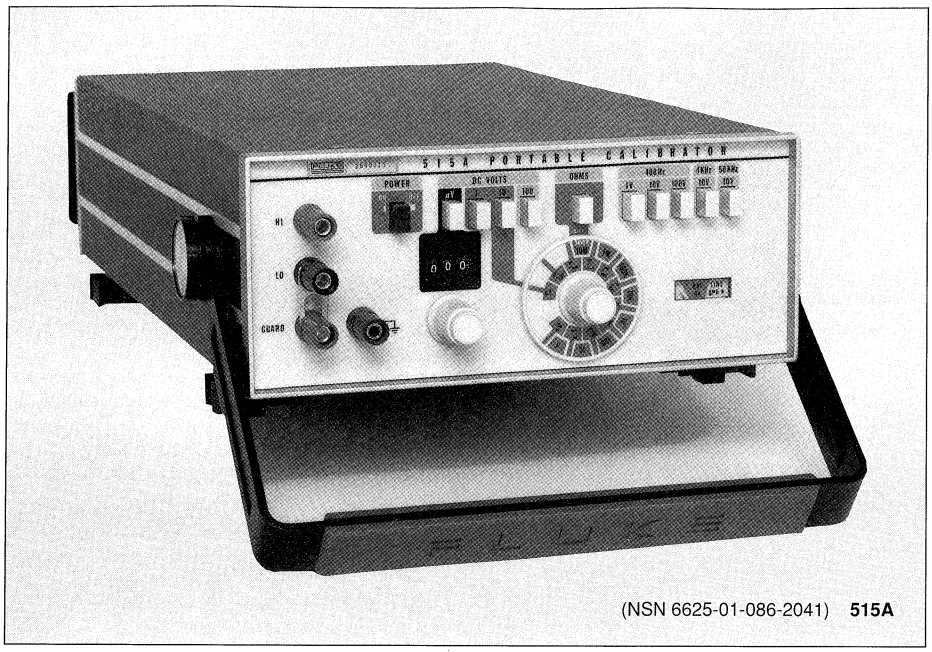
515A



(NSN 6625-01-086-2041) **515A**

515A Portable Calibrator

Precision, portable, 4 1/2 digit calibration and 5 1/2 digit verification where you need it

Battery powered when disconnected from line power

Lightweight and small size

The Model 515A Portable Calibrator is a precision voltage and resistance calibration source for on-site calibration of measuring instruments. The 515A provides direct and alternating voltage and resistance standards in a unit only 3 1/2 inches high by 8 1/2 inches wide by 16 inches deep. The instrument weighs just 13 pounds, including the rechargeable battery pack, which eliminates warm-up delays after transit and allows 8-hour operation free of line power for true portability. The 515A's basic uncertainty is specified over a temperature range of 18°C to 28°C for a 1-year period, thus making it easy to use in production test and calibration environments without complex correction terms. The long calibration cycle also makes the 515A economical to own by minimizing maintenance overhead costs.

All 515A outputs are available at a single set of output terminals. In addition, terminals are available to allow guarding and shielding of test leads in critical test situations.

If the unit is connected to the ac line, the internal battery is placed on charge; otherwise the 515A automatically operates from the battery and its state of charge is indicated on the meter to the right of the panel.

The 515A can be used effectively to test a wide range of characteristics in measuring instruments. Here are a few of the many applications:

dV: Input offset current, a/d linearity, absolute accuracy

aV: Frequency response, converter linearity, residual noise, absolute accuracy

Resistance: Linearity, residual resistance, absolute accuracy

General: Zero offset and stability, autoranging, overranging

Specifications

Technical Specifications

Direct Voltage

Ranges
μV: 0 to 99 μV continuous (0.2 μV resolution)
1V: 0 to 1.0V in 0.1V steps
10V: 0 to 10V in 1V steps
100V: 100V cardinal point

Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)
μV range: ±2 μV
1V, 10V, and 100V ranges: ±30 ppm or 30 μV of range, whichever is greater

Output Current: Function of source resistance, except 100V range which is limited at approximately 0.5 mA. No damage to instrument with short circuit on output.

Source Resistance
μV, 1V, 10V ranges: 300Ω
100V range: <1Ω (up to 0.5 mA load)

Alternating Voltage

Range: 1V, 10V, 100V cardinal points

Output Frequencies
10V: 400 Hz, 4 kHz, 50 kHz
1V, 100V: 400 Hz

Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)
1V: ±0.05%
10V: ±0.04% at 400 Hz and 4 kHz. ±0.1% at 50 kHz
100V: ±0.06%

Frequency Accuracy: ±1% except at 50 kHz ±5%

Total Harmonic Distortion and Noise: <0.03% (400 Hz and 4 kHz), <0.05% (50 kHz)

Output Current
1V, 10V output: 0 to 10 mA rms
100V output: 0 to 0.5 mA rms

Resistance

Range: 10Ω through 10 MΩ in decade steps + zero setting

Accuracy: (1 year, 18°C to 28°C, referred to "0" Ω position)
0Ω - Residual resistance is less than 0.15Ω
10Ω - 100Ω: ±0.06%
1 kΩ- 1 MΩ: ±0.015%
10 MΩ: ±0.075%

Power Rating: 0.2W or 100V (dc or rms), whichever is less

General Specifications

Temperature: 0°C to 50°C, operating

Power: 100, 115, 200, 230V ac, ±10%, 50 to 440 Hz, <10W, or internal batteries. Eight hours operation from batteries when fully charged

Weight: 5.9 kg (13 lb)

Size: 8.9 cm H x 21.6 cm W x 40.6 cm D (3.5 in H x 8.5 in W x 16 in D)

Included with Instrument: Manual, power cord, batteries, serialized and dated calibration certificate

Ordering Information

Model

515A Calibrator

Accessories (Also see Section 20)

M03-200-618 3 1/2" Rack Mount Kit, Dual
M03-200-619 3 1/2"Rack Mount Kit, Single, Offset
M03-200-620 Panel Mounting Kit
M03-203-700 Dust Cover

Y5020



Y5020 AC or DC Current Shunt

- Rated to 20A dc to 5 kHz
- 100 ppm uncertainty
- 10 milliohms nominal resistance
- Less than 250 mV burden

The Y5020 Current Shunt is a very stable, non-inductive, four-terminal resistive current shunt. It may be used to verify the accuracy of the 5220A Transconductance Amplifier or other current caliibrators. It is an inexpensive method of accurately measuring current up to 20 amperes, from dc to 5 kHz. The 0.01Ω nominal resistance creates less than 250 mV burden. A forced-air cooling fan stabilizes internal ambient temperature during use.

Specifications

The following specifications apply for one year, provided the Y5020 is operated with its cooling fan in ambient temperatures from 18°C to 28°C. Voltage terminals must be connected to a measurement circuit with an input resistance of 1 MΩ or greater and a capacitance of 500 pf or less.

Nominal Resistance: 0.01Ω ±1%
Uncertainty:* Direct current, ±100 ppm; alternating current, ±(150 ppm + 120 ppm x frequency in kHz) relative to direct current specification
Stability: Less than 20 ppm resistance change in six months
Maximum Current: 20A direct current or rms aternating current
Burden Voltage: Less than 250 mV at 20A
Temperature Coefficient: Less than 20 ppm/°C; 0°C to 18°C and 28°C to 50°C
Power Coefficient: Less than 12 ppm per watt
Operating Temperature: 0°C to 50°C ambient
Storage Temperature: -40°C to 70°C
Input Power:** 115V or 230V ac ±10%, 11 watts
Size: 12.7 cm H x 20.5 cm W x 3.6 cm D (5.0 in H x 8.0 in W x 12.9 in D)

Included with Instrument: Instruction sheet

**Referenced to the certified absolute value of shunt resistance stamped on the front panel*
***For cooling fan. Specify 115V or 230V when ordering*

Ordering Information

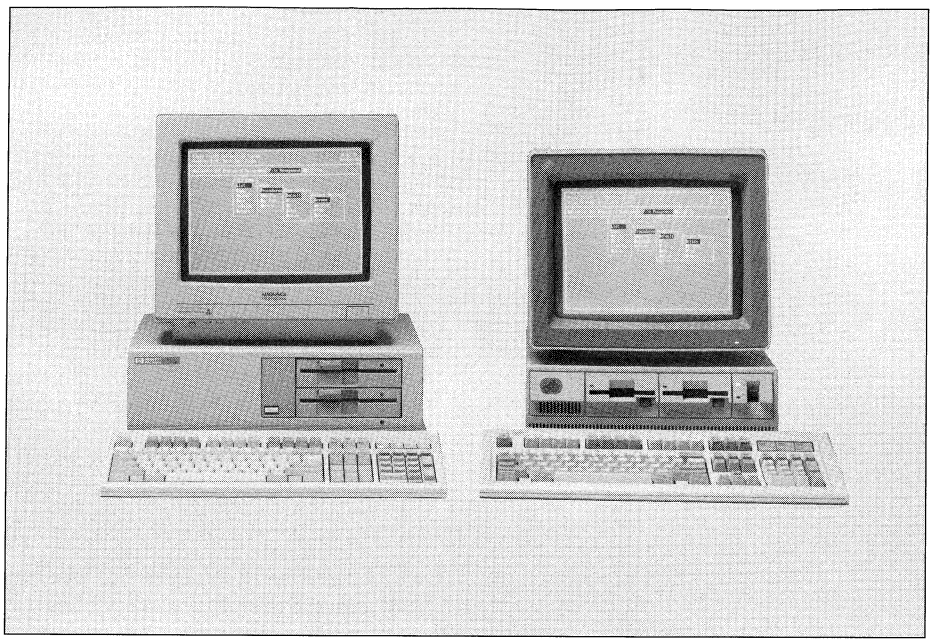
Model

Y5020* Current Shunt

** Specify supply voltage (e.g., Y5020-115 or Y5020-230)*

8

Introduction



MET/TRACK™ – Metrology Property Management Software for PCs
MET/CAL™ – Automated Calibration Software for PCs
MET/SUPPORT – Electronic Bulletin Board, FAX and Phone Support for Metrology and Calibration Software and Systems
7411C & B/U – Automated Calibration Software for Fluke 1722A Controllers
74XXX – Standard Automated Calibration Systems
A123 – Custom Configured Automated Calibration Systems

MET/TRACK: Metrology Property Management Software

Quality management of metrology assets means being prepared for the inevitable audits. You need a systematic approach to collecting the right information routinely, consistently, and completely. And an easy way to document and report every detail of an asset's location, traceability, calibration and repair history.

Automation is an ideal solution. But until now mainframe systems were the only computing option available to most organizations.

Now there's a powerful, economical metrology property management software that's been designed by metrologists for your metrology needs. MET/TRACK™ is more than a database, it's a complete metrology management system that collects, searches, sorts and reports the information you need.

MET/TRACK works the way you do. The software's logical structure is based on the flow of assets through the calibration lab. It uses familiar metrology and calibration terminology. And it's your system, giving you all the local control and flexibility of the personal computer environment.

MET/TRACK inspires confidence in the accuracy and thoroughness of the information you collect. In the access to and control of information. In documented forward and reverse traceability – up the chain to national standards and back to the workload – for all the metrology assets you're responsible for.

With information provided by MET/TRACK, you'll be thoroughly prepared for an audit at all times.

MET/TRACK also generates reports that you can use to schedule your labs workload. These reports can be read by Fluke MET/CAL Calibration Software to direct your calibration technicians to calibrate instruments in the proper order. And MET/CAL can communicate a summary of the cal results back to MET/TRACK, so you can keep accurate records of the calibration jobs your lab has handled.

MET/TRACK can also generate other management reports, such as status reports, cost summaries and so forth to help you handle your lab's data management jobs.

MET/CAL: Calibration Software Created by Metrologists for Metrologists

All too often, automating the cal lab means changing your organization to fit the software you choose.

Not so with MET/CAL.

From the opening menu to the details of procedure generation, MET/CAL was created to match the way your lab operates. And it can accomodate change as your requirements change.

MET/CAL automates the entire process of calibration and can make a dramatic difference in your lab's throughput. It helps you locate an instrument based on its recall interval. Provides operator instructions. Controls calibration instruments. Verifies and adjusts instruments under test. Saves results information automatically for off-line analysis and to meet audit requirements. And generates calibration certificates. Quickly, accurately and efficiently.

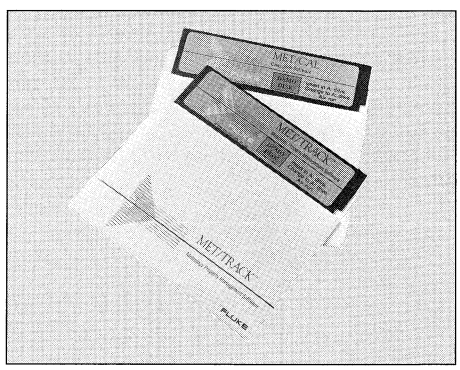
And because MET/CAL is one of Fluke's growing family of Metrology Management Software products, it comes with a unique complement of user support services.

MET/SUPPORT: Improve and Protect Your Investment

You've come to expect good service and support from Fluke. But a subscription to MET/SUPPORT gives you even more, including a toll-free hot-line, FAX communications, an electronic bulletin board, product upgrades, and access to a growing library of calibration procedures.

You automatically get a free six month introductory subscription to MET/SUPPORT when you order MET/TRACK, MET/CAL, a 74XXX system, 7411C or 7411B/U. You can extend your subscription to 18 months for a significant discount when you order the extension along with one or more of the other items.

With MET/SUPPORT you unleash the full power of Fluke Automated Metrology software and systems in your application, and your laboratory.



Introduction

Fluke Calibration Software, the Heart of your Automated System

Fluke MET/CAL and 7411 Series Calibration Software has been designed by calibration professionals to automate dc and low frequency calibration. We know that automated systems are no better than their software because software impacts everything from who can use the system to the workload it can process.

MET/CAL software runs in personal computers configured as calibration system controllers. Configuration kits for MET/CAL compatible PCs fully configured PC based system controllers and complete PC controlled calibration systems are all available from Fluke.

Model 7411C is available for new users of the Fluke 1722A Instrument Controller and Model 7411B/U is also available for existing users of 7411A or 7411B software.

Fluke calibration software is designed to control all the functions and capabilities of many calibration instruments. You can choose the instruments that cover your workload now and add to your system later as your workload changes.

With Fluke calibration software, you don't need to be a computer programmer to generate calibration procedures. Our procedure-oriented language makes generating procedures easy. Plus, Fluke calibration software includes example procedures to give you a head start at writing your own.

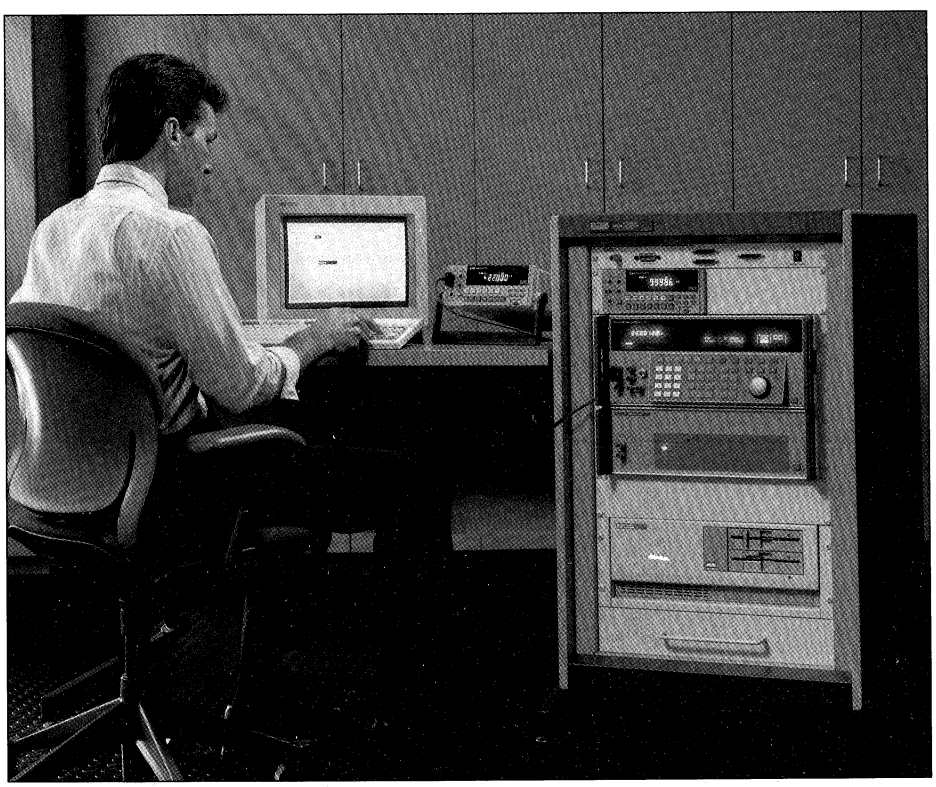
Select a Fluke System that Fits your Workload and Budget

Fluke 74XXX and A123 Automated Systems make it easy to match your calibration workload and budget. You can select your controller, DMM or oscilloscope calibrator, packaging and auxiliary instruments. You can start small and add or change instruments as your workload needs change.

Experience Counts

Automating the calibration lab is no simple task. Many questions arise. Will the system you choose meet all of your workload requirements? Can it be integrated with other systems now or in the future? Will you be able to use all the capabilities of the instruments in the system? Will it meet your reporting needs? Will it be difficult to write or edit procedures? Will they fit your lab's philosophy? Will your non-technical people be able to use the system effectively? Is the system software in wide use with strong vendor support and continuous improvements?

At Fluke, we have been building automated calibration systems for over 16 years. We understand your needs. And we know what it takes to meet them. That's why more labs automate the calibration of dc and low frequency ac test and measurement instruments with Fluke systems than any other.



Why Automate Calibration?

The calibration process is well suited to automation. You need to locate and recall an instrument, consult its manual for its calibration procedures and specifications, verify and adjust it, record the results, make calibration reports and certificates and return the instrument to its user.

It's time consuming. At every step of the way, the potential for errors is considerable. And the longer the process takes, the longer an instrument is kept out of the hands of its owner.

Increase Throughput and Productivity

Operating a Fluke automated calibration system is simple for technicians of all skill levels. Clear, plain-language instructions and illustrations prompt users at each step. Even entry level technicians can calibrate complicated instruments confidently and efficiently.

Because the procedure is in software, there is no need to consult a manual. And results information is automatically recorded.

For instruments with a GPIB/IEEE-488* interface and software calibration capability, the system can quickly perform "closed-loop, closed-case" calibrations with little operator interaction.

Enhance Quality and Consistency

Because calibration procedures run under the control of the system controller, each one is run the same way every time in every location where it is used. Decisions about what function to verify, when to perform a task and whether or not a reading is within tolerance, are made within the system, rather than by the operator. And because you write the procedure, it reflects your calibration philosophy and practice.

Streamline Data Management

Because your procedures are stored by the system controller, you have a complete record of how your instruments are calibrated. Fluke calibration software also automatically records results information for every calibration. In fact, Fluke software even has a traceability file for the calibration instruments in the system. And that file can be reported in a variety of formats to meet your needs. And you can analyze the information 'off-line' to determine instrument performance trends or to establish efficient recall schedules.

We Stand Behind Every Automated Calibration System We Sell

When you order a standard 74XXX system or custom A123, a Fluke service engineer will install and test it, and give you startup assistance for it.

To help you get the most out of your automated calibration systems instruments, Fluke offers maintenance, procedure writing, metrology and lab management training courses. These courses are held regularly at selected Fluke Service Centers. Courses can also be given on-site.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Calibration Software

Fluke Calibration Software

Software is the heart of any automated calibration system. Any system is only as fast, as capable or as easy to use as its software.

Fluke Calibration Software represents more than 16 years of experience in automating the cal lab. It is designed to be used by calibration technicians, not computer programmers. And its capabilities are driven by your need for workload coverage, flexibility and calibration results data acquisition and reporting.

Fluke offers two generic calibration software packages. MET/CAL runs on the H-P Vectra, IBM PS/2-50 and other IBM PC AT compatible personal computers under MS-DOS 3.3. The 7411C and 7411B/U run on the Fluke 1722A instrument controller, using BASIC.

Users who are familiar with earlier versions of 7411 Software for the Fluke 1722A Controller will be able to use MET/CAL with little or no training. 7411B procedures are upward compatible with MET/CAL with the use of a translator utility.

Simple Procedure Generation

When you use Fluke calibration software to write a procedure, you use calibration oriented Function Selection Codes (FSCs). You then enter the procedural data that will be used by the FSC in carrying out the function. For example, for FSCs that select a calibrator, the relevant procedural data would specify such factors as the output and tolerance. There is no need to generate cumbersome flow charts or intermediate code before you can use your procedure.

No programming. FSCs save you time by condensing multiple programming instructions into a single, easily recognizable selection. Typically, these are either instrument model numbers (5700) or English words (EVALuate). FSCs eliminate the programming knowledge usually necessary to perform complex tasks. With MET/CAL Calibration Software, you simply select the FSC you want and insert the appropriate calibration parameters. The software does the rest.

Automatic procedure checking. While you are writing a procedure, the calibration software checks it for accuracy. For example, it compares the outputs you specify with the capabilities of the calibrator used and alerts you if a command is outside the calibrator's range.

Example procedures. When you purchase MET/CAL Calibration Software, you get a set of example procedures at no extra cost. You can use these procedures in their existing form, or edit them as required to fit your equipment configuration, your cal lab philosophy or other factors specific to your application.

Simple Operation

When you run a calibration procedure on a Fluke automated calibration system, the software does the hard work. It not only leads the operator through the procedure itself, but also handles many of the tasks that are usually done by the operator – from taking the measurements to calculating and recording the error of the unit under test.

Automated calibration. For the calibration of instruments that do not have a GPIB/IEEE-488* interface, the software guides the operator through the procedure and performs the necessary calculations, helping the operator to make the actual changes to the unit.

Once the calibration procedure has been loaded, step-by-step instructions and graphics on the controller's display guide the operator through each task, allowing even inexperienced operators to perform complex calibration procedures with very little training. In addition, this close guidance assures you that calibration procedures are followed to the letter.

Closed-loop calibration. If the instrument to be calibrated has an IEEE-488 interface, you can save even more time by performing closed-loop calibration.

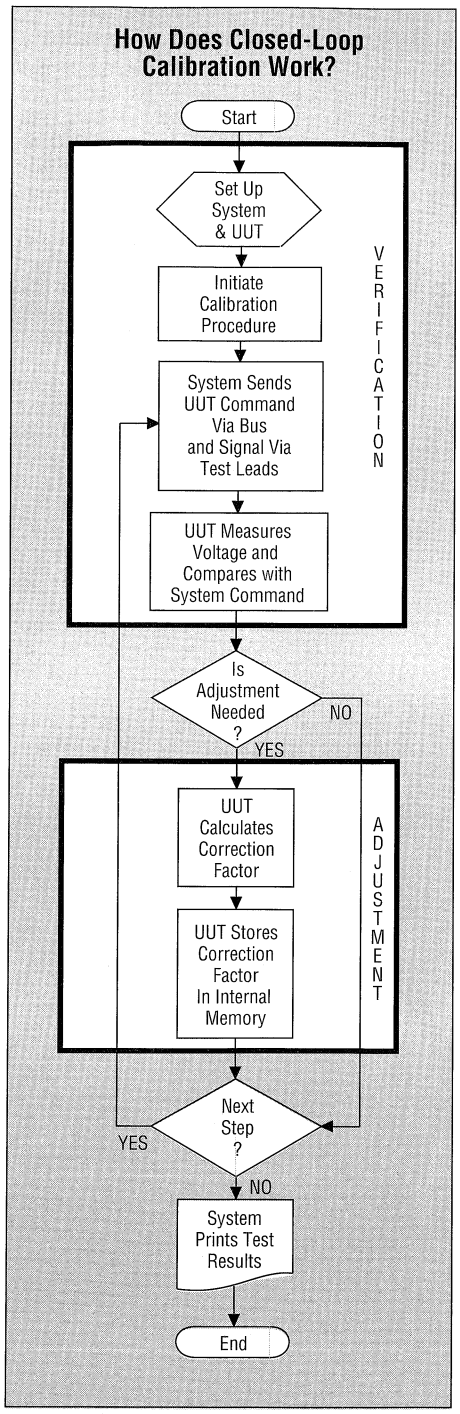
Closed-loop calibration begins with the operator identifying the unit to be calibrated and the system loading the appropriate procedure. The system then prompts the operator to connect the necessary test leads, sets the unit to the proper range and function, applies the calibrated output from the calibration instruments, evaluates the unit's reading, then proceeds to the next step until the unit has been completely verified with little or no operator intervention.

If the unit under test is capable of software adjustment, like the Fluke 8840 Series DMMs, the system can also make the necessary adjustments by storing correction factors in the unit's non-volatile memory. Otherwise, the system advises the operator of the necessary adjustments. Because of its graphics capability, procedures in Fluke calibration software can incorporate illustrations where necessary to show the operator where to make connections or adjustments.

Flexible Test Reporting

When the calibration procedure is completed, the cal results data is available in printouts with user-defined headers. In addition, a test summary and traceability data are available in a Standard Data Format (SDF) delimited file for use with your data management software.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*



Computer Comparison

Feature	HP Vectra	IBM PS/2-50	Fluke 1722A
SRM Access Possible	Yes	No	No
3rd Party Software Available	Yes	Yes	No
Operator Interface: Keyboard	Yes	Yes	Yes
Mouse	Opt	Opt.	No
Operators Aid	Opt	Opt	Yes
Bar Code Reader	Opt	Opt	Opt
Touch Sense Monitor	No	No	Yes
Rackmountable Monitor	No	No	Yes
Hard Disk	40M	20M	opt 40M
User Memory	640k	640k	1.136M
IEEE-488 Bus Interface	2 ea	2 ea	2 ea
Serial Port	3 ea	3 ea	2 ea
Parallel Port	Yes	Yes	No
Network Compatibility	Yes	Yes	No
Ruggedness	Good	Good	Best

Calibration Software Comparison

Feature	MET/CAL	7411C (7411B/U)
Runs on personal computer	Yes	No
Supports high resolution color graphics	Yes	No
Security: Passwords	Yes	No
Separate procedure/operating keyboard	No	Yes
On-line help	Extensive	None
Simple system expansion	Yes	Yes
Interrupt handling of GPIB SRQ	Yes	Yes
Supports closed-loop, closed case calibration	Yes	Yes
Text files define system capability	Yes	No
Includes system traceability file	Yes	Yes
User-defined operator prompts	Pre- and post-test	Pre-test
Reads MET/TRACK workload file	Yes	No
Templates for cal results reports	Full format	Header
Significantly out of tolerance report	Yes	Yes
Test results report includes system uncertainty	Yes	No
User-configured results printout	Complete	Header
User-configured cal certificate	Yes	No
UUT error can be reported in units or percent deviation from nominal	Yes	No
Results data formatted to export to spreadsheets and database software	Yes	Yes
Procedure writing and editing	Excellent	Good
Accepts user-defined Test Uncertainty Ratios, (TURs), warns when too low	Yes	No
Test run mode in procedure editor	Yes	No
Compatible with 3rd party text editors	Yes	No
Operator messages can be edited	Yes	Yes
Upward compatibility for procedures generated on previous versions of 7411A or B software	Yes	Yes

MET/CAL Example Procedures

Meters	Prompted Ver	Prompted Adj	Closed-loop Ver	Closed-loop Adj
Fluke				
21	•	•		
23	•	•		
25	•	•		
37	•	•		
73	•	•		
75	•	•		
77	•	•		
8000A	•	•		
8020B	•	•		
8021A	•	•		
8022A	•	•		
8024A	•	•		
8026A	•	•		
8050A	•	•		
8060A	•	•		
8840A			•	•
Hewlett-Packard				
3478A			•	•
Oscilloscopes				
Philips				
PM 3050	•	•	•	•
PM 3055	•	•	•	•
Tektronix				
465A		•		
2445A		•		•

7411C and 7411B/U Example Procedures

(Meter procedures use 5700A Calibrator)

Meters: Same as MET/CAL procedures

Oscilloscopes: Same as MET/CAL procedures except Tektronix 2445A procedures are not included

Translation Utility

Utilities to translate user-developed 7411A and 7411B procedures to use the 5700A are supplied with the 7411B/U and 7411C.

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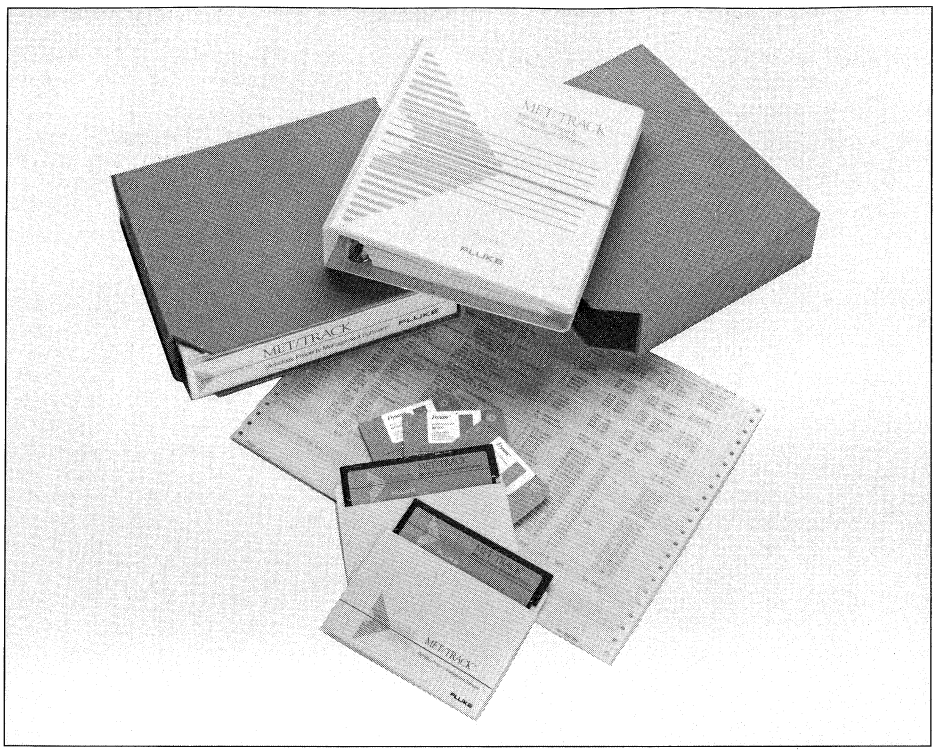
MET/TRACK

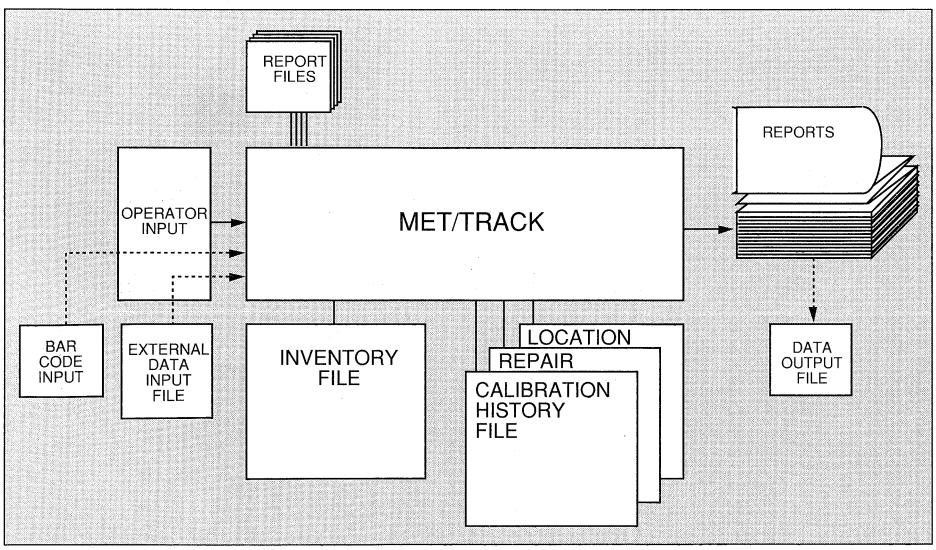
AVAILABLE OUTSIDE UNITED STATES FROM MAY 1990

NEW



MET/TRACK™ is a software package for MS-DOS compatible computers and is designed specifically for metrology property management. Through structured data collection, powerful searching, sorting and reporting capabilities, and the integration of four data bases, MET/TRACK fully supports audit requirements including MIL-STD-45662A. As a part of Fluke's Metrology Management Software family, MET/TRACK will work with MET/CAL™ Calibration Software to form a seamless calibration and asset management system.

Though the task of metrology property management is ideally suited to automation, most such systems are created by data processing personnel for use on large mainframes or minicomputers. They aren't well documented and don't always meet the metrology needs of the user. Adding requirements, like special reports, is often expensive and time consuming, and must be implemented by experienced programmers who may not understand the metrology department's unique needs.



MET/TRACK architecture

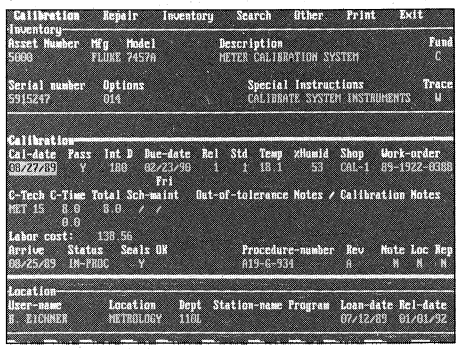
MET/TRACK takes advantage of the high performance of today's desktop computers to provide a powerful tool for metrology property management, locally, in your lab. MET/TRACK was designed by metrologists for the metrology environment, so information is collected, maintained and reported consistent with any audit requirements you might face. It is logically structured around the flow of assets through the calibration recall process. And it is flexible, so it can be adapted to meet your unique property management needs. Plus, MET/TRACK is easy to use. Familiar calibration/metrology terminology is employed throughout. Global searches and special reports often require little more than filling in the blanks. And help screens, which can be customized to fit your operational procedures, can be popped-up at a keystroke.

MET/TRACK is Designed Specifically to Support Traceability Requirements

Any time a company receives a contract dictating compliance to MIL-STD-45662A "Calibration Systems Requirements," or similiar regulations, the metrology department becomes subject to audits. These audits are often performed by government entities, or by companies who audit themselves or their vendors for quality as well as compliance reasons.

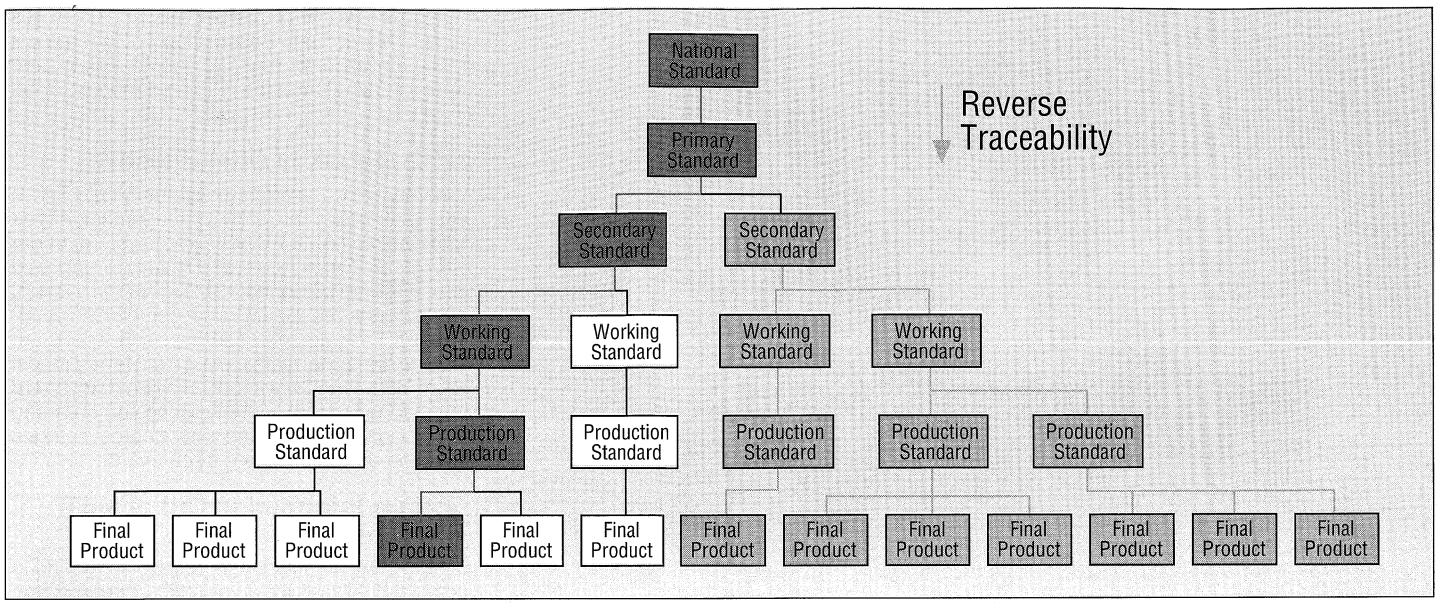
Failing an audit can delay production, or in the worst case, result in a company losing a contract, or the metrologist losing his or her job. Metrology labs fail audits for three primary reasons:

- Insufficient record keeping
- Out-of-tolerance conditions
- No documented traceability

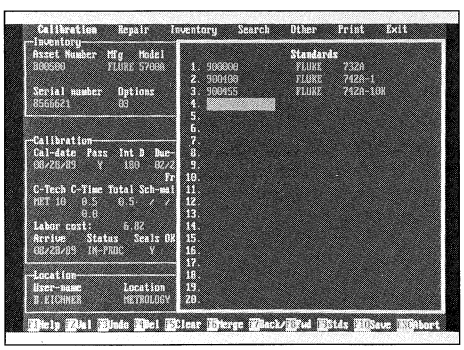


Calibration Screen

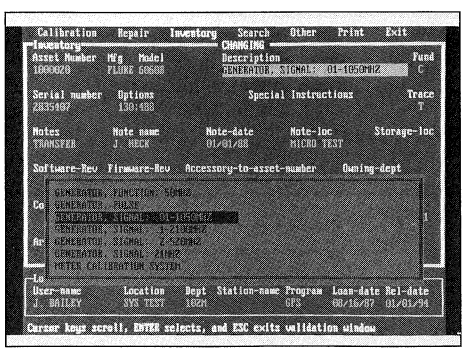
The key to passing audits is to have a systematic approach to metrology property management. MET/TRACK provides just such a system by collecting the required information – like standards used, environmental conditions, calibration intervals, procedures, out-of-tolerance



MET/TRACK supports forward and reverse traceability.



Calibration screen with standards window



Pop-up data entry validation

conditions – the same way, every time an instrument is recalled to the metrology department. In addition, related fields are linked. So for instance, MET/TRACK will automatically calculate the calibration due date based on the present date and the specified interval. It also verifies that the calculated date does not fall on a weekend or holiday. When a standard is entered into the calibration record, MET/TRACK verifies that it exists, that it is in calibration and that it is of a sufficient class for the test. MET/TRACK can also document traceability for any metrology asset, both forward to higher level standards, as well as reverse to report what instruments or standards were calibrated by a particular standard. It can generate other reports like notification of out-of-tolerance conditions.

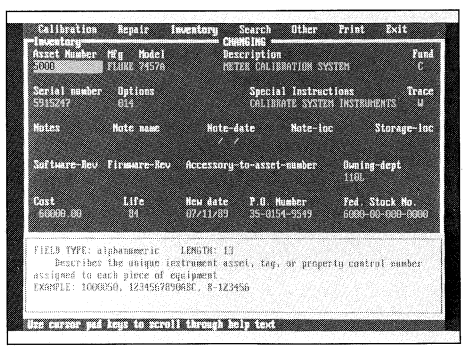
In order to maintain the consistency of data such as manufacturer names, instrument descriptions and model numbers, MET/TRACK provides comprehensive data validation. An operator may only enter information from a predefined list The valid choices may be "popped-up" at a keystroke. Validation also checks various internal linkages to assure that the proper date format is used or that a calibration date has not occurred before the asset's arrival date.

Flexibility That Supports Your Unique Requirements

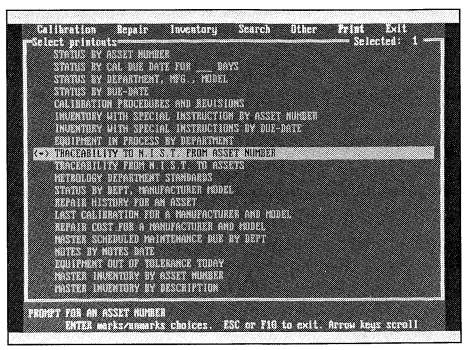
MET/TRACK is designed specifically for the metrology department, using familiar terminology and a structure based on the flow of assets through the recall process. But because not every lab operates in precisely the same way, MET/TRACK is designed to accommodate special requirements too.

You can require that certain entries always be made, or suppress entries not required by your lab. Field titles can be customized to fit your current practice, so operators don't have to learn new titles. And data validation files, which assure that instrument names, types and other information are collected consistently, can be defined to fit your needs. MET/TRACK's on-line help screens can be customized too, using your terminology.

Customizing MET/TRACK is simple. Configuration and format information is contained in simple ASCII text files. Just use your editor to

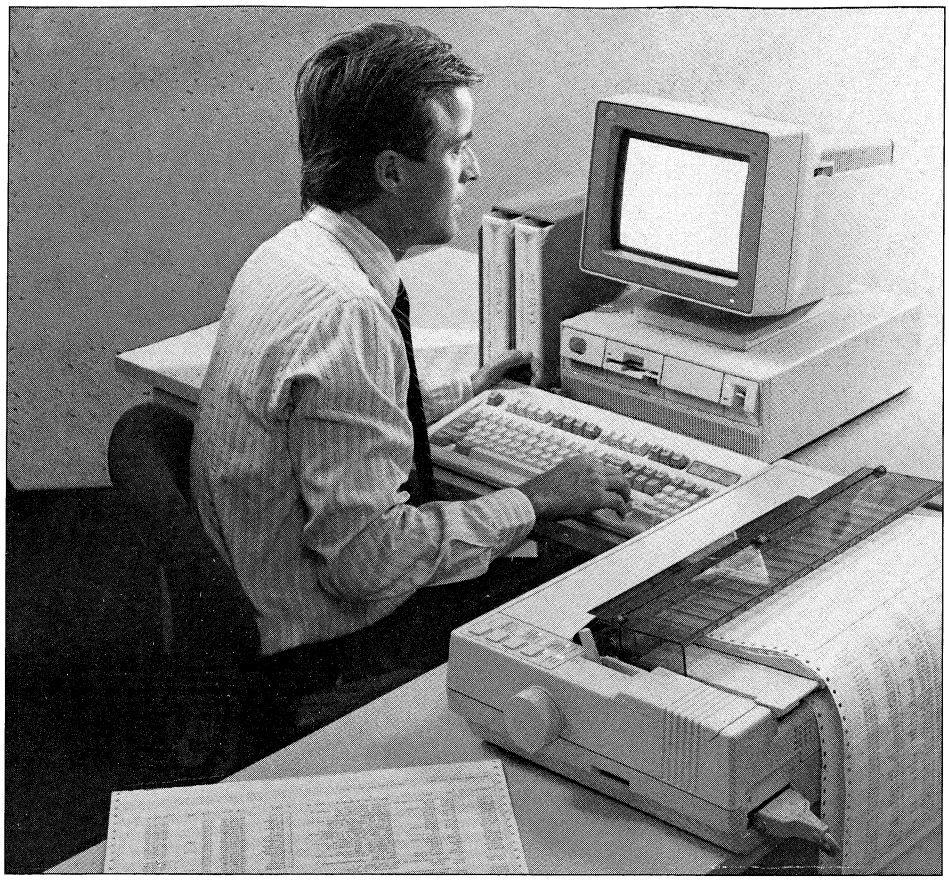


Help can be popped-up on screen

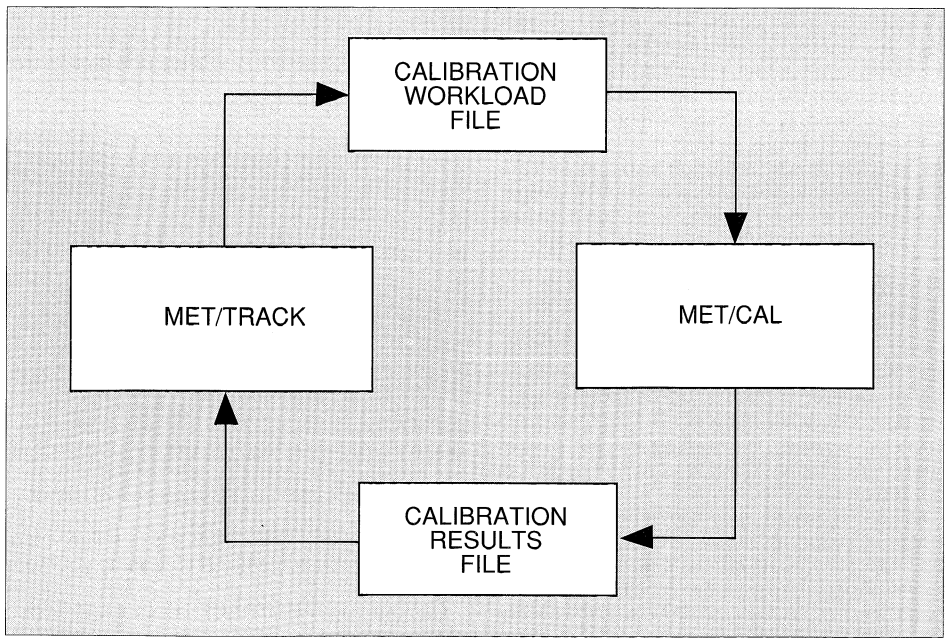


NIST/Track includes more than 50 standard reports

MET/TRACK



MET/TRACK is your asset management system, designed for your needs.



MET/TRACK and MET/CAL are designed to exchange results information and allow you to schedule your workload.

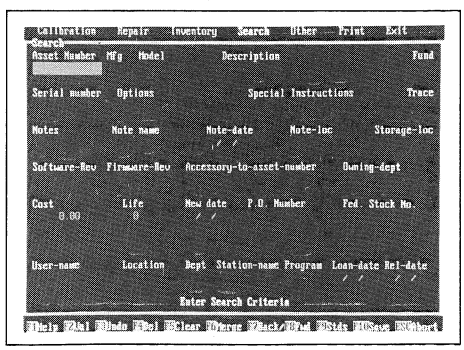
make the changes you desire. And MET/TRACK's unique Merge Data Bases allow you to create a mini-data base for any alphanumeric field, and include that information in printed reports, if you wish.

MET/TRACK is Cost Effective

Compared to mainframe systems, MET/TRACK can make your property management efforts more efficient. MET/CAL is your system, under your local control. Because it is easy to learn and to use, all lab personnel can access the system. Its features are clearly and completely documented. Even complex searches and reports are easy to generate. Data can be transferred to and from MET/TRACK without additional keyboard input. Finally, local control means you are freed from burdensome usage and storage charges from the data processing department.

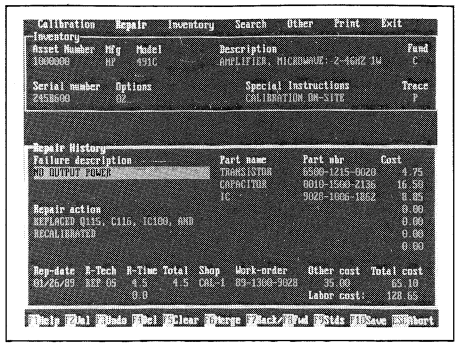
Getting Information Out of MET/TRACK is Easy

MET/TRACK includes more than 50 reports to cover virtually all the information needs of the metrology department. Included are traceability, out-of-tolerance notification, instrument recall, scheduling, and more. In addition, you can use MET/TRACK's Report Writer to create custom reports. The Report Writer simply prompts you for the information you want and takes care of the rest. Typically, it all takes no more than ten minutes. Up to 10 fields can be used for searching and sorting. And because report formats are stored in ASCII text files, you can edit them to fit your particular needs.



Search Screen

MET/TRACK's Search screen also permits you to access information easily. Fill in the blanks and MET/TRACK will locate and display the information you request for the assets that match your criteria. A related feature, Global Change, allows you to update the inventory and locations of the data bases in one operation. For instance, if all instruments from Location A are being transferred to Location B, Global Change will make all the necessary changes, as well as document the process with pre- and post-change reports.



Repair Screen

Getting Data into MET/TRACK is Easy as Well

In addition to keyboard entry, MET/TRACK can import data from any system that can create an MS-DOS ASCII text file. Data only has to be entered once. And no errors are introduced as the information is imported to MET/TRACK. Data validation remains in effect during the process. MET/TRACK can even interpret date formats, perform arithmetic conversions, like Fahrenheit to Celsius, and error checking.

When you team MET/TRACK up with MET/CAL, you have a complete calibration recall and property management system. Calibration results can be sent to MET/TRACK. In turn, MET/TRACK can send a Workload File of instruments to be calibrated to MET/CAL for calibration.

MET/TRACK Keeps Your System Secure

With five levels of security, a metrology manager can control who gains access to the MET/TRACK system. User names and passwords are required. Security levels range from "look only" to "system management." So you can determine how much access your personnel have to the system according to their job responsibility and the security you assign them. In addition, sensitive data like assigned passwords and labor and shop rates is encrypted to prevent unauthorized viewing. And a special hardware key that plugs into the computer's parallel port adds the capability to physically lock up MET/TRACK without affecting any other computer or printer operations.

MET/TRACK Supported by Fluke

Support after purchase is one of the most important factors you should consider when considering a software investment. As with all our Metrology Management Software products, your MET/TRACK purchase includes MET/SUPPORT™, a comprehensive package of support services including training, an on-line bulletin board, a 24 hour FAX line, a toll-free hot line and product updates and upgrades.

As with all our products, we want to make sure that your investment in Fluke Metrology Management Software is a sound one that will pay dividends for years to come.

Hardware Requirements

- IBM PC/AT, PS/2 or 100% compatible (an 80386-based computer would be preferable)
- 640K bytes of memory
- 40M byte or larger hard disk with 28 ms or faster access time
- MS-DOS 3.1 or greater
- EGA monitor recommended, monochrome can be used
- Parallel port
- Separate tape back up system, or equivalent

MET/CAL

GPIB IEEE-488

NEW

MET/CAL Lets You Write and Run Calibration Procedures, Not Computer Programs

MET/CAL covers your complete dc/low frequency calibration workload of analog and digital meters, and oscilloscopes up to 1 GHz. IEEE-488 controllable instruments may be verified by the system automatically. And instruments that use software calibration, like the Fluke 8840 Series and Hewlett Packard 3478A, may be verified and adjusted quickly over the bus.

You don't have to be a computer programmer to write procedures in MET/CAL. A full set of calibration-oriented Function Selection Codes (FSCs) are used to control all parts of the system. You might think of FSCs as procedure building blocks that can be arranged in a variety of different ways to meet your calibration needs. Generating a test is as simple as entering a calibrator FSC, output voltage and tolerance. The computer handles the rest.

How do you write procedures now? If you are like most people, you record a series of steps like these:

1. Turn on UUT and allow warm up for 30 minutes.
2. Connect cables and select UUT 10V dc range. Source 10V dc on calibrator.
3. Adjust calibrator output until UUT reads 10V.
4. If error is more than 0.005%, adjust UUT.

Automating your procedures with MET/CAL is very similar.

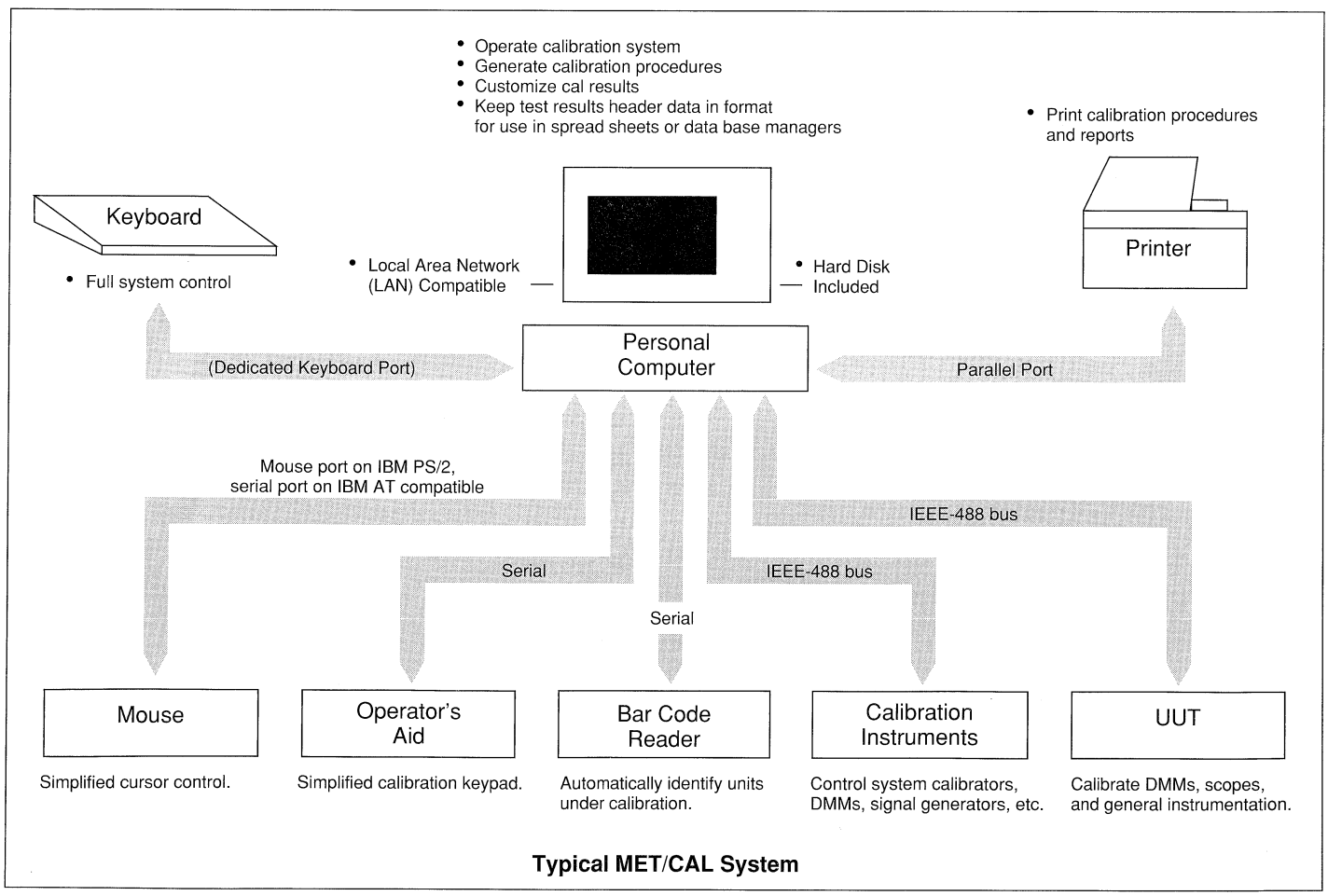
All control of your system is handled by one of MET/CAL's Function Selection Codes (FSCs). FSCs control instruments, generate operator prompts, establish or change default conditions, evaluate test results, run DOS programs from within the procedure, access device dependent functions or search for the IEEE-488 address for the instrument under test.

For instance, the FSC "5700" defines the test conditions, prompts the operator, measures and computes the error using the 5700A calibrator, and reports the result.

Procedures are automatically checked for errors as they are written. And using the specification file for the instruments in your system, MET/CAL will check the difference between the tolerance you select for the test and the performance specifications for the calibration instruments used. If the Test Uncertainty Ratio (TUR) for a test is below what you have selected for your system, MET/CAL will warn you.

FSCs also add flexibility in how you use your system. For example, an IEEE FSC permits you to access all the functions of virtually any IEEE-controllable instrument, including device dependent commands. MET/CAL also permits you to select GO/NO GO, slew or keyboard responses to an instrument test.

MET/CAL includes a built-in full screen editor for creating or revising procedures. Several test steps are shown at a time, so you can see the relationship of one test step to another. Procedure writing help is available through an on-line manual.



Typical MET/CAL System

The MET/CAL editor also offers three test modes to help you assure that the procedure is having the expected effect on the instruments in the system. Individual tests or complete procedures can be test run. Trace, debug and free run modes are supported. Development of procedures can be done in MET/CAL's demo mode which allows a procedure to be run without system instruments present.

If you have a favorite test processor, MET/CAL can accommodate you as well. Simply write your procedure, then retrieve it with the MET/CAL editor for error-checking, testing and execution.

To aid in your procedure writing, numerous example procedures are included. You can use them as is, or as a guide to writing your own procedures. We also offer MET/CAL procedure writing training classes at select locations, or at your lab.

Customize Your System

MET/CAL allows considerable freedom to customize your system environment as well as the results you report. Default system prompts are stored as text files and can be edited to fit the particular needs of your lab. Test result summaries can be customized using up to 15 information fields you define, including traceability information on the instruments in your system. Also included is a utility that helps you to recall instruments due for calibration and to locate test results from previous calibrations. And because calibration summaries are stored in a delimited text format, they can be retrieved by other popular PC programs for further analysis.

In combination with Fluke's MET/TRACK™ Metrology Property Management Software, MET/CAL will help you manage summary results to meet your audit requirements, as well as identify what instruments are due for calibration during a given period.

MET/CAL Security

To protect your system and procedures, MET/CAL supports four levels of security. So you control access to your system by assigning different levels of permission to various personnel. Passwords are assigned via a program on a separate diskette.

Supplementary Programs

A number of supplementary programs are provided with MET/CAL. These include:

- RECALL, a semi-automated calibration recall management system written in dBASEIII. Plus, it links MET/CAL result records into a database for producing printed management and recall reports.
- A TESTIT program that tests and verifies the correct installation of a mouse and its driver, the GPIB interface cards, the serial ports and the operators aid. TESTIT requires a user-supplied Fluke 8840A.
- A Translation utility that converts 5100, 5200, 5205, 5220, 5440, 5450, RESF and WIDE FSCs in existing 7411 procedures to 5700 FSCs for new MET/CAL procedures.
- Programs to transfer 7411B procedures and FDOS files to PC DOS files.

MET/CAL Kits

Fluke offers two kits that include MET/CAL, itS supplementary programs, manuals, GPIB cards, a GPIB cable, an ac divider and instruction manuals. These kits are used to configure an IBM PS/2 or PC-AT or 100% AT compatible to run MET/CAL. MS-DOS 3.3 is required.

MET/CAL-Edit

MET/CAL-Edit is used to write and edit calibration procedures off-line from the MET/CAL system controllers. It provides all MET/CAL capabilities except the ability to "Calibrate an Instrument". Example procedures and a full manual set are included with MET/CAL-Edit.

MET/CAL Support

A free six months subscription to MET/SUPPORT is included with MET/CAL, providing:

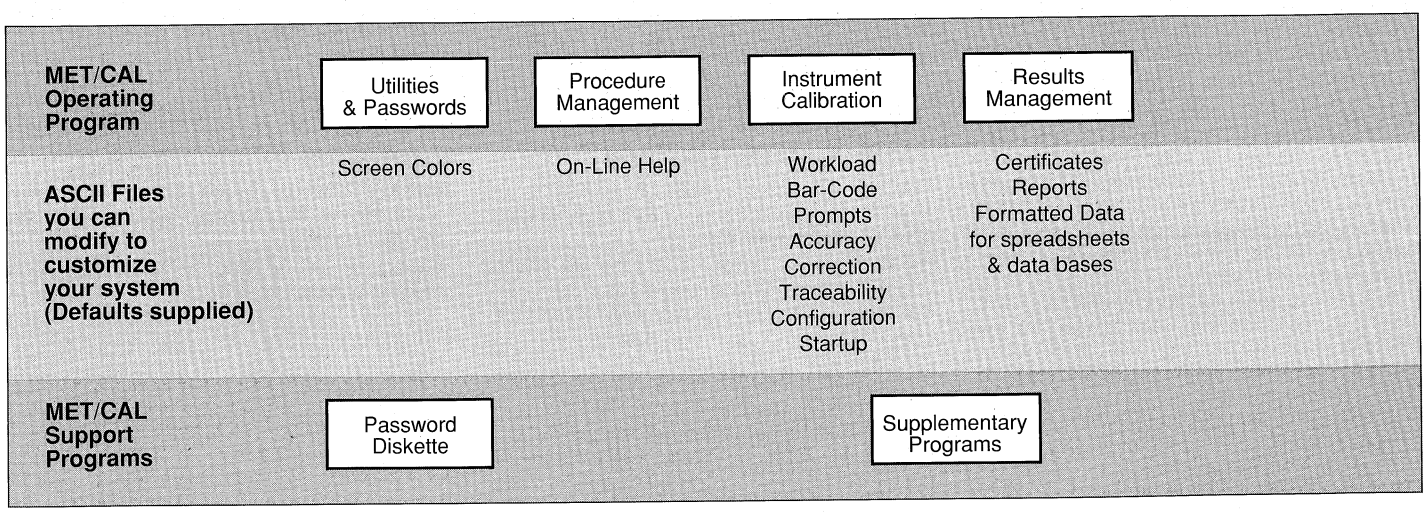
- Fast answers to your questions via phone, FAX or electronic bulletin board.
- Help with installing and operating MET/CAL.
- Help in writing MET/CAL procedures.
- Applications information via bulletin board.
- User contact via bulletin board.
- Procedure exchange via bulletin board.
- Reduced prices on major new software releases.

Ordering Information

Models

MET/CAL Calibration Software
MET/CAL-Edit Procedure Writing Software
74XXX-ATK MET/CAL Kit for IBM AT or 100% compatible. Includes MET/CAL, 2 GPIB ports, an ac divider and one GPIB cable.
74XXX-MCK MET/CAL Kit for IBM PS/2-50. Includes MET/CAL, 2 GPIB ports, an ac divider and one GPIB cable.
MET/SUPPORT 12 months subscription.

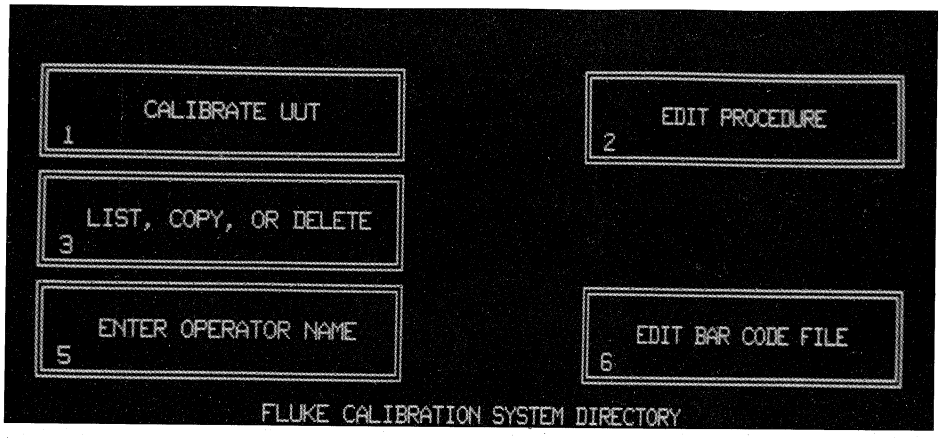
MET/CAL Software requires MS-DOS 3.3. It is supplied on 5 1/4 1.2M and 3 1/2 720K diskettes. Refer to 74XXX-ES12 and 74XXX-PS/2 descriptions for recommended computer configurations.



MET/CAL Architecture

7411C & 7411B/U

GPIB IEEE-488



7411C Main Menu with touch-sense selection or numeric selection via keyboard.

Benefits of 7411C & 7411B/U Calibration Software

- Procedures run in the Fluke 1722A, with new internal hard disk used by the 7411C.
- Procedures are easy to generate and edit. Example procedures included.
- System operation is easy. The 1722A's touch sensitive screen and the Operators Aid make entering commands easy.
- Test results are automatically recorded.
- Traceability information on the system instruments is kept on file.
- Cal Results data can be off-loaded to a PC or other computer for additional processing.
- System expansion is simple.

Applications Guide

7411C

Recommended for *new* Fluke 1722A controlled calibration systems. The 7411C has room for future Function Selection Codes (FSCs), but cannot be used with Fluke models 7405A, 7410A and some A123s (see Function Selection Code Comparison Chart).

7411B/U

Used to upgrade *existing* Fluke 1722A controlled calibration systems such as Fluke Models 7405A, 7410A, 7404A, 7404B, 7449A and A123. The system to be upgraded must use a prior version of 7411X software which must be exchanged for the 7411B/U.

There is no room for additional FSCs in the 7411B/U and users who have added their own FSCs to prior versions of the 7411X will be unable to upgrade to the 7411B/U and retain the FSCs they have written.

Any other user modifications to previously supplied 7411X source code must be added by the user to the 7411B/U.

7411C & 7411B/U Improvements and Additions for 1990

The following list summarizes changes and additions to 7411B Version 2.0 Calibration Software that have been incorporated in the 7411C & 7411B/U Version 3.0 Calibration Software.

General Capabilities

- 5700 FSC Added
- Full Screen Procedure Editor Added
- Go-No/Go Tests Added
- IEEE FSC Improved
- 5100 to 5700 Translation Utility Added
- Utility to Change Titles of Procedures/Results Added

Results Reporting

- Customized Results Header Added
- SDF Results Header Data File Added
- Traceability File in Results Header Added
- Tabulation of Test Results in Header Added
- Error Column Added to Results Printout

Operator Interface

- Procedure and Results Directories Added
- Bar Code Reader Procedure Selection Added
- Prompt for Operators Name When not Entered Added
- Operator Input from 1722A Keyboard

7411C & 7411B/U Support

A free six months subscription to MET/SUPPORT is included with the 7411C and 7411B/U. This service provides:

- Fast answers to your questions via phone, FAX or electronic bulletin board.
- Help for installation and operation of the 7411C and 7411B/U.
- Help in writing 7411 procedures.
- Applications information via bulletin board.
- User contact via bulletin board.
- Procedure exchange via bulletin board.
- Reduced prices on major new software releases.

Function Selection Code Comparison for Instruments

Instrument	7411C	7411B/U
New		
5700A	•	•
MMFC	•	•
8842A	•	
Prior Fluke		
1953A		•
5100B	•	•
5101B	•	•
5200A	•	•
5205A	•	•
5215A	•	•
5220A	•	•
5440B	•	•
5450A	•	•
6011A		•
6061A	•	•
M606	•	•
6071A		•
MGEN		•
8505A		•
8506A	•	•
8520A		•
RESF	•	•
RESV		•
WIDE	•	•
7405A Test Panel		•
7410A Test Panel		•
Prior Non-Fluke		
CG5001	•	•
278		•
2500		•
DLVP		•

Ordering Information

Models

7411C Calibration Software
7411B/U* Calibration Software (7411B Version 3.0)
MET/SUPPORT 12 months subscription
74XXX-1722A/HD Touch Screen Instrument Controller w/ Internal 40M byte hard disk (for 7411C users)

**Previous version of 7411A or 7411B must be exchanged to obtain 7411B/U*

Fluke 74XXX Series Automated Calibration Systems

Fluke 74XXX Series Automated Calibration Systems provide complete solutions to the complex task of matching the calibrator, host computer and software, packaging and other accessories with your workload and budget.

Fluke offers three 74XXX Series systems:

- The 7457A system is based on the Fluke 5700A Calibrator. It addresses the broadest cross section of meters in your workload. Also, because of the 5700A Calibrator's exceptional temperature tolerance, the 7457A system is ideally suited for on-site calibration applications outside the calibration lab.
- The 7451A system is based on the Fluke 5100B Calibrator. It addresses the calibration of medium accuracy multimeters up to $4^1/_2$ digits, or up to $5^1/_2$ digits with the 74XXX-8506A accuracy enhancement option.
- The 7409B system is based on the Tektronix CG5001 Oscilloscope Calibrator. It can be configured as a stand-alone system, with its own controller. Or it can be ordered without a controller and operated by the controller in a 7451A or 7457A system.

Each Fluke Automated Calibration System* comes with one day of start-up assistance. It will be installed by a Fluke service engineer.

Depending on your application and the instruments you buy, Fluke 74XXX systems can be packaged in three ways.

For stationary use, instruments may be simply "stacked" together in a bench-top cluster, with no packaging required.

For semi-mobile applications, you can order your Fluke system mounted in a standard 19" wide instrument rack. Rack installation permits a system to be moved about the lab with relative ease while protecting the instruments in it from damage. 74XXXs provide single-switch power and a front-mounted GPIB interface port. All necessary hardware, controller, interface panel, power distribution and ventilation are included. All instruments are installed. If you don't order all the instrument options for a particular rack, all the hardware used to install that instrument later is included.

For mobile applications, any of the rackmount systems may be ordered with a mobile base that includes semi-pneumatic wheels. These wheels isolate the rack from shocks while making it easy to roll the system over expansion joints, cracks, rough surfaces.

The Lab Cart is an inexpensive alternative to rack-mounting your system. This sturdy, open frame cart has 4" wheels and space for a calibrator, amplifier, controller and monitor.

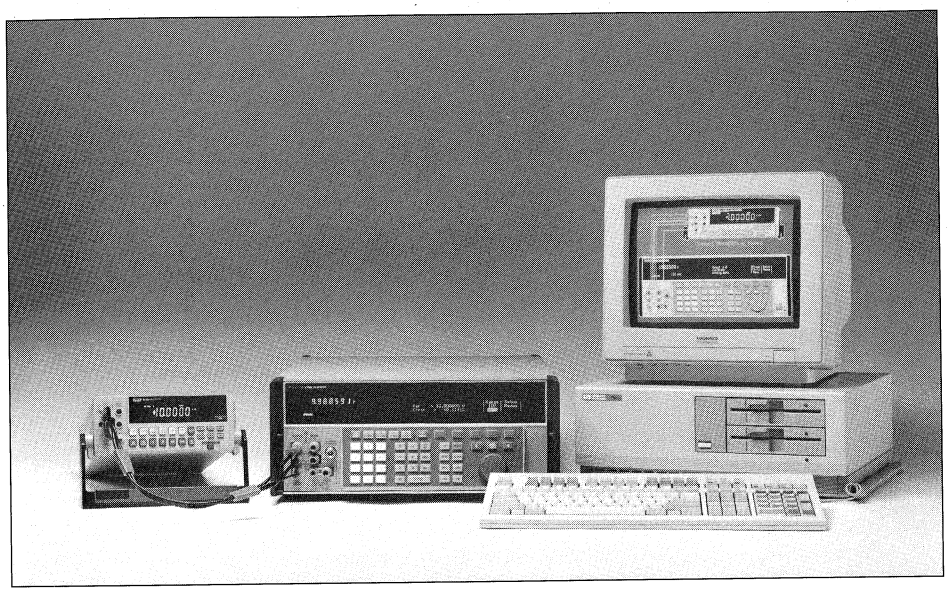
In the following pages you will find Selection Trees for the 74XXX systems. First, find the calibrator you need. Then work your way down the tree, choosing the controller, auxiliary instruments, packaging, lab carts and other accessories that you want.

** Defined as a Calibrator, Controller, and Software ordered together*

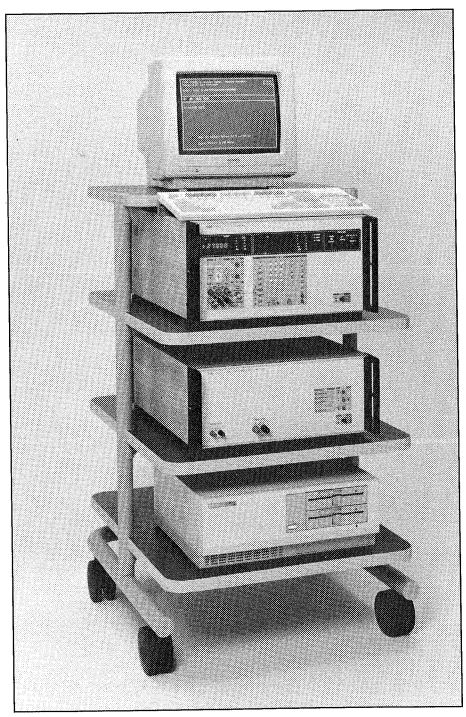
Note:Some instruments don't fit in the 74XXX racks or lab cart. Order an A123 system in these cases.

A123 Customized Systems

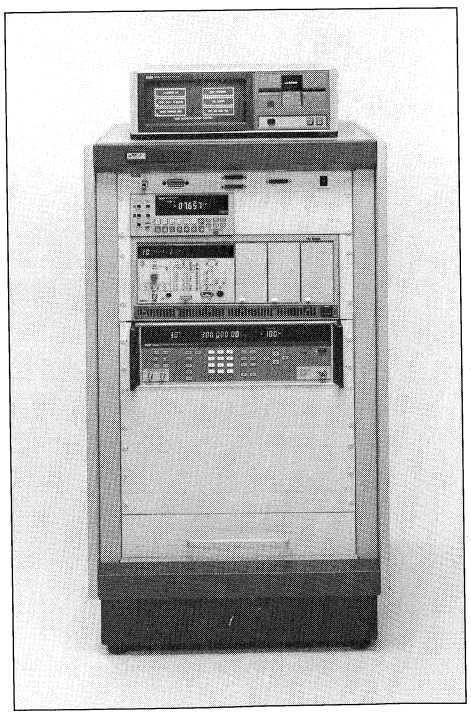
A123 calibration systems are used in custom applications. See page 238.



7457A PC Controlled Calibration Clusters
7451A and 7409B also available as clusters.



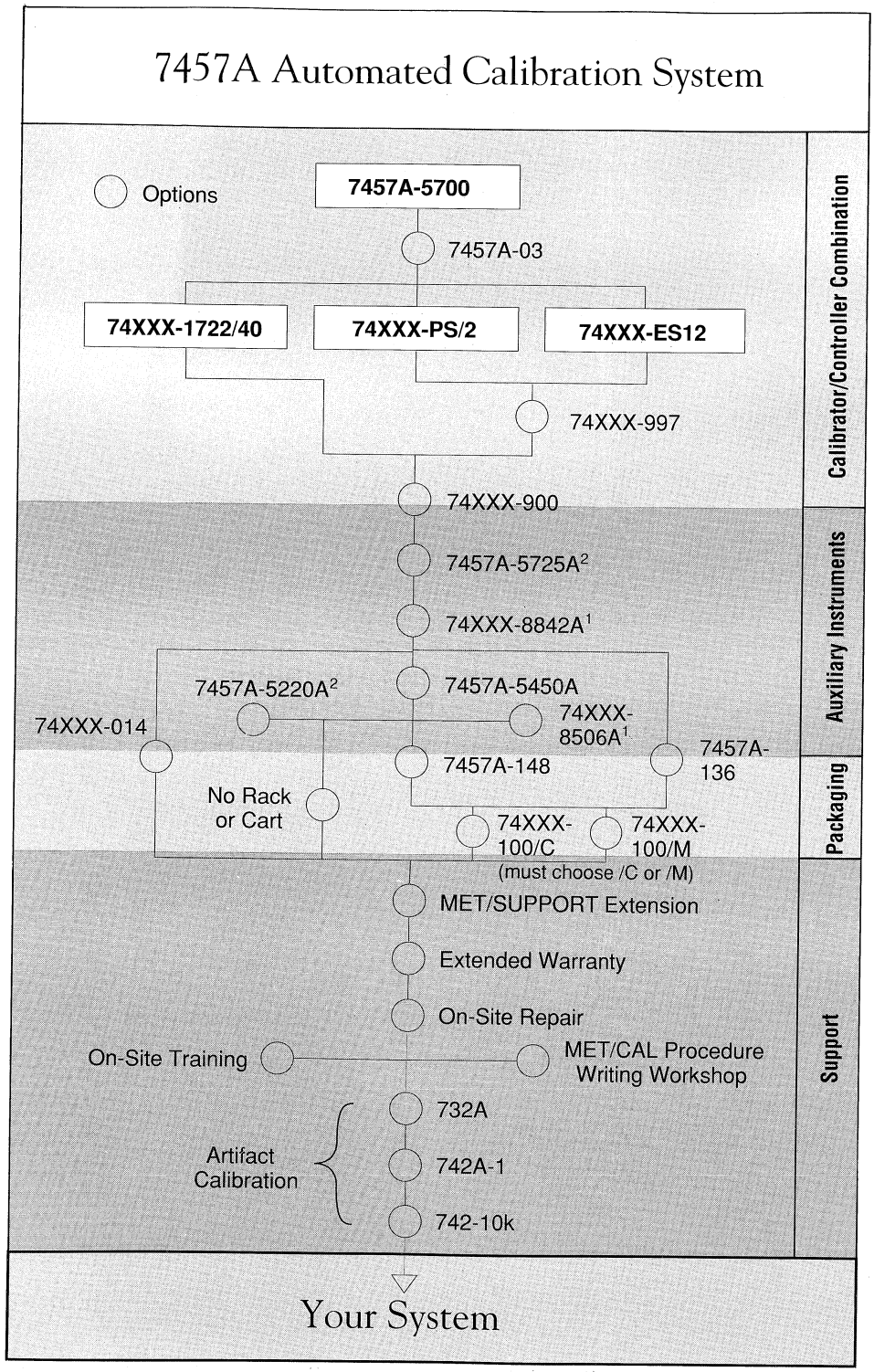
7451A Lab-Cart System
Lab-Cart also available for 7457A and 7409B



7409B Rackmounted System
Rackmounting and 1722A Controller also available for 7457A and 7451A

8

7457A



[1] *74XXX-8506A and 74XXX-8842A mutually exclusive in 7457A-148*
[2] *7457A-5220A and 7457A-5725A mutually exclusive in 7457A-148*

Introduction

The 7457A is Fluke's highest performance standard system. It is designed to calibrate a wide range of instrumentation in your dc and low frequency ac workload. 7457A systems are an excellent choice for calibrating high performance instrumentation on-site.

Choose Your Calibrator

7457A-5700A Calibrator

Designed to cover the complete meter cal workload. Sources five functions: Direct voltage to 1100V. Alternating voltage from 200 µV to 1100V with frequencies from 10 Hz to 1 MHz. Resistance from 1Ω to 100 MΩ in x1 and x1.9 values including a short. Alternating and direct current to 2.2A with alternating current output available over frequencies from 10 Hz to 10 kHz. GPIB/IEEE-488* cable is included.

Option 7457A-03 Wideband Voltage
Extends the 5700A's frequency range to 30 MHz to cover RF voltmeters.

Choose Your System Controller**

74XXX-1722/40 Touch Screen Instrument Controller

Includes 7411C Software configured for your system. Easy reconfiguration means you can add new instruments at any time. Also included: 1M byte memory expansion, 40M byte internal hard disk, two IEEE-488/RS-232 interfaces, Operator's Aid, 400K byte 5¼" floppy disk drive, AC divider, IEEE-488 cable for unit under test (UUT) control and 6 months of MET/SUPPORT.

74XXX-ES12 Controller***

This selection features the Hewlett-Packard Vectra Model ES12 configured as an instrument controller. Includes MET/CAL Software configured for your system and 6 months of MET/SUPPORT. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor, 40M byte hard disk drive, 640K byte RAM, floppy and hard disk controller, three serial ports, one parallel port, one 1.44M byte 3½" floppy disk drive, two IEEE-488 control ports, DOS 3.3, HP VGA color monitor, AC Divider, and IEEE-488 cable for UUT control.

Option 74XXX-997 Operator's Aid
Specialized keypad to simplify operation. Supplements the computer keyboard. Operates through an a serial port.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*
***All Controller options include a free 6 month subscription to Fluke MET/Support. (see page 209 for description)*
****Hewlett-Packard model number and configuration may change without notice.*

74XXX-PS/2 Controller*

This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes MET/CAL Software configured for your system, and 6 months of MET/SUPPORT. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor, 30M byte hard disk drive, 1M byte RAM, floppy and hard disk controller, three serial ports, one parallel port, one 1.44M byte, 3½" floppy disk drives, two IEEE-488 control ports, DOS 3.3, IBM VGA color monitor, AC Divider, and IEEE-488 cable for UUT control.

Option 74XXX-997 Operator's Aid

Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an serial port.

Choose Your Auxiliary Instruments

7457A-5725A Amplifier

Boosts the 5700A's current output to 11A. It also extends the 5700A's alternating voltage capability to 1100V at 30 kHz and 750V at 100 kHz for calibrating high performance bench and system meters. Includes 5700A interconnect cable and 80J-10 10A shunt.

74XXX-900 Bar-Code Reader

This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar-code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

74XXX-5450A Resistance Calibrator

Increases the best case resistance calibration accuracy of the system from 11 ppm to 7.5 ppm (±5°C, 90 days). Includes an IEEE-488 cable.

74XXX-8842A Digital Multimeter

Adds 5½ digit DMM measurement capability to the system. Cannot be combined with the 74XXX- 8506A DMM option described below. Includes a Fluke 8842A/059 with ac and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short.

7457A-5220A Transconductance Amplifier

For calibrating high current ranges of handheld and other meters. Boosts system current capability to 20A. Includes a Y5002 interface cable and 80J-20 20A current shunt.

**IBM model number and configurations may change without notice.*

74XXX-8506A Digital Multimeter

Provides for high accuracy 6½ digit DMM measurement capability in the system. Cannot be combined with the 74XXX-8842A DMM option described above. Includes an 8505A-02A ohms converter and IEEE-488 interface and cable.

Choose Your Packaging

74XXX-014 Lab Cart

A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, amplifier, controller, monitor and bar-code reader. Cannot accomodate 74XXX-5450A Resistance Calibrator, 74XXX-8842A DMM, 7457A-5220A Transconductance Amplifier or 74XXX-8506A DMM options due to a lack of room on the cart. Some assembly required.

7457A-136 36" Instrument Rack and Enclosure

Provides for complete mechanical integration of the 7457A system into one enclosure. Designed primarily for stationary use. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rack-mount kits for all 7457A options. Cannot accomodate the 74XXX-8506A DMM, 74XXX-5450A or 7457A-5220A Transconductance Amplifier options. See the 7457A-148 48" Instrument Rack and Enclosure described below.

7457A-148 48" Instrument Rack and Enclosure

Provides for complete mechanical integration of the 7457A system into one enclosure. Designed primarily for stationary use. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rack-mount kits for all 7457A options. Rack-mount kit for the 74XXX-8506A DMM is included unless the 74XXX-8842A DMM is selected. 7457A-5220A excludes 7457A-5725A.

Enclosure Base Options

You must choose either a 74XXX-100/C or 74XXX-100/M for a 36" or 48" Instrument Rack.

Option 74XXX-100/C

Provides casters for infrequent movement of enclosure on level surfaces.

Option 74XXX-100/M

Larger semi-pneumatic wheels permit movement of the rack-mounted system over bumps and rough surfaces.

Choose Your Support.

MET/SUPPORT

Phone, FAX, and electronic bulletin board support for 74XXXs.

Extended Warranty

Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service and Warranty

Convenient. Reduces system down time. Contact your local Fluke Sales office for information on extended warranty, on-site repair or on-site warranty.

MET/CAL Procedure Writing Workshop

A five-day course giving a comprehensive overview of MET/CAL Calibration Software and its applications in calibration systems. Held regularly at Fluke Service Centers.

Artifact Calibration

Includes a 732A-100 10V Direct Voltage Reference Standard, 742A-1 Resistance Standard and 742A-10k 10k Resistance Standard to support the Artifact Calibration capability of the 5700A Calibrator. Refer to 732A and 742A sections of this catalog for more information on these.

Ordering Information

Calibrators

7457A-5700A Calibrator

Options

7457A-03 Wideband Voltage Option

Controllers

74XXX-1722/40 Touch Screen Instrument Controller
74XXX-ES12 Controller
74XXX-PS/2 Controller

Options

74XXX-997 Operator's Aid

Auxiliary Instruments

7457A-5725A Amplifier
74XXX-900 Bar Code Reader
74XXX-5450A Resistance Calibrator
74XXX-8842A Digital Multimeter
7457A-5220A Transconductance Amplifier
74XXX-8506A Digital Multimeter

Packaging

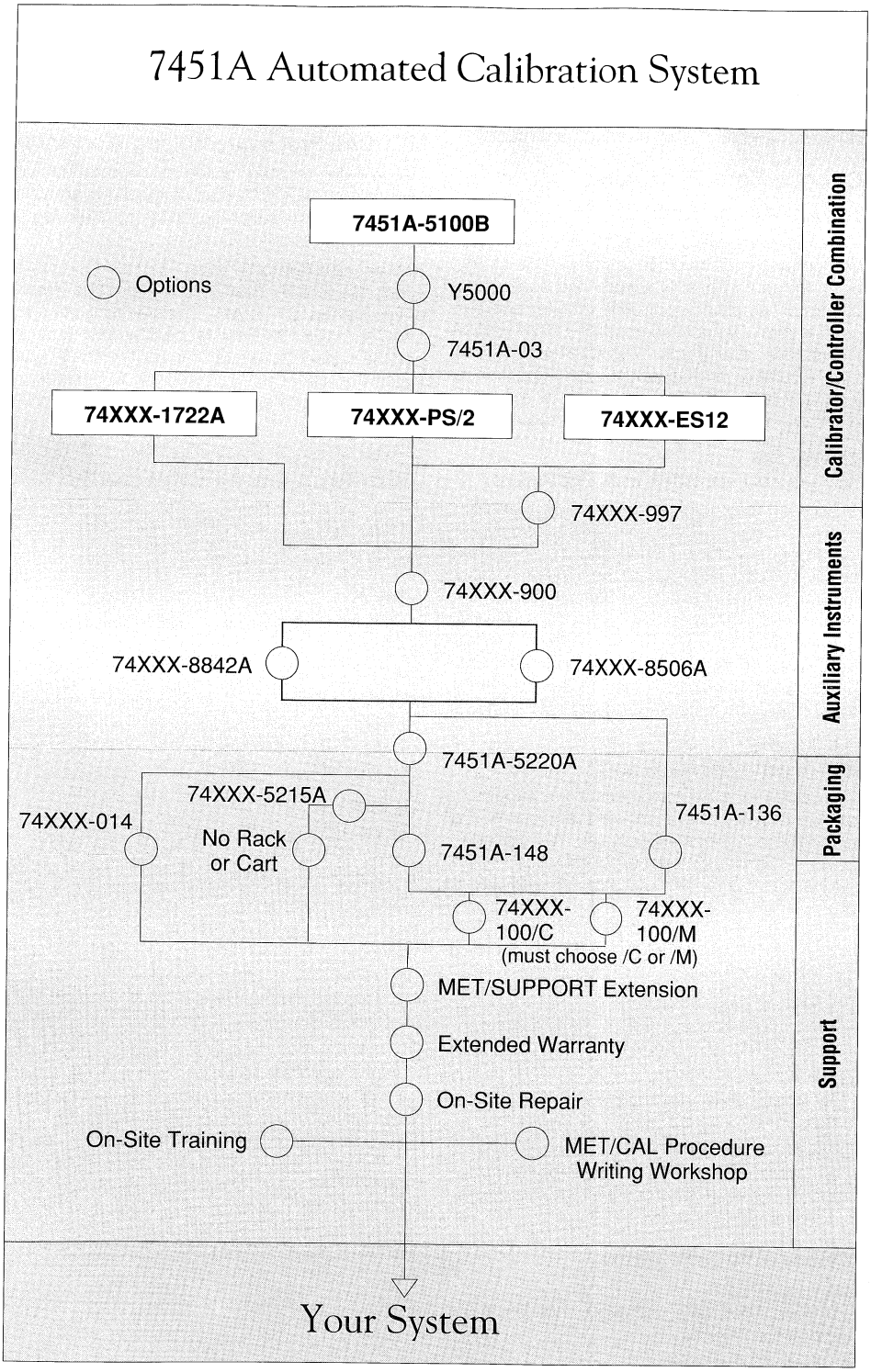
74XXX-014 Lab Cart
7457A-136 36" Instrument Enclosure
7457AB-148 48" Instrument Enclosure

Options

74XXX-100/C Caster Base
74XXX-100/M Mobile Base
MET/SUPPORT 12 Months Subscription

8

7451A



Introduction

The 7451A system is designed to meet a large cross section of your meter calibration workload – medium accuracy instruments up to 4 1/2 digits. With 8506A accuracy enhancement, it can address the 5 1/2 digit portion of your workload as well. It is based on the Fluke 5100B Calibrator, the most widely used DMM calibrator in the world.

Choose Your Calibrator

7451A-5100B Calibrator

Designed to cover calibration of meters up to 4 1/2 digits. Sources five functions: Direct voltage to 1100V. Alternating voltage to 1100V with frequencies from 50 Hz to 50 kHz. Resistance from 1Ω to 10 MΩ. Alternating and direct current to 2A. GPIB/IEEE-488* cable is included.

Y5000 Interface Buffer
Required if 5215A or 5220A amplifier are selected.

7451A-03 Wide Band Voltage Option
Extends the 5100B's frequency range to 10 Hz to 10 MHz to cover RF voltmeters.

Choose Your System Controller**

74XXX-1722A Touch Screen Instrument Controller

Includes 7411C Software configured for your system. Easy reconfiguration means you can add new instruments at any time. Also included: 1.0M byte memory expansion, 40M byte internal hard disk, two IEEE-488/RS-232 interfaces, Operator's Aid, 400K byte 5 1/4" floppy disk drive, AC divider, IEEE-488 cable for unit under test (UUT) control, and 6 months of MET/SUPPORT.

74XXX-ES12 Controller***

This selection features the Hewlett-Packard Vectra Model ES12 configured as an instrument controller. Includes MET/CAL Software configured for your system, and 6 months of MET/SUPPORT. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor, 40M byte hard disk drive, 640K byte RAM, floppy and hard disk controller, three serial ports, one parallel port, one 1.44M byte, 3 1/2" floppy disk drive, two IEEE-488 control ports, DOS 3.3, HP VGA color monitor, AC Divider, and IEEE-488 cable for UUT control.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

***All Controller options include a free 6 month subscription to Fluke MET/Support.*

****Hewlett-Packard model number and configuration may change without notice.*

Option 74XXX-997 Operator's Aid
Specialized keypad to simplify operation. Supplements the computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller*

This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes MET/CAL Software configured for your system, and 6 months of MET/SUPPORT. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor, 30M byte hard disk drive, 1M byte RAM, floppy and hard disk controller, three RS-232 ports, one parallel port, one 1.44M byte, 3 1/2" floppy disk drive, two IEEE-488 control ports, DOS 3.3, IBM VGA color monitor, AC Divider, and IEEE-488 cable for UUT control.

Option 74XXX-997 Operator's Aid
Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose Your Auxiliary Instruments

74XXX-900 Bar-Code Reader

This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar code reader, 1260 series wand with 10' coiled cord, power supply, manual and RS-232 cable.

74XXX-8842A Digital Multimeter

Adds 5 1/2 digit DMM measurement capability to the system. Cannot be combined with the 74XXX-8506A DMM option described below. Includes a Fluke 8842A/059 with ac and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short.

74XXX-8506A Digital Multimeter

Broadens 5100B Calibrator's workload coverage to 5 1/2 digit DMMs and provides for high accuracy 6 1/2 and 7 1/2 digit DMM measurement capability in the system. Cannot be combined with the 74XXX-8842A DMM option described above. Includes an 8505A-02A ohms converter and IEEE-488 interface and cable.

7451A-5220A Transconductance Amplifier

For calibrating high current ranges of handheld and other meters. Boosts system current capability to 20A. Includes a Y5002 interface cable and 80J-10 10A current shunt.

**IBM model number and configuration may change without notice.*

74XXX-5215A Voltage Amplifier

Boosts the 5100B's alternating voltage capability to 1100V at 50 kHz to calibrate instruments that measure these high volt-Hertz levels. Includes Y5001 calibrator interface cable. Can only be selected for cluster systems.

Choose Your Packaging

74XXX-014 Lab Cart

A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, DMM, 5220A amplifier, controller, monitor and bar-code reader. Cannot accomodate the 74XXX-5215A Amplifier option due to a lack of room on the cart. Some assembly required.

7451A-136 36" Instrument Rack and Enclosure

Provides for complete mechanical integration of the 7451A system into one enclosure. Designed primarily for stationary use. Also included: power/controller interface panel, line power distribution contactor, fan, 3 1/2" storage drawer and rackmount kits for all 7451A options. Cannot accomodate the 7451A-5220A Transconductance Amplifier or 74XXX-5215A Amplifier options. See the 7451A-148 48" Instrument Rack and Enclosure described below.

7451A-148 48" Instrument Rack and Enclosure

Provides for complete mechanical integration of the 7451A system into one enclosure. Designed primarily for stationary use. Also included: power/controller interface panel, line power distribution contactor, fan, 3 1/2" storage drawer and rackmount kits for all 7451A options. Rackmount kit for the 74XXX-8506A DMM is included unless the 74XXX-8842A DMM is selected. 74XXX-5215A Amplifier option cannot be installed in this rack.

Enclosure Base Options
You must choose either a 74XXX-100/C or 74XXX-100/M for a 36" or 48" Instrument Rack.

Option 74XXX-100/C
Provides casters for intermittent movement of enclosure on level surfaces.

Option 74XXX-100/M
Larger semi-pneumatic wheels permit movement of the rackmounted system over bumps and rough surfaces.

Choose Your Support

MET/SUPPORT
Phone, FAX and electronic bulletin board support for 74XXXs.

Extended Warranty
Extends the factory warranty to two years. Allows you to budget effectively for repair services and shortens turn-around time.

On-Site Repair Service and Warranty
Convenient. Reduces system down time. Contact your local Fluke Sales Office for information on extended warranty, on-site repair or on-site warranty.

MET/CAL Procedure Writing Workshop

A five-day course giving a comprehensive overview of MET/CAL Calibration Software and its applications in calibration systems. Held regularly at Fluke Service Centers.

Ordering Information

Calibrators

7451A-5100B Calibrator

Options

Y5000 Interface Buffer
7451A-03 Wide Band Voltage Option

Controllers

74XXX-1722A Touch Screen Instrument Controller
74XXX-ES12 Controller
74XXX-PS/2 Controller

Options

74XXX-997 Operator's Aid

Auxiliary Instruments

74XXX-900 Bar Code Reader
74XXX-8842A Digital Multimeter
74XXX-8506A Digital Multimeter
7451A-5220A Transconductance Amplifier
74XXX-5215A Voltage Amplifier

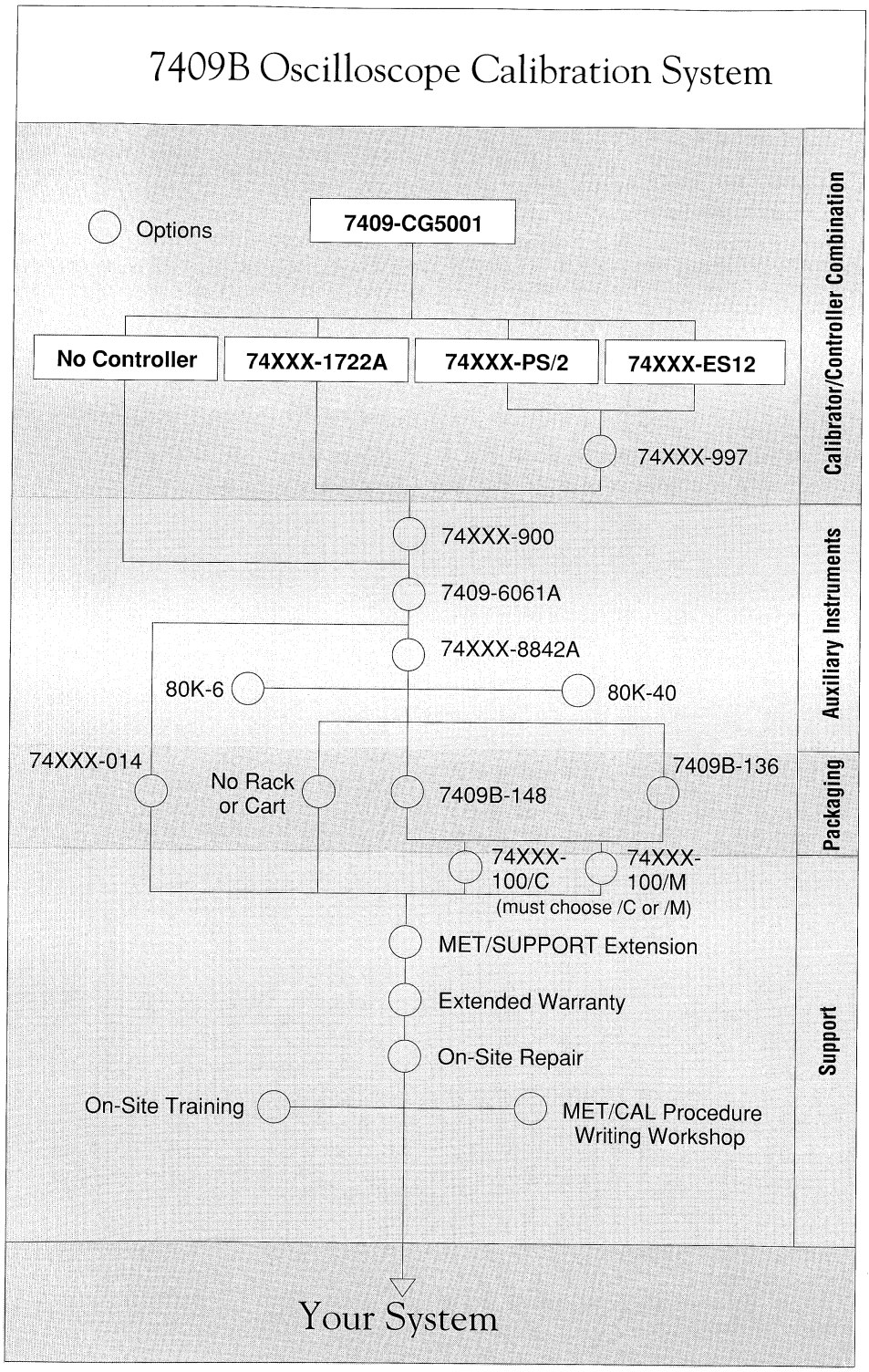
Packaging

74XXX-014 Lab Cart
7451A-136 36" Instrument Enclosure
7451A-148 48" Instrument Enclosure

Options

74XXX-100/C Caster Base
74XXX-100/M Mobile Base
MET/SUPPORT 12 Months Subscription

7409B



Introduction

The 7409B system can be configured with its own controller to operate as a stand-alone analog oscilloscope calibration system. Or it can be ordered without a controller and operated as a supplement to a 7457A or 7451A meter calibration system.

Choose Your Calibrator

7409B-CG5001
Oscilloscope Calibrator

Verifies vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy and up to six functions for meter calibration.

Choose Your Controller

No Controller. The 7409B system is controlled by the controller in a 7457A or 7451A meter calibration system.

74XXX-1722A
Touch Screen Instrument Controller

Includes 7411C Software configured for your system. Easy reconfiguration means you can add new instruments at any time. Also included: 1.0M byte memory expansion, 40M byte internal hard disk, two GPIB/IEEE-488*/RS-232 interfaces, Operator's Aid, 400K byte 5¼" floppy disk drive, AC divider, IEEE-488 cable for unit under test (UUT) control, and 6 months of MET/SUPPORT.

74XXX-ES12 Controller***

This selection features the Hewlett-Packard Vectra Model ES12 configured as an instrument controller. Includes MET/CAL Software configured for your system, and 6 months of MET/SUPPORT. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 12 MHz 80286 processor, 40M byte hard disk drive, 640K byte RAM, floppy and hard disk controller, three serial ports, one parallel port, one 1.44M byte, 3½" floppy disk drive, two IEEE-488 control ports, DOS 3.3, HP VGA color monitor, AC Divider, and IEEE-488 cable for UUT control.

Option 74XXX-997 Operator's Aid

Specialized keypad to simplify operation. Supplements the computer keyboard. Operates through an RS-232 port.

74XXX-PS/2 Controller*

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

***All Controller options include a free 6 month subscription to Fluke MET/Support.*

****Hewlett-Packard model number and configuration may change without notice.*

This selection features the IBM PS/2 Model 50 configured as an instrument controller. Includes MET/CAL Software configured for your system, and 6 months of MET/SUPPORT. Easy reconfiguration means you can add new instruments at any time. The hardware configuration includes: 10 MHz 80286 processor, 30M byte hard disk drive, 1M byte RAM, floppy and hard disk controller, three RS-232 ports, one parallel port, one 1.44M byte, 3½" floppy disk drive, two IEEE-488 control ports, DOS 3.3, IBM VGA color monitor, AC Divider, and IEEE-488 cable for UUT control.

Option 74XXX-997 Operator's Aid

Specialized keyboard for calibration procedures. Simplifies operation. Supplements the existing computer keyboard. Operates through an RS-232 port.

Choose Your Auxiliary Instruments

74XXX-900 Bar-Code Reader

This selection adds the capability to read bar-coded property numbers directly. Streamlines identification of the unit to be tested and selection of the proper procedure. Includes an Intermec 9510 bar code reader, 1260 Series wand with 10' coiled cord, power supply, manual and RS-232 cable.

7409B-6061A Synthesized RF Signal Generator

Provides an accurate amplitude signal from 10 kHz to 1.05 GHz for verifying oscilloscope bandwidth. Includes IEEE-488 cable.

74XXX-8842A Digital Multimeter

Adds 5½ digit DMM measurement capability to the system. Includes a Fluke 8842A/059 with ac and IEEE-488 options, IEEE-488 cable and Y8077 low thermal four-wire short. For complete specifications, ask for Fluke document G0142.

80K-6 High Voltage Probe. Extends the 8842A's voltage measurement capacity to 6000V.

80K-40 High Voltage Probe. Extends the 8842A's voltage measurement capacity to 40000V.

**IBM model number and configuration may change without notice.*

Choose Your Packaging

74XXX-014 Lab Cart

A simple, inexpensive way to move your calibration system from place to place. This sturdy, open frame cart has 4" wheels and space for a calibrator, signal generator controller, monitor and bar-code reader. Cannot accomodate the 74XXX-8842A DMM option due to a lack of room on the cart. Some assembly required.

7409B-136 36" Instrument Rack and Enclosure

Provides for complete mechanical integration of the 7409B system into one enclosure. Designed primarily for stationary use. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rackmount kits for all 7409B options.

7409B-148 48" Instrument Rack and Enclosure

Provides for complete mechanical integration of the 7409B system into one enclosure. Designed primarily for stationary use. Also included: power/controller interface panel, line power distribution contactor, fan, 3½" storage drawer and rackmount kits for all 7409B options.

Enclosure Base Options

You must choose either a 74XXX-100/C or 74XXX-100/M for a 36" or 48" Instrument Rack.

Option 74XXX-100/C

Provides casters for intermittent movement of enclosure level surfaces.

Option 74XXX-100/M

Larger semi-pneumatic wheels permit movement of the rackmounted system over bumps and rough surfaces.

Ordering Information

Calibrators

7409B-CG5001
Oscilloscope Calibrator

Controllers

74XXX-1722A Touch Screen Instrument Controller
74XXX-ES12 Controller
74XXX-PS/2 Controller

Option

74XXX-997 Operator's Aid

Auxiliary Instruments

74XXX-900 Bar Code Reader
7409B-6061A Synthesized RF Signal Generator
74XXX-8842A Digital Multimeter

Packaging

74XXX-014 Lab Cart
7409B-136 36" Instrument Enclosure
7409B-148 48" Instrument Enclosure

Options

74XXX-100/C Caster Base
74XXX-100/M Mobile Base
MET/SUPPORT 12 Months Subscription

A123

GPIB
IEEE-488

Fluke Custom-Designed Automated Calibration Systems

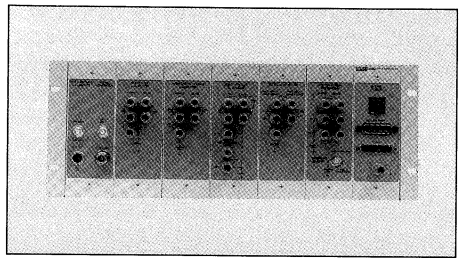
Flexibility is the key word for Fluke's custom automated calibration workstations. Now you can select the instrument combinations necessary to automate your calibration needs. Fluke offers a wide selection of both meter and oscilloscope calibration instruments which can be configured to satisfy your requirements and your budget. These workstations combine the accuracy of computer-aided calibration, the convenience of a test interface panel and the flexibility of customized configurations to meet a wide range of applications. These workstations can be mounted in mobile racks to allow the calibrator to be easily transported to the work site.

Fluke will configure arrangements of various instruments. Contact your local Fluke Sales Representative for help in configuring a workstation.

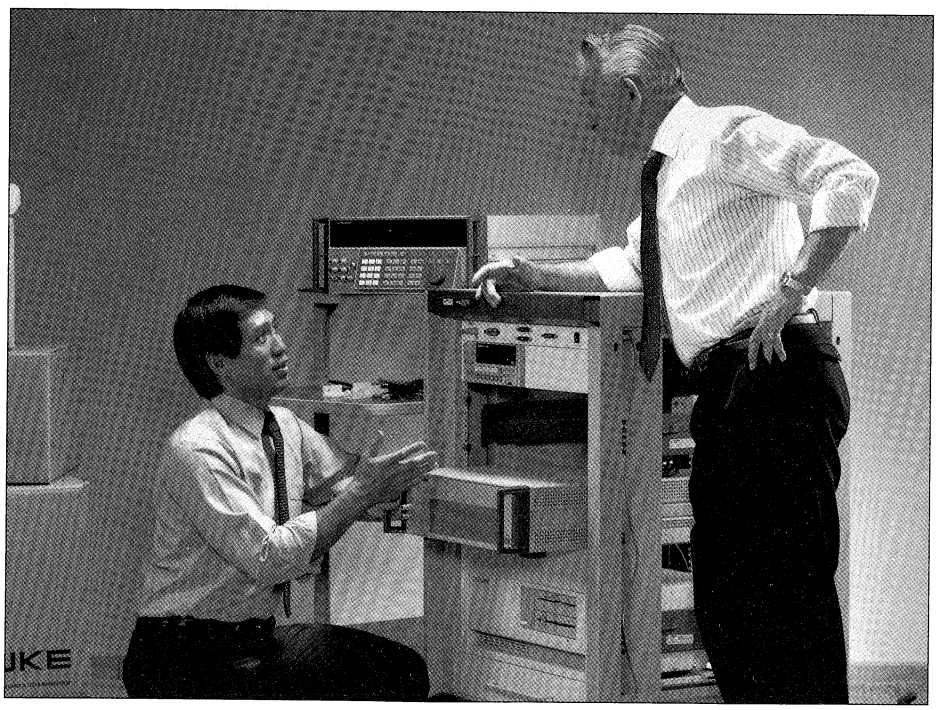
The Fluke A123 - Automated Meter Calibration Workstation

The Fluke A123 is a computer-aided automated calibration workstation which can be configured in a variety of ways to calibrate even the most accurate DMMs and oscilloscopes. All systems provide complete sourcing capabilities of direct volts, alternating volts, direct current, alternating current and resistance as well as measuring capability for direct volts, alternating volts, and resistance. Optional equipment can also boost the alternating voltage output and current output.

The unit under test (UUT) is connected to the A123 through the Modular Test Interface Panel (MTIP). This provides all the connectors for the system instruments as well as the controller's data ports. The UUT can be connected to the 1722A's port for closed-loop calibration via the IEEE-488 bus. In this case, the operator simply starts the calibration test and the system digitally calibrates itself and the UUT.



Modular Test Interface Panel



Ordering Information

Model number and price supplied in response to a request for quotation. All A123 systems include a free 6 months subscription to MET/SUPPORT.

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Tektronix is a trademark of Tektronix, Inc.

Specifications subject to change without notice. Some products and services may not be available outside the U.S. Contact your local Fluke or Philips representative for details.

Standards for Your Traceability Requirements

The best of instruments are only useful when you can depend on them to make accurate measurements. Fluke supports the accuracy of the instruments it sells through a line of calibration instruments and standards. Because these instruments have excellent short- and long-term stability, they are the ideal choice for transferring and maintaining electrical traceable units in your facility.

The most recent additions to the line are the 742A Resistance Standard and the 792A AC/DC Transfer Standard, developed to support the calibration requirements of the 5700A Calibrator.

Two of the most recent additions to Fluke's line of standards are the 732A Direct Voltage Reference Standard and the 752A Reference Divider, developed to support the accuracy requirements of the 5440 Series Calibrators and Fluke's own Primary Standards Lab. These two standards make it possible for you to maintain direct voltage standards in your facility with accuracies not previously attainable outside a national laboratory. Also, an innovative calibration scheme, the Direct Voltage Maintenance Program, is operated by Fluke to make it possible for you to maintain this superb accuracy.

As Fluke continues to advance the state of the art in measurement and calibration, there will be a continuing need for better, more accurate, and more effective ways to assure your measurements are accurate. You can have complete confidence in Fluke's commitment to supporting existing and future instruments through effective standards and innovative, efficient methods for applying them to your needs.

aV Standards and Accessories

- 540B Thermal Transfer Standard
- 510A AC Reference Standard
- A40 and A40A Current Shunts
- A55 Thermal Converters

Resistance Standards

- 742A Resistor Standards

Transfer Standards

- 792A AC/DC Transfer Standard

dV Standards and Accessories

- 732A dV Reference Standard
- Transport Case and Battery Charger for 732A
- Direct Voltage Maintenance Program
- 731B dV Reference Standard

Dividers, Lead Compensators, and Null Detectors

- 752A Reference Divider
- 750A Reference Divider
- 720A Kelvin-Varley Divider
- 721A Lead Compensator
- 845AB/AR Voltmeter/Null Detector

"Principles of Metrology" Course

The Fluke Principles of Metrology training course provides five days of intensive training for solving the problems of day to day cal lab operation. The course includes practical tips and exercises to illustrate:

- Loading errors
- Lead impedance
- Using voltage dividers
- Low level measurements
- Thermal EMFs
- Grounding and guarding

The course also includes in-depth discussions of traceability and measurement uncertainty, and general background information on the role of calibration and metrology. The course is designed to make your technicians more productive in calibrating test instrumentation. The student will begin to see and use creative techniques for specific measurement and calibration applications.

Traceability

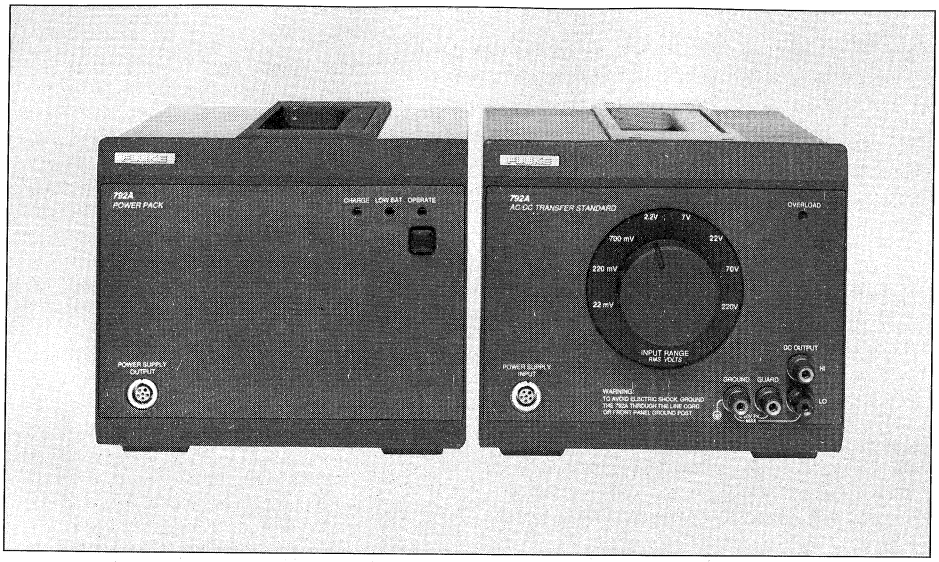
Traceability means that there is a documentable link between the accuracy of an instrument and the highest level of standards as maintained by a national or international laboratory. The highest level of standards are referred to as legal standards. This means that they are recognized among several nations as being the standard of reference. The standards themselves may take the form of physical constants or natural phenomena, standard reference material, or proven ratio techniques.

Traceability requirements must be fulfilled in order for you to have confidence in your measuring instruments. Traceability requirements are often legal as well as practical requirements. You can think of traceability as the pedigree of measurement much like tracing the bloodline of champion animals. From a particular calibration job, each measurement can be traced all the way back to national standards. This trail of calibration is carefully recorded along with the details of the procedure. This typically includes the conditions of the test, the instruments used to make the calibration, and the time between calibrations.

New Product Preview

792A

NEW



792A AC/DC Transfer Standard

- 10 ppm total uncertainty
- Traceable to national standards
- Voltage range 10 mV to 1000V
- Frequency range 10 Hz to 1 MHz

The Fluke 792A AC/DC Transfer Standard is a reference standard designed to provide direct traceability to national standards, and for use as a working standard for calibration of your high performance alternating voltage sourcing and measuring instrumentation. First units are scheduled for shipment in the spring of 1990.

The 792A is based on the patented Fluke solid-state rms sensor. Compared to a traditional thermal voltage converter, the Fluke rms sensor settles faster, exhibits smaller reversal error, and has a large signal-to-noise ratio.

The model 792A consists of three sub-assemblies: (1) the transfer unit, which includes the analog circuitry for all voltage ranges except 1000 volts; (2) the power supply, which contains a battery and charger; (3) a range resistor, which is used to scale voltages above 220 volts.

The following table of specifications are uncertainties, in ppm, for assigned ac/dc differences. These uncertainties are absolute and traceable to national standards.

Preliminary Specifications

Voltage Range	Frequency							
	20 Hz	100 Hz	1 kHz	20 kHz	50 kHz	100 kHz	500 kHz	1 MHz
0.022 - 0.7	TBD*	TBD	TBD	TBD	TBD	TBD	TBD	TBD
2.2	30	10	10	10	40	60	100	200
7	30	10	10	10	40	60	100	200
22	30	15	15	15	40	60	100	200
70	30	15	15	15	40	60	100	X
220	30	30	30	30	45	80	X	X
1000	30	30	30	30	45	80	X	X

** To be determined*

Specifications

General Specifications

Time: 1 year
Operation Temperature Range: 18°C to 28°C
Storage Temperature: 0°C to 40°C
Power: 115V or 230V ac ±10%, 50 Hz to 60 Hz, 40 VA

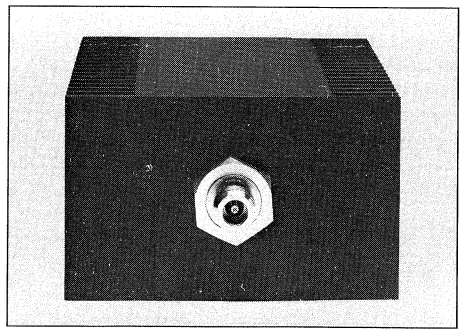
Size
Transfer Unit: 17.8 cm H x 21.6 cm W x 30.5 cm D (7 in H x 8.5 in W x 12 in D)
Power Supply: 17.8 cm H x 21.6 cm W x 30.5 cm D (7 in H x 8.5 in W x 12 in D)
Range Resistor: 7.6 cm H x 12.7 cm W x 17.8 cm D (3 in H x 5 in D x 7 in D)

Weight
Transfer Unit: 8.4 kg (18.5 lb)
Power Supply: 8.9 kg (19.5 lb)
Range Resistor: 1.5 kg (3.3 lb)

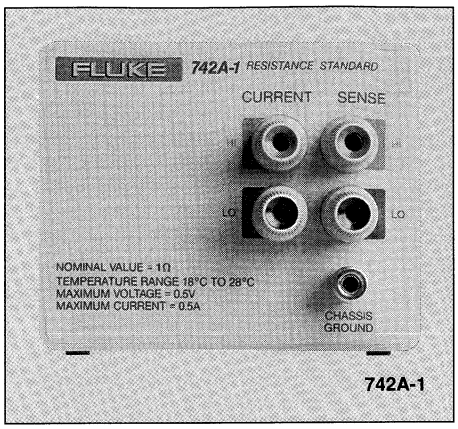
Ordering Information

Model

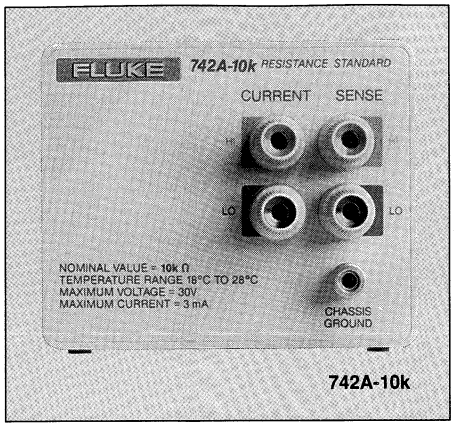
792A AC/DC Transfer Standard



Range Resistor



742A-1



742A-10k

742A Resistance Standards

- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Supplied with temperature characterization
- Six month stability to 2.5 ppm

Fluke 742A Standard Resistors are high accuracy working standards for precision, on-site resistance calibration. Their excellent temperature stability allows them to be used from 18°C to 28°C with typically less than 2 ppm degradation. Using the calibration table supplied with the standards, which lists corrections in 0.5°C increments, this uncertainty can be reduced to near zero. No cumbersome oil or air baths are required.

Because 742A Standard Resistors are small and rugged, they are easy to transport. Care has been taken to reduce resistance changes brought about by thermal and mechanical shock. Retrace (permanent shift in resistance) is typically less than 2 ppm after cycling between 0°C and 40°C.

The 742A-1 1Ω and the 742A-10k 10 kΩ units are ideally suited for Artifact Calibration of the Fluke 5700A Calibrator. The other values can be used to verify the calibration if you desire.

A convenient transit case, designed to hold two standards, is available as an option.

Specifications

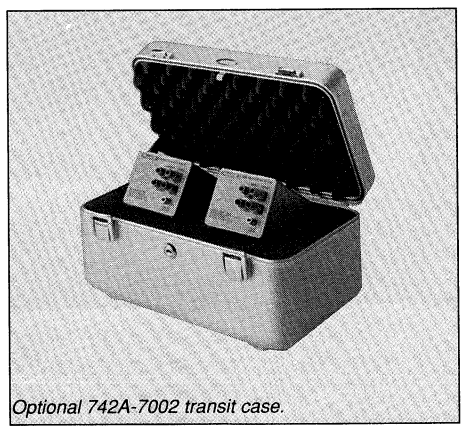
Model	Nominal Value ±2 ppm (Ohms)	Stability 6 Month (PPM)	Stability 12 Month (PPM)	Calibration Uncertainty 23°C (PPM)	Max. Change 18-28°C (± PPM)	Max. Voltage (Volts)
742A-1	1.0	5.0	8.0	1.0	3.0	0.5
742A-1.9	1.9	5.0	8.0	1.0	3.0	0.38
742A-10	10.0	5.0	8.0	1.0	3.0	1.0
742A-100	100.0	4.0	6.0	1.0	3.0	2.0
742A-1k	1.0k	4.0	6.0	1.5	2.0	10.0
742A-10k	10.0k	2.5	4.0	1.0	1.5	30.0
742A-19k	19.0k	2.5	4.0	1.5	2.0	28.5
742A-100k	100.0k	4.0	6.0	2.5	2.0	100.0
742A-1M	1.0M	6.0	8.0	5.0	2.0	100.0
742A-10M	10.0M	6.0	9.0	10.0	3.0	200.0
742A-19M	19.0M	8.0	10.0	20.0	4.0	190.0

Operating Temperature Range: 18-28°C
Storage Temperature: 0-40°C
Retrace Error (hysteresis):
23°C-18°C-23°C cycle: Negligible resistance shift
23°C-28°C-23°C cycle: Negligible resistance shift
23°C-0°C-23°C cycle: <2 ppm resistance shift
23°C-40°C-23°C cycle: <2 ppm resistance shift
Size: 8.6 cm H x 10.5 cm W x 12.7 cm D (3.4 in H x 4.15 in W x 5 in D)
Weight: 1.5 lb to 2 lb depending on the model

Ordering Information

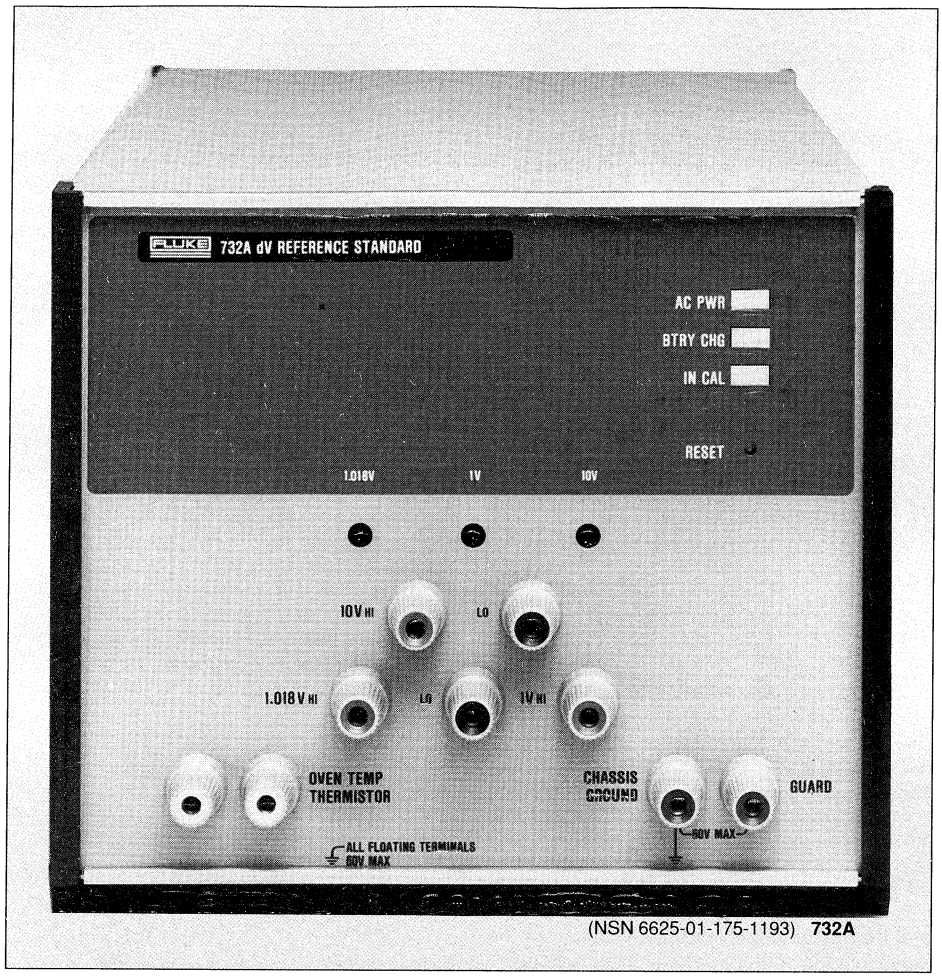
Model

742A-1 1Ω Resistance Standard
742A-1.9 1.9Ω Resistance Standard
742A-10 10Ω Resistance Standard
742A-100 100Ω Resistance Standard
742A-1k 1 kΩ Resistance Standard
742A-10k 10 kΩ Resistance Standard
742A-19k 19 kΩ Resistance Standard
742A-100k 100 kΩ Resistance Standard
742A-1M 1 MΩ Resistance Standard
742A-10M 10 MΩ Resistance Standard
742A-19M 19 MΩ Resistance Standard
742A-7002 Transit Case (holds 2 units)


Optional 742A-7002 transit case.

8

732A



(NSN 6625-01-175-1193) **732A**

732A dV Reference Standard

- 10V, 1V and 1.018V outputs
- 0.5 ppm stability per month
- 18°C to 28°C operation at full accuracy specs
- Short circuit proof
- Traceable calibration to NIST, through the Fluke Direct Voltage Maintenance Program
- Line and rechargeable battery powered
- 24-hour battery life for calibration transfer

The Fluke 732A is a solid state, dV reference standard which provides significant performance improvements in stability, ruggedness, and transportability. Its 10V output offers better resolution, lower noise, and simpler operation than standard cells. The 732A also includes outputs of 1.0 and 1.018 volts.

The accuracy and stability of the 732A allows direct substitution for saturated standard cells in many applications. Its stability of 0.5 ppm for 30 days provides the confidence necessary to calibrate high-performance instruments. In addition, the use of the 10V output as a primary reference standard means that the effects of thermal emfs and noise are reduced.

The 732A can be shorted, even for extended periods of time, without damage and recovers without loss of stability. The unit may be powered by line voltage or will operate 24 hours on its internal battery — even longer on external batteries. Either line power or the external battery may be removed without affecting the output.

Saturated standard cells are fragile and susceptible to shock and vibration during traveling. The 732A was designed for air or ground shipment with no special handling.

The internal oven has high thermal gain allowing full accuracy to be specified over an operating range of 23°C ±5°C. Therefore, this reference standard may be used outside of the conventional standards laboratory environment in areas where saturated cells or other transfer standards would not be accurate.

The 732A dV Reference Standard was originally developed by Fluke to transfer the volt into our own manufacturing facility. The unprecedented success achieved by this effort led to the development of the 732A for the commercial market. Fluke has developed a worldwide network of regional support centers to provide calibration support for the 732A where local standards are not available. These centers maintain volt-transfer programs with the national standards laboratories.

Transport Case and Battery Charger

The 732A-7002 Transport Case is a rugged, fiberglass, foam-lined case capable of holding a 732A dV Reference Standard and a 732A-7003 Battery Charger, complete with up to four 732A-7005 Battery Packs. The extra battery capacity of four battery packs plus the heat-conserving insulation of the foam lined case will extend the off-line operating time of the 732A to about 100 hours.

The 732A-7003 Battery Charger is specially designed to hold and charge from one to four battery packs with the proper constant current, constant voltage cycle to avoid damage from over-charging. Fully discharged batteries are returned to approximately 95% charge in 24 hours. The charger provides the necessary isolation diodes and interconnections to provide the optimum charge to battery packs which may have unequal capacities or states of charge and to connect the batteries to the 732A dc power input connector.

Specifications

Technical Specifications

Absolute Uncertainty: The 732A is normally delivered without absolute uncertainty specifications because, to maintain calibration as a traceable standard, the 732A must continue to receive uninterrupted operating voltage from line power or from the self-contained batteries, which provide approximately 24 hours of off-line operation. The 732A is normally shipped from the factory with the battery switch turned off. Upon receipt, the 732A must be powered up and stabilized for 24 hours before calibration against traceable standards. The absolute uncertainty specifications for the 732A must then relate to the uncertainty specifications of the traceable standards used for this calibration.

For a certified calibration by the Fluke Standards Laboratory and shipment under power, refer to the 732A-000 and 732A-100 options described under the Direct Voltage Maintenance Program, next page.
These specifications include effects of line voltage variations of ±10% and assume the 732A has been continuously powered.

Stability: Parts per million, 18°C to 28°C

Output	30 Days	90 Days	6 Months	1 Year
10V	±0.5	±1.0	±1.5	±3.0
1.018V	±1.5	±4.0	±6.0	±12.0
1V	±1.5	±4.0	±6.0	±12.0

Temperature Coefficient: ±0.05 ppm per °C for 10V range, ±1.0 ppm per °C for 1V and 1.018V ranges, from 18°C to 0°C to or 28°C to 40°C
Output Adjustment: ±50 μV for 10V and 1.018V ranges, ±5 μV for 1.0V range
Output Impedance: 1 mΩ for 10V output, 1 kΩ for 1V and 1.018V outputs
Output Current: ≤12 mA at 10V output. Limited by 1 kΩ output impedance at 1V and 1.018V output
Output Protection: May be shorted indefinitely. Protected against high voltage input transients to 1100V
Load Regulation: ≤1.2 ppm at 10V output from 0 to 12 mA
Line Regulation: ≤0.05 ppm of output for ±10% line change
Output Noise: ≤1 μV rms at 10V output from 0.1 Hz to 10 Hz

Note: See the Direct Voltage Maintenance Program description on next page for the improved specifications and traceability which can be obtained for the 732A.

General Specifications

Temperature: 0°C to 40°C, operating; 0°C to 50°C, non-operating (with internal battery pack switched off)
Relative Humidity: ≤95% to 30°C, ≤75% to 40°C, non-condensing
Altitude: ≤3050m (10,000 ft) operating
Vibration: Per MIL-T-28800, Type III, Class 5, Style E
Safety: IEC 348, 2nd edition, 1978 and ANSI C39.5, 1980
Power: 100V, 120V, 220V, or 240V ac ±10%, 50 to 400 Hz or 24 to 30V ac 50 to 60 Hz. Also external 24 to 40V dc. Internal 24V lead acid, gelled electrolyte battery operates for 24 hours at 23°C when fully charged. Trickle-charged continually when external power is applied
Size: 19.1 cm H x 22.1 cm W x 60.3 cm D (7.53 in H x 8.69 in W x 23.75 in D)
Weight: 12.3 kg (27 lb)

Included with Instrument: Instruction manual, line cord, adjustment tool and one 732A-7003 Battery Pack

732A-7002 Transport Case
Size: 77 cm x 61 cm x 31 cm (30 in x 24 in x 12 in)
Weight: 12 kg (26 lb)

732A-7003 Battery Charger
Input Power: 100V, 110V, 115V, 120V, 200V, 220V, 230V, or 240V ac 10%, 50 to 400 Hz, 100W max
Size: 61 cm x 19 cm x 22 cm (24 in x 8 in x 9 in)
Weight: 5.9 kg (13 lb) alone; 23 kg (50 lb) when equipped with four battery packs (732A-7005)

Ordering Information

Models

732A DC Reference Standard
732A-000 w/Special Calibration, shipped hot*
732A-100 w/Special Calibration and Drift Certification, shipped hot*
** Under power*

Accessories (Also see Section 20)

732A-7002 Transit Case
732A-7003 Battery Charger and Auxiliary Battery Case
732A-7004 8 3/4" Rack Shelf (Holds 2 732As or 732A and 752A)
732A-7005 Battery Pack
5440A-7002 Low Thermal Copper EMF Plug-in Cables
845AB Voltmeter/Null Detector w/battery
845AR Voltmeter/Null Detector w/rack mount

8

Direct Voltage Maintenance Program

Direct Voltage Maintenance Program

- Volt traceability for your calibration laboratory with significant cost reductions over direct NIST calibration
- Uncertainty within a few tenths of a ppm
- Complies with MIL-STD-45662
- Avoid investing in redundant hardware: equipment never needs to leave laboratory
- No possibility of accidental loading and destruction as with saturated standard cells

Built around the 732A Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the U.S. National Institute of Standards and Technology (NIST). The 732A is a solid-state direct voltage reference standard which enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a range of operating temperatures. This level of performance is made possible by the low, predictable drift rate, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, dissemination of the legal volt can be easily accomplished with an uncertainty of less than one ppm at the 10 volt level.

Traceability

Traceability to the legal volt is the principle objective of the DVMP. The Fluke Primary Standards Laboratory in Everett, Washington (U.S.A.) maintains traceability to NIST and other national standards laboratories at the 10 volt level. Fluke establishes a "Traceability Plane" for you consisting of the mean (average) of the reference voltages maintained by your participating laboratories.

Four Services, Six Options to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, resulting in six possible options, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel, in the Fluke Standards Lab. These calibrations may be ordered as an option on a new 732A or as an option to be added to a 732A purchased previously. The other two calibration services are performed by the user, using a Fluke-owned standard, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732A-000.** Order this option to have an output voltage calibration performed on a newly ordered 732A. Before shipment, your new 732A will be compared to the direct voltage standards maintained in the Fluke Primary Standards Laboratory which are regularly compared to the Legal Voltage Standards maintained by the U.S. National Institute of Standards and Technology. A report of calibration, listing the deviation from the nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration.
2. **Option 732A-000R.** This is the option to order for calibration or recalibration of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration as detailed under 732A-000 above, and will be returned to you under power.
3. **Option 732A-100.** Order this option to have a new instrument calibrated for output voltage and characterized for drift rate before shipment from the factory. Your new 732A will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days in the Fluke Primary Standards Laboratory. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage, drift rate, and uncertainties is delivered with the instrument which is delivered under power.
4. **Option 732A-100R.** This is the option to order for output voltage calibration and drift rate testing of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration and 60 day drift rate characterization as detailed under 732A-100 above, and will be returned to you under power.
5. **Option 732A-200.** This is the option to order for calibration of your 732A in your own laboratory. A Fluke-owned, calibrated 732A, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, relative to the legal volt, and a report of calibration is returned to you. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned 732A.
6. **Option 732A-201.** If you have more than one 732A in your lab, this is the option to order for calibration of each additional reference at the same site (must be ordered with Option 732A-200). Data collected by the user will be reduced and evaluated by the Fluke Standards Lab, and a report of calibration issued for the reference standard.

Specifications

Option Number	Calibration Uncertainty (CU)*	Drift Rate Uncertainty (DU)**			Total Uncertainty
		30 Days	90 Days	1 Year	
732A-000	0.6 ppm	0.5 ppm	1.0 ppm	3.0 ppm	$\sqrt{[(CU)^{2+}+(DU)^2]}$
732A-100	0.5 ppm	0.35 ppm	0.5 ppm	1.0 ppm	
732A-200	0.3 ppm	**	**	**	

** Typical 99% confidence level; actual uncertainties determined at the time of test*

*** Drift rate uncertainty will be established with repeated participation in the DVMP*

How To Order

At the present time, due to the difficulty in making timed shipment to international customers, calibration services requiring shipment under power are only available in the United States.

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732A under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- If options 732A-000R or 732A-100R are ordered, include the serial number of the instrument to be returned to Fluke for the service.
- **The exact address where the shipment will be received.**
- **The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.**
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.
- Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

Ordering Information

Models

732A-000 New 732A w/Special Cal, shipped under power
732A-000R Special Calibration, shipped under power
732A-100 New 732A w/Cal, and Drift Certification, shipped under power
732A-100R Calibration, Drift Certification, shipped under power
732A-200 On-Site 10V Certification w/Fluke Standard (includes shipping charges)
732A-201 Certification of Additional Reference/ Same Site

More Than Just a Standard, Fluke Provides You with the Volt – the Total Solution to a Standards Problem

Given proper equipment and knowledge, it is surprisingly simple to maintain a fractional-ppm voltage standard. Fluke has maintained its Corporate Volt in the mean of four 732A Solid State References for the past six years. Figure 1 depicts the intercomparison system used in its Primary Standards Lab. Required knowledge, both theoretical/statistical and practical/experimental, has been translated into software for reducing and interpreting data from intercomparison of reference standards and other standards.

Numerical averaging of the references, with frequent transfers to National Institute of Standards & Technology (NIST), have proved to be a powerful way to maintain a standards quality voltage reference. Averaging reduces the already low noise (0.03 ppm, 1 sigma) by a factor of two, and reduces the average drift rate. Repeated transfers to NIST have reduced the uncertainty in the Drift rate to ±0.016 ppm/year and the uncertainty in the average value to ±0.04 ppm relative to 10 volts as maintained by NIST. When combined with the 0.29 ppm uncertainty in absolute value reported by NIST, the total uncertainty in the Fluke Volt is a respectable ±0.3 ppm.

From the beginning, Fluke has "shared the wealth" with its customers. Not content just to sit on one of the best voltage standards in the country, we have shared the benefits with customers through the Direct Voltage Maintenance Program (DVMP). Figure 2 shows an actual transfer between Fluke and NIST, in which the transfer standard passed through five customer facilities (not shown) on its way to NIST. This state of the art calibration service provides customers direct traceability to NIST, and is made possible by using Fluke's voltage reference to determine the drift and noise of the transfer standard. Typical transfer uncertainty in this program is about ±0.04 ppm, which allows calibration of customers standards with uncertainties of ±0.3 ppm.

The drift rate and value of a standard can be very well characterized with repeated calibration, linear curve fitting of the calibration results, and statistical analysis. Figure 3 shows the results for the Fluke Corporate Volt. Transfer uncertainty in this case is about ±0.04 ppm at 99% confidence – similar results are possible for customers' standards.

It is easy to evaluate how well a system actually performs in measuring other 10 volt references. Fluke does this for its system by assigning values to the transfer standards sent to NIST, then compares the NIST value. Differences should fall within computed uncertainty limits with 99% confidence. Figure 4 shows the excellent results obtained with Fluke's system. We can provide this service to customers who participate in the DVMP.

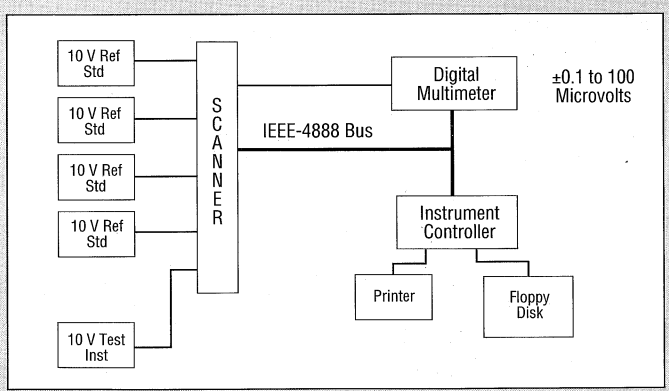


Fig. 1. Block diagram of the solid state reference intercomparison system.

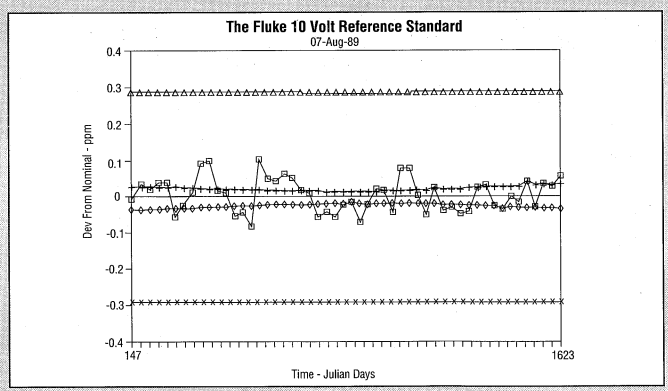


Fig. 3. The Fluke solid-state voltage reference – 18 Transfers to NIST.

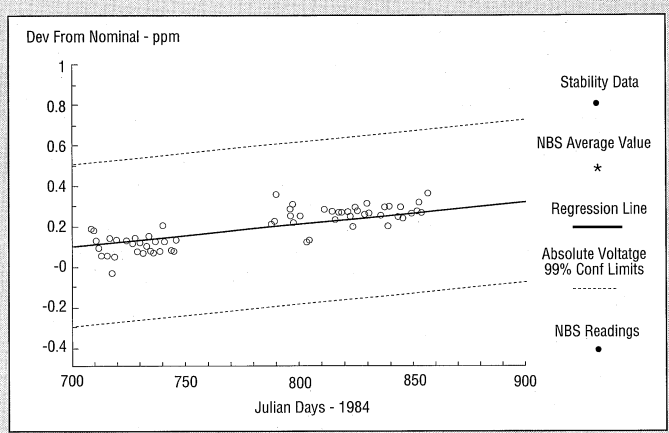


Fig. 2. Calibration of a transfer standard by NIST.

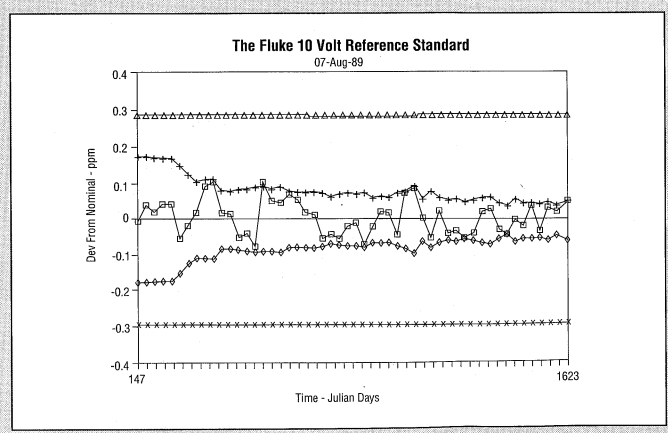


Fig. 4. Verifying the uncertainty analysis – 22 calibrations by NIST.

8

752A



(NSN 6625-01-175-1192) **752A**

752A Reference Divider

- 10:1 and 100:1 division ratios
- Ratio accuracy of 0.2 ppm on 10:1 ratio
- Ratio accuracy of 0.5 ppm on 100:1 ratio
- Built in calibration bridge

The Fluke 752A Reference Divider sets new standards for direct voltage ratio accuracy and ease of use. It offers two divider outputs, 10:1 and 100:1 with output uncertainties of less than 0.2 ppm and 0.5 ppm respectively.

Before each use, the 752A is easily calibrated with only a stable voltage source and null detector like the Fluke 845AB or 845AR. The entire procedure requires only five minutes and does not require external standards.

The 752A also includes internal switching for calibrating the 100 mV, 1V, 10V, 100V, and 1000V ranges of a voltage calibrator to a 10V reference source (such as the Fluke 732A dV Reference Standard) without having to change the lead connections. It provides the voltage division capability required to calibrate state- of-the-art calibrators and similar instruments.

A "self-calibration" procedure allows you to compensate for long term changes in value of the divider resistors by switching their positions in various Wheatstone bridge configurations and using the BALANCE pot on the front panel.

Specifications

These specifications apply for the lifetime of the instrument over the temperature range of 18°C to 28°C.

Ratio Ranges: 10:1 and 100:1

Ratio Accuracy: The following table specifies the ratio accuracies of the 752A that apply for a temperature variation of less than ±1°C from the self-calibration temperature (between 18°C and 28°C) for up to 8 hours following self-calibration.

Range	Input Voltage	Output Uncertainty	Null Accuracy*
10:0	0 to 100V	0.2 ppm	±0.5 µV
100:1	0 to 1000V	0.5 ppm	±1.0 µV

**Null accuracy refers to the required accuracy of the null detector reading during self-calibration*

Temperature Coefficient: ≤±1 ppm per °C over range of 18°C to 28°C (typically 0.1 ppm per °C from 15°C to 30°C)

Input Resistance

10:1 Ratio: 380 kΩ ±1%

100:1 Ratio: Divider is 4 MΩ; Driven Guard is 4 MΩ; total is 2 MΩ ±1%

Maximum Input Voltage: 200V for the 10:1 ratio; 1100V for the 100:1 ratio

Power Coefficient: ≤0.05 ppm of output with 100V applied for 10:1 ratio and ≤0.3 ppm of output with 1000V applied for 100:1 ratio (included in the ratio accuracy specifications)

Temperature: 0°C to 50°C, operating; -40°C to 75°C non-operating

Relative Humidity: ≤75% to 40°C, ≤45% to 50°C, non-condensing, operating; <100% 10-50°C, non operating

Altitude: ≤3050m (10,000 ft) operating; ≤12,200m (40,000 ft) non-operating

Vibration: Per MIL-T-28800C, Type III, Class 5, Style E

Safety: IEC 348, 2nd edition, 1978; ANSI-C39.5, 1980

Size: 19.1 cm H x 22.1 cm W x 60.3 cm L (7.53 in H x 8.69 in W x 23.75 in L)

Weight: 8.4 kg (18.5 lb)

Included with Instrument: Instruction manual

Ordering Information

Models

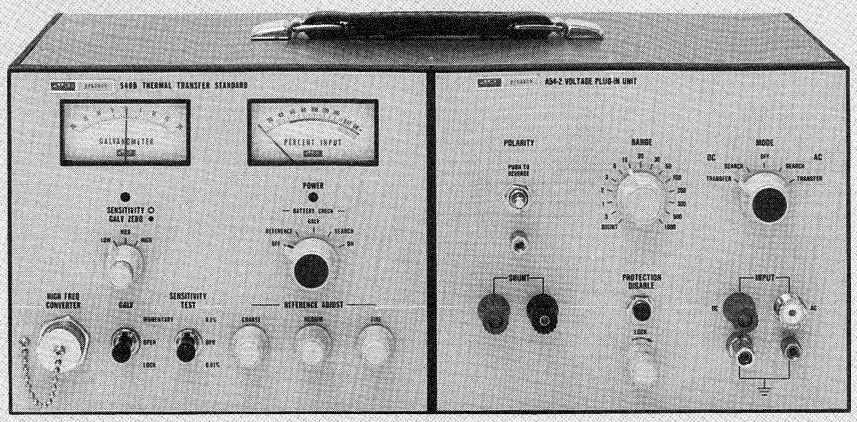
752A Reference Divider

Accessories (Also see Section 20)

5440A-7002 Low Thermal Copper EMF Plug-in Cables

845AB Voltmeter/Null Detector w/battery pack

845AR Voltmeter/Null Detector w/rack mount



(NSN 6625-00-288-0184) **540B**

540B Thermal Transfer Standard

- 100 ppm aV/dV transfer uncertainty
- Less than 100 ppm dc reversal error
- Frequency range 5 Hz-1 MHz (to 50 MHz with A55)
- Overvoltage protection
- Polarity reversal switch

The Fluke 540B is a thermal transfer instrument for precise measurement and calibration of alternating voltage and current. The 540B is designed for simple operation with positive protection from overloads. Voltage transfers may be made from 0.25V to 1000V rms in 14 ranges, with a frequency range from 5 Hz to 1 MHz. Each range maintains specified accuracy down to half of range. Resolution of input per scale division varies from 12 ppm at full range to 60 ppm at half of range. Basic aV to dV transfer uncertainty is 100 ppm (±0.01%) without the use of calibration curves or correction tables.

The thermal element in the 540B is a specially constructed vacuum thermocouple protected from overvoltage. Up to 1500V dc or rms ac may be applied on any range without damage. A pushbutton protection disable switch allows confirmation that diode aging in protection circuitry is not contributing to error.

Three galvanometer sensitivity settings are provided. A sensitivity test function provides momentary galvanometer deflection for 0.1% and 0.01% of input voltage, at any galvanometer sensitivity setting.

The 540B includes a meter-display search function, for continuous visual indication of input percent of range. The search function indicates when the overload circuit has activated, by deflecting upscale into a red "overload" area. After an overload condition, the 540B is returned to normal operation simply by setting the mode switch to "off."

The basis of transfer comparison in the 540B is always 1:1; ac and dc voltages are placed across the same transfer circuit. In this way, accuracy is independent of range division ratios.

DC reversal error in the thermocouple is less than 100 ppm (0.01% of input voltage). A convenient "push-to-reverse" switch is provided to reverse dc input polarity.

A high frequency thermal converter input jack is provided so that the galvanometer and Lindeck reference supply may be used with Fluke Model A55 High Frequency Thermal Converters.

The 540B operates from rechargeable nickel-cadmium battery cells for complete isolation from line power. Fully charged, the 540B may be operated for up to 200 hours without an interuption for charging.

Calibration

Each range is adjusted to be within the specified deviations from zero error as defined by reference standards maintained by the Fluke Standards Laboratory and periodically calibrated by the U.S. National Institute of Standards and Technology. These ac/dc difference figures do not include U.S. National Institute of Standards and Technology's random and systematic errors. Fluke test reports to the nearest 100 ppm are available at extra cost upon request.

Characterization

Model 540B-900 is a 72-point characterization of a 540B Thermal Transfer Standard. Model 540B-901 is the same characterization service for a customer-owned 540B, available through Fluke Technical Service Centers. All characterizations are actually performed by the Fluke Standards Laboratory in Everett, Washington. This 72-point characterization is intended to support customers who wish to characterize 5200A-800 Enhancement Software.

Special characterizations to meet specific calibration requirements are also available. Consult your local Service Center for further information.

Specifications

Voltage Ranges: 0.5, 1, 2, 3, 5, 10,20,30,50,100, 200, 300, 400, and 1000V, with each range usable from 1/2 to 1 times rating

aV to dV Transfer Uncertainty

Frequency	Voltage Ranges			
Hz	0.5-10V	10-50V	100-500V	1000V
5k-20k	±0.01%	±0.01%	±0.01%	±0.02%
20k-50k	±0.01%	±0.01%	±0.01%	±0.04%
50k-100k	±0.5%	±0.05%	±0.20%	X
100k-500k	±0.10%	±0.10%	X	X
500k-1M	±0.10%	X	X	X

Search Function: Meter display of input as percentage of range
Input Impedance: 180Ω/V
Polarity: Reversible, front panel push-button
Galvanometer: Fluke electronic type
Galvanometer Resolution: 12 ppm of input/scale division at full range; 60 ppm of input/scale division at half range
Thermocouple Reversal Error: ≤100 ppm of input at full range; ≤300 ppm at half range
Overload Protection: Withstands up to 1500V dc or rms ac, any range
Power: 115V or 230V ac ±10%, 50 to 440 Hz, 7W; self-contained rechargeable batteries; 200 hours operation, 16 hours recharge time
Size: 17.2 cm H x 41.7 cm W x 19 cm D (7 in H x 17 in W x 7.75 in D)

Included with Instrument: Instruction manual, A55 connecting cable

Ordering Information

Model

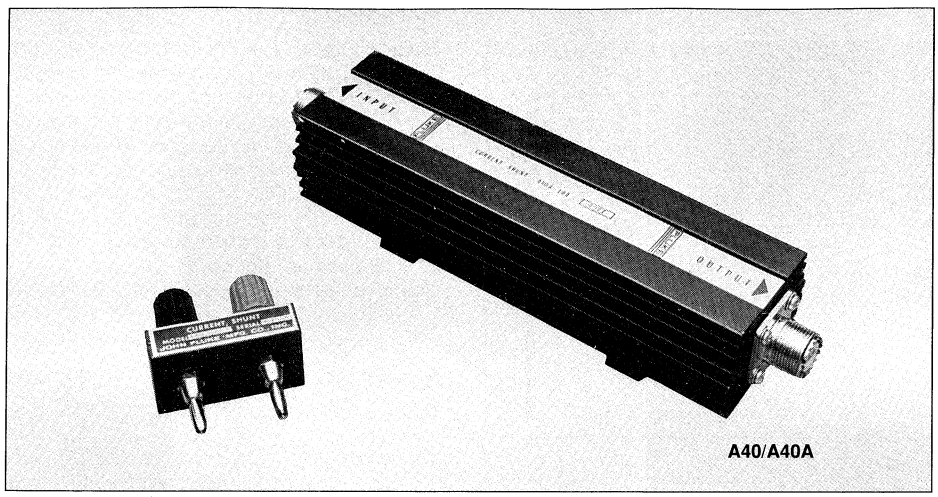
540B Thermal Transfer Standard

Accessories (Also see Section 20)

540B-103 7" Rack Mount Kit
540B-110 Rechargeable Battery Pack
A40 Current Shunts
A40A Current Shunts
A55 High Frequency Thermal Converters

8

A40, A40A



A40/A40A

A40 and A40A Current Shunts

AC current transfer measurements form 2.5 mA to 20A

Frequency response from 5 Hz to 100 kHz

Designed for use with Model 540B

Models A40 and A40A Current Shunts make possible accurate ac to dc current transfer measurements using the Model 540B Thermal Transfer Standard and a known dc source. Measurements may be made over a 2.5 milliampere to 20 ampere range with a frequency response from 5 Hz to 50 kHz. Measurements to 100 kHz may be made up to 5 amperes.

Twelve A40 Current Shunts are available with current ratings from 10 milliamperes to 5 amperes. A40A shunts are available with current ratings of 10 and 20 amperes. Each shunt maintains specified accuracy down to half its rated current level. With no shunt in place, the 540B may be used directly for current transfer measurements from 2.5 milliamperes to 5 milliamperes.

A40 shunts plug into panel connectors on the 540B. A40A shunts require special cables, available separately.

Calibration

All ac to dc differences expressed in the specifications are deviations from dc standards maintained by the U.S. National Institute of Standards and Technology, and may be obtained without the used of calibration curves or correction tables. When properly used with a Fluke 540B Thermal Transfer Standard, each A40 and A40A Current Shunt is within the specified deviation from zero error, as defined by reference standards maintained by the Fluke Standards Laboratory and periodically calibrated by the U.S. National Institute of Standards and Technology. These ac to dc difference figures do not include U.S. National Institute of Standards and Technology random and systematic errors. Fluke test reports to the nearest 100 ppm (0.01%) are available at extra cost upon request.

Specifications

A40 Current Ratings: 10, 20, 30, 50, 100, 200, 300, and 500 mA; 1, 2, 3, and 5A (RMS)
A40A Current Ratings: 10 and 20A (RMS)
Uncertainty

Frequency	AC to DC Difference	
	A40	A40A
5 Hz - 20 kHz	±0.02%	±0.03%
20 kHz - 50 kHz	±0.03%	±0.05%
50 kHz - 100 kHz	±0.05%	

Ordering Information

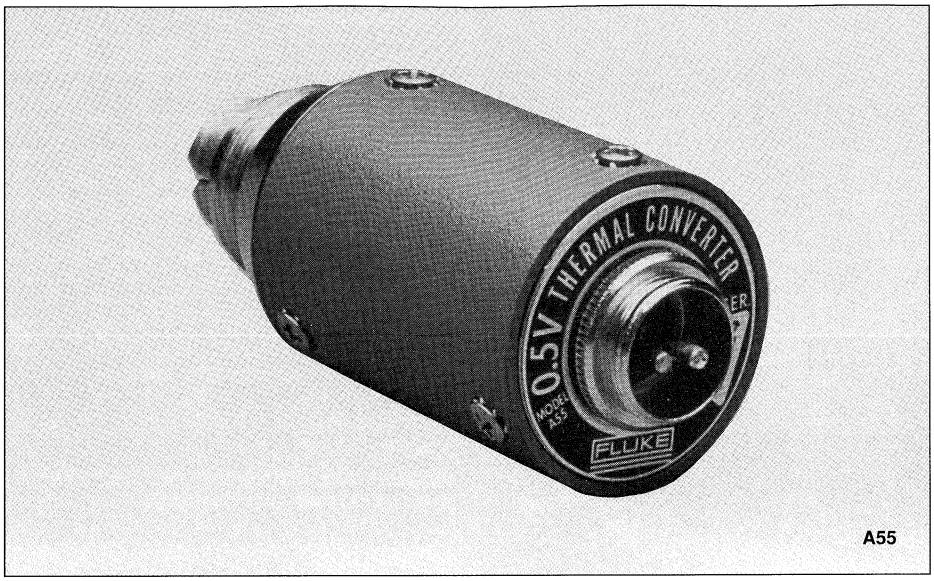
Models

A40 Current Shunts
A40A Current Shunts

Accessories (Also see Section 20)

A45-4003 Input Cable for A40A Shunts
A45-4004 Output Cable for A40A Shunts
Y8133 Universal Test Lead Set
C41 Storage Case for A40 Shunts

Note: National Stock Numbers are available for most A40 and A40A Shunts. Contact your sales engineer for details.



A55

A55 High Frequency Thermal Converters

Useable to 50 MHz

Designed for use with Model 540B

Model A55 Thermal Converters make possible accurate thermal-transfer aV to dV measurements form subaudio frequencies to the VHF region. The design is comparable to that of standards maintained by the U.S. National Institute of Standards and Technology (NIST).

Designed for use with the Model 540B Thermal Transfer Standard, nine model A55 Thermal Transfer Standards are available to match each 540B voltage range from 0.5V to 50V. The 540B includes a compatible connector that bypasses its internal transfer circuit, using only the null detector and reference supply. Each A55 converter maintains specified accuracy down to half its rated voltage.

A specially constructed thermocouple, selected for frequency characteristics and low dV reversal error, is the thermally responsive element. Input voltage is applied directly across the thermocouple heater on the 0.5V model. For higher voltages, low temperature-coefficient coaxially mounted metal film series dropping resistors are used.

Certification

Each A55 converter includes a Fluke production test record of aV to dV differences at 1, 10, 20, and 30 MHz. A55 converters rated below 20V also include a production test record of aV to dV difference at 50 MHz. Fluke test reports at other frequencies and voltages are available at extra cost upon request. AV to dV differences are established to within ±100 ppm by comparison to Fluke standards that are periodically intercompared with the U.S. National Institute of Standards and Technology.

Accessory Kit

The Model A55-110 Accessory Kit is recommended for use with A55 Thermal Converters in virtually any calibration or measurement setup. The kit includes:

- Coaxial tee for A55 input (GR type 874-TL).
- Three coaxial adapters for A55 input: UHF, BNC, and type N jack.
- Interconnecting coaxial cable, as source to coaxial tee.

Specifications

Voltage Ratings: 0.5, 1, 2, 3, 5, 10, 20, 30 & 50V*

** Each converter is useable from ½ to 1 times its rated voltage (rms)*

Uncertainty:

Frequency	Calibration Uncertainty*	Typical aV to dV Difference
<1 MHz		<±0.01%
1 MHz	±0.05%	±0.01%
10 MHz	±0.10%	±0.01%
20 MHz	±0.15%	±0.02%
30 MHz	±0.20%	±0.10%
50 MHz**	±0.50%	±0.30%

** All calibration is referenced to center of GR 874-TL coaxial tee attached to converter input connector*

***50 MHz calibration available only for 0.5, 1, 2, 3, 5, and 10V converters*

Input Impedance: 200Ω/V, approximate
Output Voltage: 7 mV nominal, at rated input
Output Resistance: 8Ω
Reversal Error: <250 ppm (0.025%)
Input Connector: GR type 874-TL
Output Connector: Amphenol 80-PC2M (2-pin microphone)

Size and Weight

Converters	Diameter cm	Length cm	Weight kg
0.5V	3.5	8.4	28
1V, 2V	3.5	13.2	370
3V, 5V	3.5	16.5	430
10V, 20V	3.5	17.9	450
30V, 50V	3.5	17.9	450

Included with Instrument: Instruction manual and certification

Ordering Information

Model

A55* Thermal Converter

** Order by voltage rating, eg: A-55 -05V.*

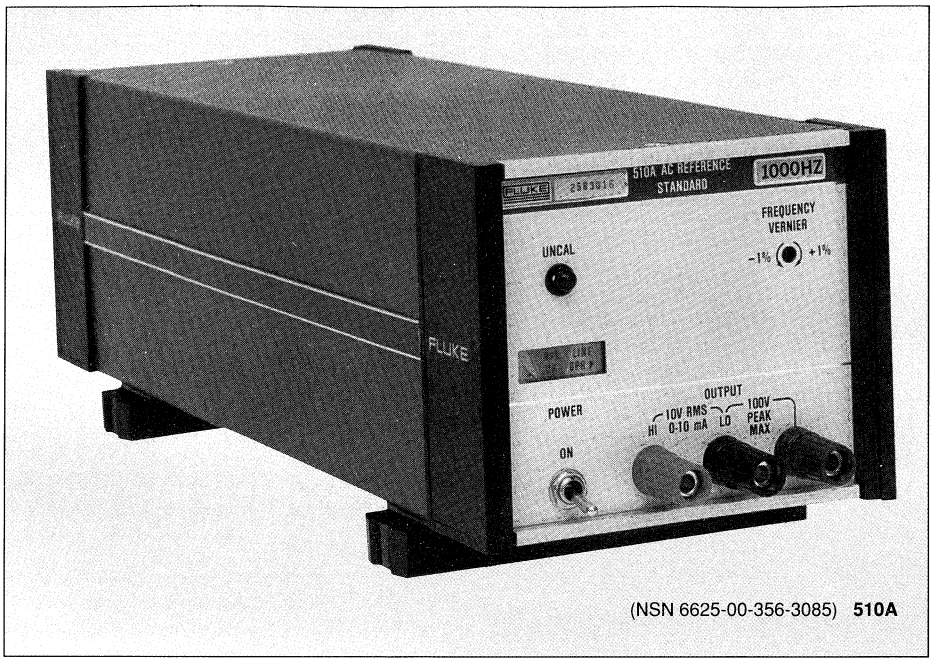
Accessories (Also see Section 20)

A55-110 Accessory Kit
C55 Storage Case

Note: National Stock Numbers are available for most A55 Converters. See your sales engineer for details.

8

510A



(NSN 6625-00-356-3085) **510A**

510A AC Reference Standard

- Uncertainty to ±100 ppm
- Optional battery operation
- Output voltage 10V rms
- Output current levels to 10 mA rms
- Fixed frequency, 50 Hz to 100 kHz

The 510A is a precision, fixed frequency, alternating voltage source designed for use as an amplitude calibration standard for test applications. In the calibration laboratory, the 510A provides an accurate aV reference for calibrating both true rms and average-sensing aV voltmeters. On the production line, the 510A can be used to rapidly verify aV test instrumentation or to generate a precise aV stimulus for circuit testing.

Output of the 510A is both fixed frequency and fixed amplitude. The frequency may be varied ±1% of center frequency with a front panel screwdriver adjustment.

Total harmonic distortion is less than 50 ppm up to 10 kHz, and less than 300 ppm at 10 kHz. This assures a pure sineware for calibrating average, peak, or true rms reading aV-to-dV converters.

The optional rechargeable battery pack provides up to 16 hours of operation independent of line power. A front panel display provides a continuous display of battery condition. When operated from line power, the battery is maintained at full charge. The battery automatically operates the 510A whenever line power is removed.

Up to four 510As may be connected together for mounting in a standard rack. Output terminals are provided on both the front and rear panels for easy access in both bench and system applications.

Specifications

Output Voltage: 10V rms
Output Current: 10 mA rms, short-circuit protected
Frequency: Any specified single frequency from 50 Hz to 100 kHz Standard frequencies are: 50, 60, 400, 1000, 2400. 5000, 19,200, & 100,000 Hz
Amplitude Uncertainty:* ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz-20 kHz	100	150	200
20 kHz-50 kHz	150	250	350
50 Hz-100 kHz	400	500	600

** After 10-minute warm-up in ambient temperature 21°C to 25°C*

Amplitude Stability: ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz-20 kHz	20	50	100
20 kHz-100 kHz	40	100	200

Total Harmonic Distortion: Less than 50 ppm to 10 kHz; less than 300 ppm at 100 kHz
Center Frequency Uncertainty: ±0.1%, adjustable ±1%
Frequency Stability: 500 ppm per mo
Load Regulation: ≤20 ppm to 10 kHz; ≤80 ppm at 100 kHz
Line Regulation: ≤10 ppm for ±10% line change
Input Power: 115 or 230V ac ±10%, 50 to 500 Hz, or optional rechargeable batteries
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in H x 4.25 in W x 12 in D)
Weight: 2.26 kg (5 lb)

Included with Instrument: Instruction manual, power cord, calibration certificate

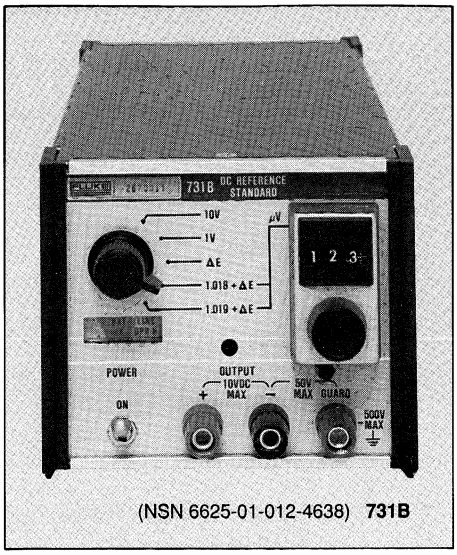
Ordering Information

Models

510A* AC Reference Standard
510A-01* AC Reference Standard w/battery pack
510A/SF* AC Reference Standard (Special Frequency)
510A-01K Rechargeable Battery Pack (for retrofit)
**Specify frequency when ordering*

Accessories (Also see Section 20)

M03-201-601 3 1/2" Rack Mount Kit, Single
M03-202-603* 3 1/2" Rack Mount Kit, Dual
M03-206-604* 3 1/2" Rack Mount Kit, Triple
M03-205-605* 3 1/2" Rack Mount Kit, Quad
** May be combined with the 731B*



(NSN 6625-01-012-4638) **731B**

731B DV Reference Standard

- Outputs at 10, 1, 1.018, and delta E
- 10 ppm output accuracy
- Guarded floating output up to 500V above ground
- Line and battery powered

The Fluke Model 731B DC Reference Standard is a versatile instrument providing stability, while utilizing the excellent performance capabilities of solid-state technology. The instrument furnishes a variety of prevision voltages with switched output ranges including 1.0, 1.018 + ΔE, 10.0, and ΔE volts. Delta E (ΔE) provides a variable output of 0 through 999 μV which is either added to the voltage of a standard cell transfer or may be used directly as a low-level, stable direct voltage source.

Specifications

Output Ranges: 10V, 1V, 1.018 + ΔE, 1.019 + ΔE, ΔE

Output Accuracy:*

Range	30 Days	90 Days	1 Year
10V	±10 ppm	±15 ppm	±30 ppm
1V	±10 ppm	±15 ppm	±30 ppm
1.018+ΔE	±10 ppm	±15 ppm	±30 ppm
1.019+ΔE	±10 ppm	±15 ppm	±30 ppm
ΔE	—	—	±2 μV

**Absolute accuracy at 23°C ±1°C after 30 minutes warm-up*

Transfer Accuracy (Stability)

Between	4 Hours
Standard cells on 1.018V + ΔE ranges ranges or 1.019V + ΔE ranges	2 ppm
Standard cell and 1V output	3 ppm
10V output and standard cell or 1V output	5 ppm

Source Resistance: 10V range is <0.07Ω. The 1V, 1.018V, 1.019V, and ΔE ranges are <1 kΩ

Output Protection: The output may be shorted indefinitely without damage to instrument
Line Regulation: <1 ppm for ±10% line voltage variation
Ripple & Noise: <1 ppm peak-to-peak 0 to 1 Hz, <20 μV rms 1 Hz to 1 MHz, except <70 μV rms at 10V output
Common Mode Noise Rejection: ≥120 dB at 0 Hz, ≥100 dB at 60 Hz, ≥85 dB at 400 Hz
Isolation: Output may be floated up to 500 dV between chassis ground and guard
Temperature: 0°C to 55°C, operating
Power: 115V or 230V ac ±10V, 50 to 400 Hz or internal rechargeable batteries, 6W max, 120 mA max
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in H x 4.5 in W x 12 in D)
Weight: 2.26 kg (5 lb)

Included with Instrument: Instruction manual, power cord, batteries, serialized and dated calibration certificate

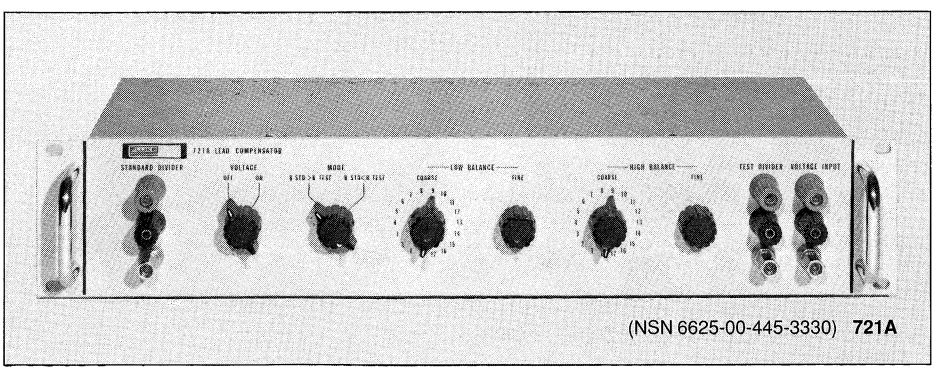
Ordering Information

Models

731B DC Reference Standard

Accessories (Also see Section 20)

M03-201-601 3½" Rack Mount Kit, Single
M03-202-603 3½" Rack Mount Kit, Dual
M03-206-604 3½" Rack Mount Kit, Triple
M03-205-605 3½" Rack Mount Kit, Quad



(NSN 6625-00-445-3330) **721A**

721A Lead Compensator

The 721A Lead Compensator equalizes the voltage drop across two resistive dividers connected in parallel for calibration. The errors due to contact and lead resistance are eliminated.

Specifications

Resolution of Resistance Compensation: 0.1 mΩ
Maximum Ratio Between Divider Resistance: 4000:1
Maximum Allowable Lead Resistance: 150 mΩ

Maximum Divider Voltage: 1500V dc
Size: 8.8 cm H x 48.2 cm W x 15.2 cm D (3½ in H x 19 in W x 6 in D)
Weight: 2.72 kg (6 lb)

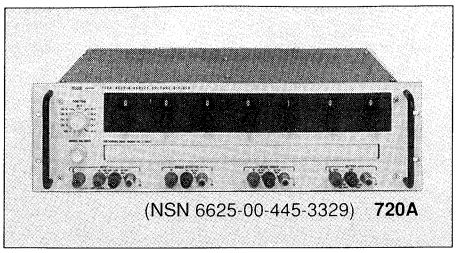
Ordering Information

Model

721A Lead Compensator

8

720A & 750A



(NSN 6625-00-445-3329) **720A**

720A Kelvin-Varley Divider

- 0.1 ppm resolution, seven decades
- 0.1 ppm of input absolute linearity
- Built-in self calibration bridge
- Front panel self calibration

Model 720A Kelvin-Varley Divider is a high-resolution primary ratio standard with absolute linearity of 0.1 ppm, temperature coefficient of linearity of 0.1 ppm/°C, and self-calibration capability.

Specifications

Ratio Range: 0 to 1.0 (1.0 input tap) and 0 to 1.1 (1.1 input tap)
Resolution: 0.1 ppm of input with seven decades
Absolute Linearity: (At calibration temperature and without the use of a correct chart) ±0.1 ppm of input at dial settings of 1.1 to 0.1, ±0.1 $(10S)^{1/3}$ of input at dial settings (S) of 0.1 to 0
Absolute Linearity Stability: (Without self-calibration) ±1.0 ppm of input/yr at dial settings of 1.1 to 0.1, ±1.0 $(10S)^{2/3}$ ppm of input/yr at dial setting (S) of 0.1 to 0

NOTE: Absolute linearity is defined as the linearity between max and min output voltages. The self-calibration procedure may be used at any time to reset absolute linearity to ±0.1 ppm of input.

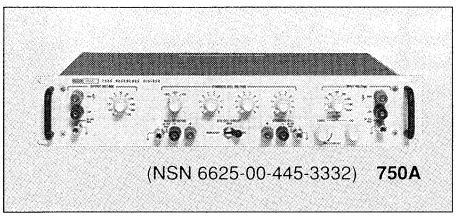
Temperature Coefficient of Linearity: ±0.1 ppm of input/°C maximum at dial settings of 1.1 to 0.1
Short-Term Linearity Stability: Under typical conditions in a standards laboratory environment (temperature maintained within ±1°C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days
Power Coefficient of Linearity: ±0.2 ppm of input/W max at dial settings of 1.1 to 0.1; ±0.2 $(10S)^2$ ppm of input/W max at dial settings (S) of 0.1 to 0
Maximum End Errors: Zero error at output low: 0.004 ppm of input. Zero error at input low: 0.05 ppm of input. Full-scale error: 0.05 ppm of input
Thermal Voltages: ±0.5 μV max
Maximum Input Voltage: 1000V on 1.0 input terminal, 1100V on 1.1 input terminal
Input Resistance: 100 kΩ ±0.005% at 1.0 input terminal at 25°C; 110 kΩ ±0.005% at 1.1 input terminal at 25°C
Temperature Coefficient of Input Resistance: ±1 ppm per °C max
Size: 14 cm H x 48.2 cm W x 33 cm D, rack-mounted (5.5 in H x 19 in W x 13 in D)
Weight: 8.16 kg (18 lb)

Included with Instrument: Instruction manual

Ordering Information

Model

720A Kelvin-Varley Voltage Divider



(NSN 6625-00-445-3332) **750A**

750A Reference Divider

- 10 ppm basic division ratio accuracy
- Switched input and output ranges
- Built-in Kelvin-Varley Divider for standard cell reference
- Overvoltage protection to 2 kV, any range

Model 750A Reference Divider is an extremely accurate and stable voltage divider for calibration of precision meters, calibrators, etc. The instrument is a 10 ppm (0.001%) divider with switched input taps ranging from 1100 to 1.1V, and switched output taps ranging from 1100V to 0.1V.

Specifications

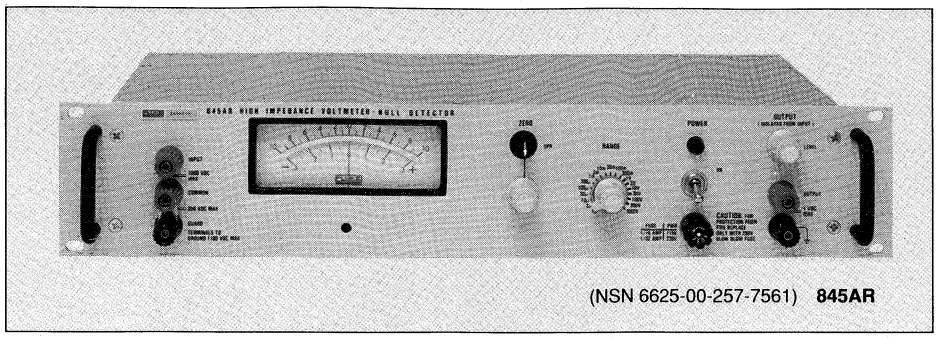
Input Voltages: (Switched) 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Output Voltages: (Switched) 0.1, 0.5, 1, 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Standardizing Output: 1.017000 to 1.019999 dV in 1 μV steps
Division Ratio Accuracy and Stability: (Referenced to Standard Cell tap) ±(0.001% of output +0.5 μV) for 1 year
Calibration: All ranges above 1.1V are adjustable ±10 ppm
Calibration Resolution: 0.2 ppm
Divider Current: 1 mA nominal
Input Current Adjust: Coarse and fine front panel rheostats provide an input voltage adjustment span of 10 mV with better than 1 μV resolution
Overvoltage Protection: Up to 2 kV may be applied on any range without damage
Power: Two 6.75V mercury batteries (1 year life)
Size: 8.8 cm H x 48.2 cm W x 33.0 cm D (3 in H x 19 in W x 13 in D)
Weight: 7.25 kg (16 lb)

Included with Instrument: Instruction manual

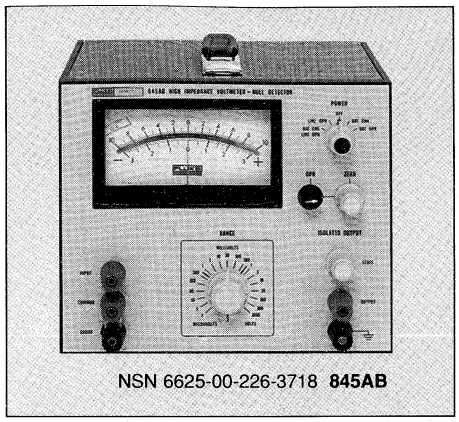
Ordering Information

Models

750A Reference Divider



(NSN 6625-00-257-7561) **845AR**



NSN 6625-00-226-3718 **845AB**

845AB & 845AR Null Detector

- 10 ranges from 1 μV through 1000V
- Input isolation greater than 10^{12} ohms
- Input may be floated to 1100V above ground
- Overload protected to 1100V on all ranges
- Recorder output isolated from input

The Fluke 845AB and 845AR are solid-state null detectors designed for extremely high input impedance, sensitivity, and isolation. Model 845AB operates either from the line or from built-in rechargeable batteries. Model 845AR is a line-powered rack-mounting version, with a height of 3 inches. Source loading through leakage is virtually eliminated by input isolation of 10^{12} ohms regardless of power line, chassis ground, or guard connections. Recorder output provides ±1V dc for end-scale deflection with ±0.5% linearity and does not affect input isolation. The 845AB and 845AR are capable of being floated up to 1100V dc from ground at either input terminal when used in a bridge circuit to compare voltage divider ratios. The unit withstands overloads up to 1100V dc on any range with a typical recovery time of four seconds.

Specifications

Range: 1 μV through 1000V dV end-scale in nineteen ranges, using 1, 3, 10 progression
Input Resistance: 100 MΩ on 300 mV range and above. 10 MΩ on 3 mV through 100 mV range, 1 MΩ on 1 mV range and below
Accuracy: Model 845AB ±(2% end-scale +0.1 μV). Model 845AR ±(3% end-scale +0.1 μV)
Maximum P-P Meter Noise: 0.20 μV on 1 μV range, 0.25 μV on 3 μV range, 0.3 μV on 10 μV to 1000V range, with input shorted
Input Isolation: Better than 10^{12} ohms at ≤50% relative humidity and 25°C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35°C. With driven guard, isolation improves to at least 10^{13} ohms. Either input terminal can be floated 1100V off chassis ground
DC Common Mode Rejection: Better than 160 dB, input short-circuited, ≤80% relative humidity; better than 140 dB, open-circuited, ≤50% relative humidity; better than 120 dB, open-circuited, ≤80% relative humidity
AC Common Mode Rejection: (Below 100 kHz) 100V rms or 120 dB greater than end-scale, whichever is less, will affect reading <2% of end-scale (input open-circuited)
AC Normal Mode Rejection: (60 Hz and above) ac voltages 60 dB above end-scale will affect reading <2% of end-scale. Maximum voltage not to exceed 750V rms
Recorder Output: ±1V dc at full scale deflection. Linearity, 0.5%. Output impedance, 5K to 7.5K. Recorder output is isolated from input and is referenced to ground
Stability of Zero: Better than 0.15 μV/hour; better than 0.3 μV/day
Overload Capability: Up to 1100V dc may be applied on any range. Typical recovery time is 4s
Power, Model 845AR: 115 or 230V ac ±10%, 50 to 440 Hz, approx. 3W
Power, Model 845AB: 115 or 230V ac ±10%, 50 to 440 Hz or rechargeable battery. Approximately 6W during recharge. 40 hr operation on full charge. Batteries trickle-charge while instrument operates from power line
Size, Model 845AB: 17.8 cm H x 21.6 cm W x 20.3 cm D (7 in H x 8.5 in W x 8 in D)
Size, Model 845AR: 8.9 cm H x 48.3 cm W x 21 cm D (3.5 in H x 19 in W x 8.25 in D)
Weight: Model 845AB: 4.65 kg (10.25 lb); Model 845AR: 4.08 kg (9 lb)

Ordering Information

Models

845AB Voltmeter/Null Detector w/batteries
845AR Voltmeter/Null Detector

Accessories (Also see Section 20)

881A-102 7" Rack Mount Kit, Single, for 845AB
881A-103 7" Rack Mount Kit, Dual, for 845AB
5440A-7002 Low Thermal Copper EMF Plug-in Cables

Limited Availability



(NSN 4931-00-115-0567) **410B**

High Voltage Power Supplies

The 410B and 415B are extremely stable dc sources that cover the range of 0V to 10,000V with 5 mV resolution and 0.25% calibration accuracy. The 410B provides 0V to ±10,000V at 10 mA maximum output current. The 415B covers from 0V to ±3100V at 30 mA maximum. Both models include adjustable over-current protection.

410B High Voltage Power Supply
415B High Voltage Power Supply



(NSN 6625-00-459-3219) **80E-10**

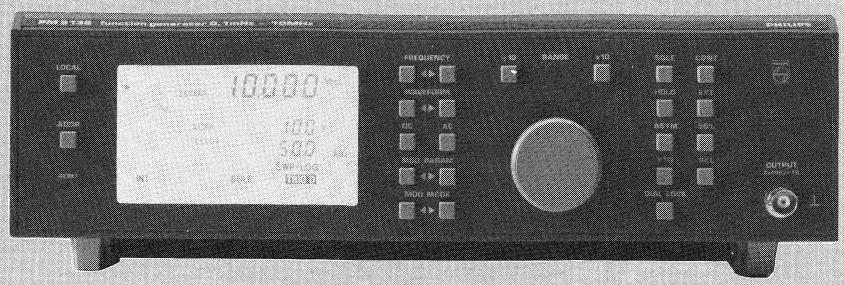
80E-10 High Voltage Divider

The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

80E-10 High Voltage Divider

Signal Sources

NEW



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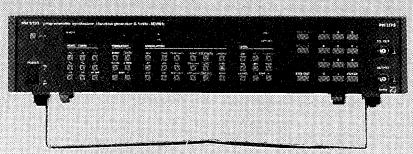

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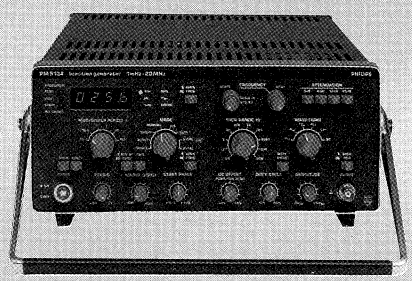

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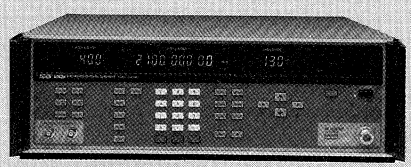

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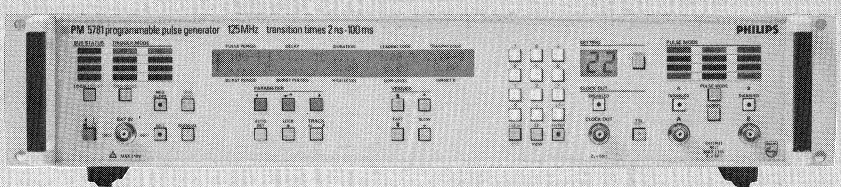
NEW



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From ultra high frequency L-Band application to low-frequency mechanical testing, Fluke and Philips offer signal sources to fit your budget and performance needs. Fluke and Philips sources include:

- RF Signal Generators (10 Hz to 2100 MHz)
- RC + Function Generators (0.1 to 50 MHz)
- Pulse Generators (0.1 Hz to 125 MHz)

Fluke's 6060 Series Synthesized Signal Generators provide excellent spectral purity and amplitude accuracy at frequencies up to 2100 MHz. Simple, solid construction provides excellent performance with high reliability and minimum downtime.

Philips' new PM 5138 introduces a new concept to waveform generation and frequency synthesis – menu-driven operation – with the wide range of waveforms provided, including arbitrary waveforms. All with superior precision and repeatability, from 0.1 mHz to 10 MHz.

Philips' pulse generators are used for pulse response measurements in design, manufacturing test, and service applications. The new PM 5781, for instance, is particularly suited to automatic test systems, with a wide 0.25 to 125 MHz frequency range, and rise/falltimes between a fast 2 ns and 100 ms.

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Synthesized RF Signal Generators	Page 260
TV & Video Generators	Page 277
Function Generators	Page 281
Pulse Generators	Page 313

Selection Guides

Synthesized RF Signal Generators

Models	Frequency			Amplitude			Modulation					Purity				SSB Noise			Res FM	Miscellaneous						
	Minimum	Maximum	Resolution	Minimum	Maximum	Resolution	Int Source	AM/FM	ø Modulation	Combination	Pulse	Harmonics	Sub-Harmonics	Spurious	Line Spurious	For 1 Hz BW	At Frequency	With Offset	RMS 15kHz BW at 500 MHz	Switching Time	Rev Pwr Protect	Rel Ampl &	Digital Sweep	Audio Out	IEEE-488 I/F	Page
	kHz	MHz	Hz	dBm	dBm	dBm						dBc*	dBc*	dBc*	dBc*	dBc*	MHz	kHz	Hz	ms						
6011A	0.01	11	0.1/10	-55	+27	0.01		Opt		•		-40	–	-60	–	-106	11	20	–	2/34		•			Opt	274
6060B/AK [1]	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-116	500	20	12	100	•	•			Opt	266
6060A/AN [2]	10	520	10	-127	+13	0.1	•	•		•		-30	–	-35	–	-113	500	20	15	100	•	•			•	264
6060B	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-116	500	20	10	100	•	•			Opt	260
6061A	10	1050	10	-127	+13	0.1	•	•		•		-30	–	-60	–	-123	500	20	6	100	•	•			•	260
6062A	100	2100	10/20	-127	+13	0.1	•	•	•	•	•	-30	-45	-54	–	-123	500	20	6	100	•	•			•	260
6070A	200	520	1	-127	+19	0.1	•	•	•	•	Opt	-35	–	-90	-56	-132	500	20	2.5	85	Opt	•	•	•	•	268
6071A	200	1040	1/2	-127	+19	0.1	•	•	•	•		-25	-35	-84	-50	-132	500	20	2.5	85	Opt	•	•	•	•	268
6160B	1000	160	0.1/1	+3	+13	Vac						-30	–	-83	–	-121	160	32	–	0.8					Opt	272

*– Not applicable or insignificant •Yes *At maximum carrier frequency (1) For pager and communications testing (2) Includes FM deviation meter*

Function Generators

Models	Frequency Range	Setting Error	Output Vp-p	DC Offset	Waveforms			1)			Variable Duty Cycle	Output Characteristics			Sweep				Burst	Single	Gating	Int	Ext	IEEE	Pg
															Linear		Log								
	Hz-MHz											600Ω	50Ω	TTL	Int	Ext	Int	Ext				AM	FM	IEC	
PM 5109	10-0.1	±5%	30		•	•						•	•	•											311
PM 5110	10-0.1	4%	6		•	•						•		•											310
PM 5131	0.1-2	10%	30	•	•	•	•						•	•			•	•							308
PM 5132	0.1-2	2%	30	•	•	•	•	•			•	•	•	•	•	•									306
PM 5133* **	0.01-2	3%	20	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•			•		303
PM 5134*	0.001-20	5%	20	•	•	•	•	•			•	•	•	•	•	•			•	•		•	•		300
PM 5138	0.0001-10	±2%	20	•	•	•	•	•	1) •	2)	•			•	•	•	•	•	•	•	•	•	•	•	292
PM 5190	0.001-2	1ppm	20	•	•	•	•							•	•								•	IEC	297
PM 5191	0.0001-2	1ppm	30	•	•	•	•		•					•	•								•	IEEE	289
PM 5192	0.0001-20	1ppm	20	•	•	•	•		•					•	•	•	•	•	•		•		•	IEEE	286
PM 5193**	0.0001-50	1ppm	20	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	•	IEEE	281

**PM 5134 also provides crystal mode and crystal AM mode **PM 5193 includes 3 ns pulse generator 1) positive and negative 2) arbitrary waveform ***PM 5133S adds audio sweep output*

6060 Series Option Compatibility

Option	Description	6060A	6060A/AN	6060B	6060B/AK	6061A	6062A
6060A-130	Most Accurate Timebase	–	–	1	1	1	1
6060B-132	Second Best Timebase	–	–	1	1	1	1
6060B-488	IEEE-488 Interface	–	#	•	•	#	#
6060A-488K	IEEE-488 Interface Kit	•	–	–	–	–	–
6060B-488K	IEEE-488 Interface Kit	–	–	•	•	–	–
6060A-570K	Non-Volatile Memory	•	–	–	–	–	–
6060A-651	Low-Rate FM	–	–	•	*	–	•
6060B-651	Low-Rate FM	–	–	–	*	•	–
6060B-830	Rear Output	–	–	•	•	•	–
6062A-830	Rear Output	–	–	–	–	–	•
Other Items							
Y6001	Rack Kit w/24" Slides	•	•	•	•	•	•

Notes: All options are customer-installable except where noted.
• Compatible option

#Option included
** Feature included*
1 Factory installation only. Only one timebase installed in one instrument

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg Co, Inc

Selection Guides

Pulse Generators

Model	Transition Time	Duration	Max Frequency	Operating Modes			External Control					Outputs					Pg
				Square Wave	Double Pulse	Counted Burst	External Trigger	Var Trigger Level	Var Delay	External Duration	External Gate	Amp (50Ω load)	Offset (50Ω load)	Pulse Outputs	Sync (Clock)	GPIB/ IEEE-488	
PM 5785	1,1.5, 2 ns	3.5 ns to 100 ms	125 MHz	•	•	Opt	•	•	8 ns to 100 ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		317
PM 5786	2 ns to 0.1s	3.5 ns to 100 ms	125 MHz	•	•	Opt	•	•	8 ns to 100 ms	•	•	0.2V to 5V	-2.5V to +2.5V	A,B	•		317
PM 5712	4 ns	10 ns to 100 ms	50 MHz	•	•		•		10 ns to 100 ms	•	•	0.2V to 10V	-5V to +2V	A	• (2 outputs)		323
PM 5715	6 ns to 0.5s	10 ns to 100 ms	50 MHz	•	•		•		10 ns to 100 ms	•	•	0.2V to 10V	-5V to +2.5V	A	• (2 outputs)		323
PM 5716	6 ns to 0.1s	10 ns to 100 ms	50 MHz	•	•		•	•	10 ns to 100 ms	•	•	2V to 20V	-18V to +18V	A	• (2 outputs)		320
PM 5705	<10 ns	50 ns to 500 ms	10 MHz	•			•			•		+1V to +15V	0V to 2V	A	• (2 outputs)		325
PM 5781	2 ns to 0.1s	4 ns to 100 ms	125 MHz	•	•	•	•	•	8 ns to 100 ms	•	•	0.2V to 10V	-9.8V to +9.8V	A, B	•	•	313

Note 1: Amplitudes may be set within -20V to +20V window.

TV and Audio Generators

Models	Frequency			Amplitude			Modulation			Purity		SSB ø Noise			Res FM	Miscellaneous			Pg
	Min	Max	Res	Min	Max	Res	Int Source	AM/ FM	Video	Harmonics	Spurious	For 1 Hz BW	At Frequency	With Offset	RMS, 15kHz BW at 500	Switching Time	Digital Sweep	IEEE-488 I/F	
	kHz	MHz	Hz	dBm	dBm	dBm				dBc*	dBc*	dBc	MHz	kHz	Hz	ms			
PM 5390	100	1020	1k/10k	-127	-7	(1)	•	•	•	-30	-30	-100	340	20	75	100	•	•	277
PM 5390S	100	1020	1k/10k	-127	+13	(1)	•	•	•	-20	-30	-100	340	20	75	100	•	•	277
PM 5326**	100	125	10.10k	–	(1)	–	•	•	•	–	–	–	–	–	–	–	•		511

*– Not applicable or insignificant • Yes *At maximum carrier frequency (1) Max output 50 mV at 75Ω. Continuous attenuation to -80 dB*
***PM 5326X adds counter facility*

TV and Video Pattern Generators

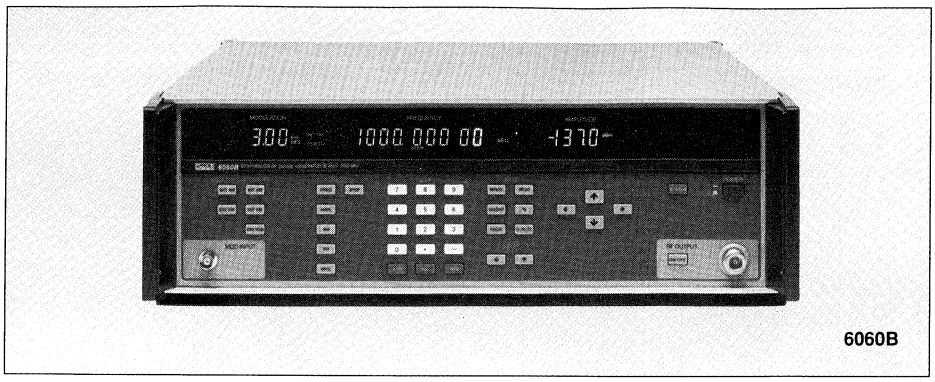
Model	Color and Monochrome TV	PAL	NTSC	SECAM	VCR/VLP	Video Monitors	Page
PM 5514V		•	•		•	•	494
PM 5515	•	•	•		•		496
PM 5518	•		•	•	•		496

9

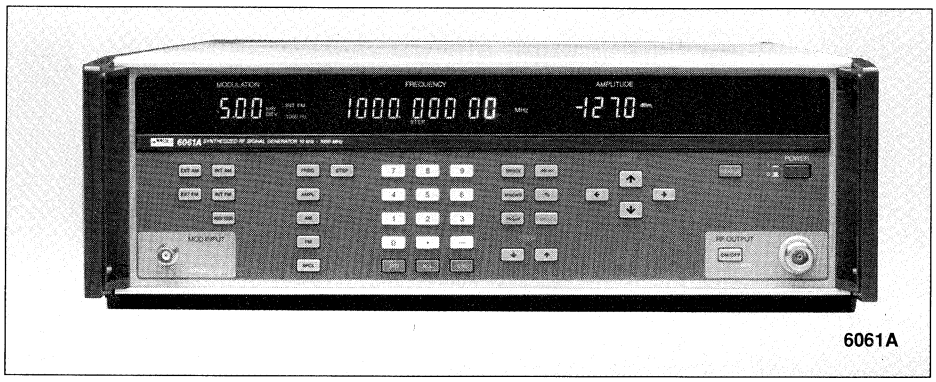
Synthesized RF Signal Generators

6060B, 6061A & 6062A

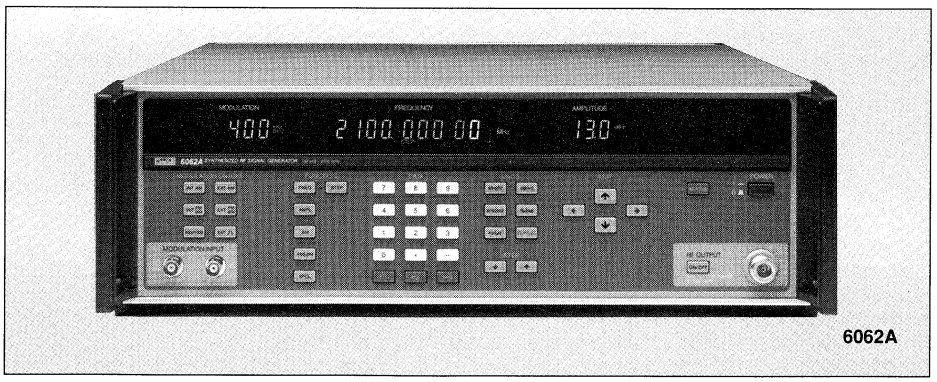
GPIB
IEEE-488



6060B



6061A



6062A

6060 Series Synthesized RF Signal Generators

.01 to 1050 MHz and 0.1 to 2100 MHz
±1 dB amplitude accuracy to 1 GHz and ±1.5 dB accuracy to 2100 MHz (6062A)
Non-harmonic spurious -60 dBc to 1050 MHz
GPIB/IEEE-488
Built-in diagnostics and error code display
Reverse power protection
50 location non-volatile memory
Relative frequency and amplitude modes
Bright-digit editing

Economy and Performance

The Fluke 6060 Series is a family of fully programmable, synthesized signal generators covering 10 kHz to 2100 MHz.

The 6060B is an economical solution for most general purpose RF testing needs. The 6061A is equivalent to the 6060B, but has superior noise performance, making it desirable for receiver testing. These generators have output frequency selectable in 10 Hz steps from 10 kHz to 1050 MHz. Non-harmonic spurious products are less than -60 dBc, and harmonics less than -30 dBc. Level is programmable in 0.1 dB steps over the range -147 to +13 dBm, with overrange to +19 dBm. Accuracy is guaranteed ±1 dB in the range -127 dBm to +13 dBm.

The 6062A spans 100 kHz to 2100 MHz in 20 Hz steps (10 Hz steps below 1050 MHz). Specified amplitude accuracy is ±1.5 dB from -127 dBm to +13 dBm. Like its lower frequency family members, it has amplitude and frequency modulation. Also, the 6062A has phase modulation and fast-rise pulse modulation.

High-performance Pulse Modulation in the 6062A

The 6062A's gallium arsenide pulse modulator generates fast, high quality pulses for testing of pulsed communication and navigation circuits. It employs a design that can generate very narrow pulses, limited only by the modulator's 15 nanosecond rise and fall time.

Microprocessor Control

Microprocessor technology gives the 6060 family sophisticated operator functions including:

Keyboard Parameter Entry and Fluke **Bright-digit Editing.**

Increment Step Function, to allow an operator to vary frequency, amplitude, or modulation in specific increments.

Memory Store and Recall, for fifty complete front panel set-ups with internal non-volatile memory.

Relative Amplitude allows compensation for cable loss in test set-ups.

Relative Frequency speeds testing of frequencies relative to a reference, during filter testing or receiver selectivity measurements.

Self-Test Capabilities

Built-in diagnostics and error code displays provide immediate feedback of incorrect operation. Also, the generators perform a series of internal digital and analog tests at power-up and isolate problem areas immediately via a coded display on the front panel. These internal checks may be accessed and initiated at any time from the front panel. Special service and trouble-shooting test routines are contained within the unit to aid in calibration and maintenance.

Options Summary

The GPIB/IEEE-488* interface is optional on the 6060B (Option -488), and is included as standard equipment on the 6061A and 6062A. The generators come with a 10 MHz free-air crystal reference oscillator, or may be fitted with one of two oven oscillator references: the high stability reference (Option -130) with $\pm 5 \times 10^{-10}$/day aging rate, or a medium stability reference (Option -132) with $\pm 1 \times 10^{-7}$/month aging. Other options are rear output (Option -850), and low-rate FM (Option -651).

6060B General Purpose 1 GHz Signal Generator

- 10 kHz to 1050 MHz, 10 Hz resolution
- -127 to +13 dBm output, plus overrange
- 1 dB amplitude accuracy
- 0.1 dB resolution
- Non-harmonic spurious -60 dBc
- IEEE-488 (optional)
- Reverse power protection
- Non-volatile memory
- Relative frequency and amplitude modes

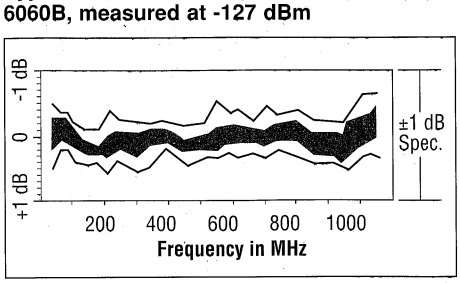
6061A Low-Noise Performance

- All features of the 6060B, plus:
- IEEE-488 included standard
- Lower SSB phase noise: typical -123 dBc/Hz at 20 kHz offset from 500 MHz carrier
- Lower Residual FM: 12 Hz rms at 1000 MHz

6062A 2.1 GHz General Purpose Signal Generator

- Contains all the features of the 6060B and 6061A
- Incorporates the low-noise improvements of the 6061A
- Adds these new features:
- Frequency coverage from 0.1 to 2100 MHz
- Phase modulation
- Fast-rise pulse modulation
- AC/DC-coupled AM
- 400 kHz FM deviation on 1050 to 2100 MHz range
- On-site manual or automated calibration
- IEEE-488 included standard

Typical Level Accuracy vs. Frequency for 6060B, measured at -127 dBm



The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Specifications

Technical Specifications

Frequency

Range: .01 to 1050 MHz (6060B and 6061A); .1 to 2100 MHz (6062A)
Resolution: 10 Hz to 1050 MHz, 20 Hz from 1050 to 2100 MHz (6062A only)
Switching Speed: <100 ms to be within 100 Hz of final frequency
Accuracy & Stability: Same as Reference Oscillator

Reference Oscillator

Internal Reference Oscillator Characteristics

Characteristic	Standard, Free-Air Crystal	-132 Option Medium Stability Oven	-130 Option High Stability Oven
Frequency	10 MHz	10 MHz	10 MHz
Temperature	$<\pm 5 \times 10^{-6}$ total, 0-50°C	$<\pm 1 \times 10^{-7}$ total, 0-50°C	$<\pm 2 \times 10^{-10}$ /°C 0-50°C
Aging Rate	$<\pm 5 \times 10^{-7}$ /mo	$<\pm 1 \times 10^{-7}$ /mo	$<\pm 5 \times 10^{-10}$ day $<\pm 1.5 \times 10^{-8}$ /mo
Warm-up (typical)	1 hr to within 1 ppm of final frequency	20 min to within $<\pm 3 \times 10^{-8}$ of final frequency	30 min to within $<\pm 1 \times 10^{-8}$ of final frequency

Reference Output

Frequency: 10 MHz, sinewave
Level: 0 dBm min into 50Ω
Source Impedance: 50Ω nominal

External Reference

Input Frequency: 1, 2, 2.5, 5, 10 MHz
Input Level: .3 to 4V pk-pk, sinewave or square-wave
Input Impedance: 50Ω nominal

Spectral Purity

Harmonics:

Amplitude	6060B and 6061A	6062A
+13 to +16 dBm	N/A	-25 dBc
>+13 dBm	-30 dBc (freq. >100 kHz)	-30 dBc (freq. >1 MHz)
	-26 dBc (10-100 kHz)	-25 dBc (0.1-1 MHz)

Subharmonics:

Carrier Frequency	6060B and 6061A	6062B
Below 1050 MHz	None	None
1050 to 2100 MHz	N/A	-50 dBc

Non-Harmonic Spurious:

Output Frequency	6060B and 6061A	6062B
10 kHz to 100 kHz	-55 dBc	N/A
.1 to 1050 MHz	-60 dBc	-60 dBc
1050 to 2100 MHz	N/A	-54 dBc

For offsets >10 kHz from carrier, cw mode

Residual FM (Hz rms) in 0.3 to 3 kHz BW:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	20	12	8	12	8
245 to 512 MHz	10	6	4	6	4
512 to 1050 MHz	20	12	8	12	8
1050 to 2100 MHz	N/A	N/A	N/A	24	16

** Residual FM specifications for 6060B apply for temperature 25°C ±5°C. 6061A and 6062A specifications apply for full 0° to 50°C range.*

Residual FM (Hz rms) in .05 to 15 kHz BW:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	44	18	12	18	12
245 to 512 MHz	22	9	6	9	6
512 to 1050 MHz	44	18	12	18	12
1050 to 2100 MHz	N/A	N/A	N/A	36	24

Residual FM (Hz rms) CCITT:

Frequency Range	6060B	6061A		6062A	
		(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	Not Specified	10	7	10	7
245 to 512 MHz		5	3.5	5	3.5
512 to 1050 MHz		10	7	10	7
1050 to 2100 MHz		N/A	N/A	20	14

Residual AM in .05 to 15 kHz BW: <0.1% rms (-60 dBc)

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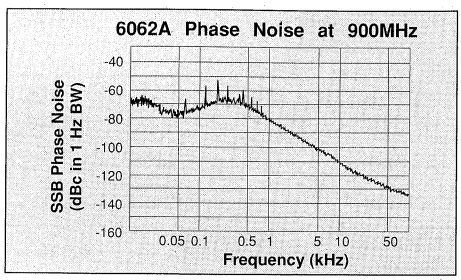
6060B, 6061A & 6062A

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Amplitude

Amplitude Range: 6060B and 6061A: -127 to +13 dBm (+13 dBm peak on AM), with overrange to +19 dBm and underrange to -147 dBm. 6062A: -137 to +16 dBm (+16 dBm peak on AM) to 1050 MHz, to +13 dBm (+13 dBm peak on AM) above 1050 MHz. Overrange to +17 dBm and underrange to -147 dBm
Resolution: 0.1 dB
Annunciators: 6060B and 6061A: dB, dBm, V, mV, µV; 6062A: dB, dBm, V, mV, µV, dB µV, dB mv
Amplitude Accuracy: 25°C ±5°C

6060B and 6061A

Amplitude Range	10 kHz to 400 kHz	400 kHz to 1050 MHz
+13 to -100 dBm	±2 dB	±1 dB
-100 to -127 dBm	±3 dB	±1 dB

6062A

Amplitude Range	1 MHz to 1050 MHz	1050 kHz to 2100 MHz
+16 to -127 dBm	±1.0 dB	N/A
+13 to -127 dBm	±1.0 dBm	±1.5 dB

Amplitude Accuracy: 0°C to 50°C

6060B and 6061A

Amplitude Range	400 kHz to 1050 MHz
+13 to -127 dBm	±1.5 dB

6062A

Amplitude Range	100 kHz to 1 MHz	1 to 1050 MHz	1050 to 2100 MHz
+16 to +13 dBm	±2 dB	±1.5 dB	N/A
+13 to -127 dBm	±2 dB	±1.5 dB	±1.5 dB

Output Impedance: 150Ω, nominal
Output VSWR:
<1.5:1 for amplitude <+1 dBm
<2.0:1 for amplitude >+1 dBm

Reverse Power Protection: 6060B and 6061A: 50W RF from a 50Ω source, 10 kHz to 1050 MHz. Will withstand up to 50V dc. 6062A: 25W RF from a 50Ω source; up to 30V dc
Trip/Reset: Flashing RF OFF annunciator indicates when Reverse Power Protection circuit is tripped. Pushing RF ON/OFF button will reset generator. The 6062A is protected when the instrument is off; the 6060B and 6061A are not.

Leakage:

	6060B	6061A	6062A
RF Leakage at Carrier Frequency	1 µV	0.5 µV	1 µV

Supplemental Characteristics

Amplitude Switching Speed: <100 ms typical (within 0.1 dB of selected value)
Level Flatness: ±0.5 dB (6060B and 6061A)

Amplitude Modulation

AM Depth: 0 to 99% in 1% steps
AM Accuracy: (6060B and 6061A) ±(2% + 4% of setting)
AM Accuracy: (6062A) ±(3% + 5% of setting), 0.1 to 1 MHz, to +16 dBm pk; ±(2% + 4% of setting), 1 to 1050 MHz, to +16 dBm pk; ±(2% + 4% of setting), 1050 to 2100 MHz, to +13 dBm pk

AM Distortion: 6060B and 6061A

AM Depth	10 kHz to 1050 MHz
0 to 30% AM	<1.5% THD
30 to 70% AM	<3% THD
70 to 90% AM	<5% THD

AM Distortion: 6062A

AM Depth	100 kHz to 1 MHz	1 MHz to 1050 MHz	1050 MHz to 2100 MHz
0 to 30% AM	<3% THD	<1.5% THD	<3% THD
30 to 70% AM	<5% THD	<3% THD	<3% THD
70 to 99% AM	<7% THD	<5% THD	<5% THD

Incidental FM:
<.3 f_m at internal rates and <30% AM to 1050 MHz
<.6 f_m above 1050 MHz (6062A)
Rates
Internal Rates: 1400 Hz and 1 kHz (see Modulation Source for specifications)
External BW: 1(3 dB)

	6060B & 6061A	6062A
AC-coupled	.02 to 30 kHz	.02 to 50 kHz
DC-coupled	N/A	DC to 50 kHz

Frequency Modulation

Deviation Ranges: 100 to 999 Hz, 1 to 9.99 kHz, 10 to 99.9 kHz, 100 to 400 kHz (6062A only)

Maximum Deviation: The following table applies for modulating frequencies of 200 Hz and above

	Maximum Peak Deviation	
Output Frequency	6060B and 6061A	6062A
Below 245 MHz	100 kHz	200 kHz
245 to 512 MHz	100 kHz	100 kHz
512 to 1050 MHz	100 kHz	200 kHz
1050 to 2100 MHz	N/A	400 kHz

Maximum Deviation for Low Modulating Frequencies: At low audio frequencies, maximum FM deviation is modulation-index limited. Use the following formulas to compute maximum allowable deviation

	6060B and 6061A	6062A
Below 24 MHz	dev. = $2f_m(f_o+800)$	dev. = $2f_m(f_o+800)$
245 to 1050 MHz	dev. = $2f_m f_o$	
245 to 2100 MHz		dev. = $2f_m f_o$

f_o = RF frequency in MHz
f_m = modulation frequency in Hz
dev.= max peak deviation in Hz
Example: If f_o = 300 MHz and f_m = 50 Hz, the maximum allowable deviation is 30 kHz. i.e., (2)(50)(300) = 30,000 Hz or 30 kHz

FM Deviation Accuracy: ±7% for rates of 0.3 to 20 kHz for carrier frequency greater than 400 kHz, FM deviation >100 Hz
AF Bandwidth: .02 to 100 kHz (3 dB)
Distortion: Less than 1% THD for .3 to 20 kHz rates, FM deviation >100 Hz (effects of Residual FM excluded)
Incidental AM: Less than 1% AM at 1 kHz rate and less than 50 kHz deviation
Internal Rates: 400 Hz and 1 kHz (see Modulation Source for specifications)
External BW: (3 dB) 20 Hz to 100 kHz

Phase Modulation (6062A only)

Deviation Ranges: .01-.099 rad, .100-.999 rad, 1.00-9.99 rad, and 10.0-40.0 rad
Maximum Phase Deviation:

	Peak Deviation
Below 245 MHz	20 radians
245 to 512 MHz	10 radians
512 to 1050 MHz	20 radians
1050 to 2100 MHz	40 radians

Accuracy: ±7% for rates of 0.3 to 10 kHz and greater than .01 rad deviation
Distortion: Less than 1% THD at 1 kHz rate and >.01 rad deviation
Bandwidth: 20 Hz to 10 kHz (3 dB)
Incidental AM: Less than 1% AM at 1 kHz rate and less than 40 rad deviation

Pulse Modulation (6062A only)

ON/OFF Ratio: 80 dB minimum
Rise and Fall Times: 15 nanoseconds maximum
Level Error: For pulse width ≥50 nsec, power in pulse within ±0.5 dB of CW level
Duty Cycle: 0-100%
Rep Rate: DC-16 MHz
Internal Modulation: 400 Hz, 1000 Hz rates, 50% duty cycle
Pulse Modulator Input (External): Nominal 50Ω impedance with internal pull-up. Can be driven directly by TTL

Input Voltage	Modulator State*
<0.9 Volts	RF OFF
>1.1 Volts	RF ON
Open Circuit	RF ON

**EXT PULSE enabled*

Modulation Source

Internal: 400 Hz or 1 kHz, ±3% for 20-30°C; add ±0.1%/°C outside this range
External: 1 volt peak causes indicated modulation index. Internal and External modulation sources may be enabled simultaneously, and combine linearly
Input Impedance: 600Ω nominal (560Ω nominal when EXT AM and EXT FM enabled simultaneously)
External Modulation Annunciators: EXT HI/EXT LO indicator when 1V peak, ±2% is applied at MOD IN connector .02 to 100 kHz BW

Memory

Type: Non-volatile. Data is stored 2 years (typical) with power off
Size: 50 complete front panel settings
Features: Store, recall, sequence

Option Specifications

Option -130: High Stability Crystal Oscillator
Option -132: Medium Stability Crystal Oscillator
See data under Reference Oscillator section.
Option -488: IEEE-488 Compatible Interface (standard on 6061A and 6062A). For field installation order -489K (Kit)
Interface: IEEE-488-1978
Functions Controlled: All front panel controls except line power switch
Data Output: Instrument status, stored memory contents, instrument settled, instrument ID, option complement, uncal/reject entry status, operating time
Indicators: Remote, Addressed, SRQ
Interface Functions: SH1, AH1, T5, TE0, L3, LE0, SR1, LR1, PP0, DC1, DT1, C0, E1
Option -651: Low Rate AC-coupled FM
Maximum Deviation: 9.99 kHz
Bandwidth (3 dB): 0.5 Hz to 100 kHz (typical)
Droop: 15% typical on 7 Hz squarewave
Maximum DC Input: ±10 mV
Note: See also 6060B/AK for enhanced low-rate FM capability.
Option -830: Rear Only RF output and modulation inputs. Type N RF output connector on rear panel

Rear Panel Connectors and Controls

Standard:
10 MHz OUT: Connector to monitor internal 10 MHz reference
REF INT/EXT: Control to enable REF IN connector and disable internal reference
REF IN: Connector to input external reference (see Reference Oscillator)

Option:
MOD IN, RF OUT: Present only if -830 is installed
PULSE IN (6062A): Present only if -830 is installed
IEEE-488 Connector: Standard on 6061A and 6062A, optional on 6060B

General Specifications

Operating Temperature: 0°C to 50°C
Storage Temperature: -40°C to 75°C
Humidity (operating): 0-95% up to 30°C, 0-75% 30°C to 40°C, 0-45% 40°C to 50°C
Altitude (operating): ≤10,000 ft
EMI: Meets MIL-STD 461B RE02, CE03, FCC Part 15(j), Class B
Power: 100, 120, 220, 240V ac ±10%, 47-63 Hz, (for 400 Hz consult the factory) <180 VA, (<15 VA standby with Opt -130
Size: 13.3 cm H x 43.2 cm W x 55.3 cm D (5.25 in H x 17 in W x 21.8 in D)
Weight: <16 kg (35 lb)

Included with Instrument: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

6060B Signal Generator, 1 GHz
6061A Signal Generator, 1 GHz
6062A Signal Generator, 2 GHz

Options*

-130 High Stability Reference
-132 Mid Stability Reference
-488 IEEE-488 Interface (6060B only)
-488K IEEE-488 Interface (6060B only)
-651 Low-rate AC-FM
-830 Rear Output and Modulation Input

**See option compatibility chart at the beginning of this section.*

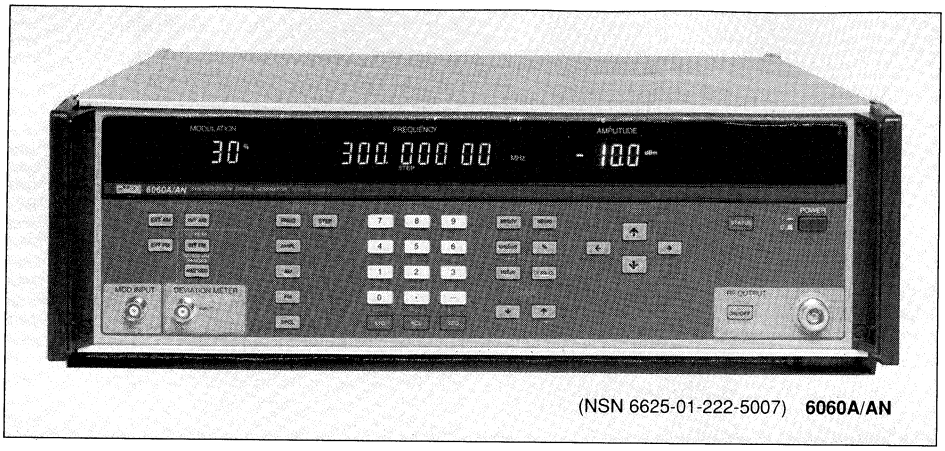
Accessories (Also see Section 20)

Y6001 Rack Mount Kit, w/24" slides
Y9100 Attenuator, 50Ω, 6 dB, BNC
Y9101 Attenuator, 50Ω, 14 dB, BNC
Y9102 Attenuator, 50Ω, 20 dB, BNC
Y9103 50Ω Feed-through Termination, BNC
Y9111 50Ω Cable, BNC to BNC, 3 ft (0.91m)
Y9112 50Ω Cable, BNC to BNC, 6 ft (1.83m)
Y9301 Min-Loss Pad, 50Ω to 75Ω
Y9307 Adapter, N to BNC, 75Ω
Y9308 Adapter, N to BNC, 50Ω
Y9315 Coaxial Cable, N male to N male, 6 ft
Y9316 Cap, Non-shorting, BNC
Y9317 50Ω Termination, N

PM 21XX Modular GPIB Switching System
PM 2122 50Ω coaxial switch
PM 2240 TestTeam Software

6060A/AN

GPIB IEEE-488



(NSN 6625-01-222-5007) **6060A/AN**

6060A/AN Signal Generator/Deviation Meter

10 kHz to 520 MHz

-127 dBm to +13 dBm

500 kHz FM deviation

Built-in FM deviation meter for transmitter alignment

The 6060A/AN combines the capabilities of the Fluke 6060B, with the ability to measure FM deviation in one stand-alone unit.

The signal generator portion of this advanced unit has frequency range from 10 kHz to 520 MHz, +13 dBm to -127 dBm output amplitude range and AM and FM modulation.

The maximum FM deviation is 500 kHz allowing the 6060A/AN to be used on many more applications than just voice communications.

The user-interactive front panel provides instant operator feedback and helps reduce entry errors. A convenient memory feature will save you time. Also included standard are GPIB/IEEE-488* programmability and Reverse Power Protection. Surrounding all these capabilities is excellent RF shielding. And it is easy to service.

The FM Deviation measurement capability included in the 6060A/AN furnishes an effective means to measure the peak deviation (plus or minus) of a frequency modulated RF signal. Simply connect the signal of interest at the front panel connector provided for this function, then select the function and range. The result is displayed at the front panel.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

Specifications apply 1 hour after turn-on within operating temperature range.

Frequency (8 1/2-Digit Display)

Range: 0.01 MHz to 520 MHz
Resolution: 10 Hz
Accuracy: Same as reference (see Reference)

Reference
Internal: Accuracy within 10 ppm of indicated frequency. Unit operates on an internal free-air 10 MHz crystal oscillator, aging <±0.5 ppm/month. <±5 ppm for 25°C, ±25°C. Frequency stability <±0.5 ppm/hour 1 hour after warm up. Internal reference signal (10 MHz TTL) available at rear connector
External: Accepts 10 MHz TTL signal

Amplitude (3 1/2-Digit Display)

Range (Indicated): +13 (+13 peak on AM) to -127 dBm
Resolution: 0.1 dB (<1% or 1 nV in volts)
Accuracy: ±2.5 dB
Source SWR: <1.3, below -10 dBm

Spectral Purity (CW Mode Only)

Spurious: <-35 dBc
Harmonics: <-30 dBc from 10 MHz to 520 MHz; <-26 dBc from 0.01 MHz to 10 MHz
Residual FM (peak in 0.05 kHz to 15 kHz band): <200 Hz
Residual AM (in 0.05 kHz to 15 kHz band): <-60 dBc

Amplitude Modulation (2-Digit Display)

Depth Range: 0% to 99%
Resolution: 1%
Accuracy: ±6% of setting for internal rates; RF peak amplitude of +13 dBm or less
Distortion: <5% THD at 50% AM for 1 kHz rate
Rates: 10 Hz to 20 kHz
External Input Level: Less than 10V peak-to-peak into 600Ω

Frequency Modulation (3-Digit Display)

Deviation Ranges: 1 kHz to 9.99 kHz, 10 kHz to 99.9 kHz, and 100 kHz to 500 kHz
Maximum Deviation: 500 kHz at rates above 50 Hz. 50 kHz between frequencies of 0.1 MHz and 5 MHz and rates above 50 Hz
Resolution: Three digits
Accuracy: ±5% for 1 kHz rate and >1 kHz deviation
Rates: 0.05 kHz to 100 kHz
External Input Level: Less than 10V peak-to-peak into 600Ω

Modulation Source

Internal: 0.4 kHz or 1 kHz, ±5%
External: ±5% max; 1V peak provides indicated modulation index. Nominal input impedance is 600Ω
Modes: Any combination of Internal AM, Internal FM, External AM, and External FM. Modulation may also be disabled. The nominal input impedance with both External AM and External FM enabled is 560Ω

Deviation Meter

Frequency Input: 30 MHz to 500 MHz
Input Signal Level: 15 mV to 5V rms
Input Impedance: 50Ω nominal
Measurement Ranges: Two ranges of 500 kHz and 50.0 kHz full scale
Polarity: Selectable ± peak
Modulation Rate: 100 Hz to 8 kHz
Accuracy: ±6% of full scale range from 100 Hz to 8 kHz

Supplemental Characteristics

The following characteristics are provided to assist in the application of the instrument and to describe the typical performance that can be expected.

Frequency Switching Speed: <150 ms to be within 100 Hz of final frequency
Amplitude Switching Speed: <100 ms to be within 0.1 dB of final amplitude
Amplitude Range: Programmable to +19 dBm and -147.4 dBm, usable to +15 dBm. Fixed-Range, selected by Special Function, allows for more than 12 dB of vernier without switching the attenuator

AM Accuracy: ±(2% + 4% of setting) for internal rates, for depths 90% or less and peak amplitude of +13 dBm or less
AM Distortion: <1.5% THD to 30% AM, <30% to 70% AM, <5% to 90% AM at internal rates
Incidental FM: <0.3f_m for internal rates and 30% AM
FM Accuracy: ±7% for rates from 0.3 to 20 kHz >1 kHz deviation f_o >0.4 MHz
FM Distortion: <1% THD for rates of 0.3 kHz to 20 kHz, 1 kHz to 99.9 kHz deviation for f_o >5 MHz
Incidental AM: <1% AM at 1 kHz rate, for the maximum deviation or 50 kHz, whichever is less
Residual FM (rms in 0.3 kHz to 3 kHz Band): <15 Hz from 245 to 520 MHz; <30 Hz elsewhere
Residual FM (rms in 0.05 kHz to 15 kHz Band): <30 Hz from 245 to 520 MHz; <60 Hz elsewhere
Noise (at 20 kHz offset): <-113 dBc/Hz (except <-107 dBc/Hz below 245 MHz)
Spurious: <-60 dBc for offsets greater than 10 kHz. Fixed frequency spurs are <-60 dBc or <-140 dBm, whichever is larger
External Modulation: Annunciators indicate when a 1V peak signal is applied, ±2%, over a 0.02 kHz to 100 kHz band
Deviation Meter Accuracy: ±5% of reading ±1 count for rates between 100 Hz and 10 kHz
IEEE-488 Interface: All controls except the power switch and the internal/external reference switch are remotely programmable via IEEE Std 488-1978

General Specifications

Temperature: 0°C to 50°C (32°F to 122°F), operating; -40°C to 70°C (-40°F to 158°F), non-operating
Humidity Range: 0-95% non-condensing, operating
Vibration: 5 Hz to 15 Hz at 0.06 in, 15 Hz to 25 Hz at 0.04 in, and 25 Hz to 55 Hz at 0.02 in. DA, non-operating
Shock: Bench handling per MIL-T-28800C Class 5, Style E, non-operating
Electromagnetic Compatibility: The radiated emissions induce <1 μV of the generator's output signal into a 1-inch diameter, two-turn loop, 1 inch from any surface as measured into a 50Ω receiver. Also complies with the following standards: CE03 of MIL-STD-461B (power and interconnecting leads), 0.015 MHz to 50 MHz; RE02 of MIL-STD-461B (14 kHz to 10 GHz); FCC Part 15 (j), Class A; CISPR 11
Reverse Power Protection Level: Up to 50 watts from a 50Ω source, 0.01 MHz to 520 MHz. Will withstand up to 25V dc. Protection not provided when instrument is off
IEEE-488 Interface Functions (IEEE Std 488-1978): SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1
Size: 43 cm W x 13.3 cm H x 55.3 cm D (17 in W x 5.25 H x 21.8 D)
Power: 115V, 230V ac ±10%, 47 Hz to 400 Hz, <100 watts
Weight: <18.2 kg (40 lb)
Calibration Interval: After calibration, the equipment shall meet each performance requirement within the tolerance specified for a period of 9 months

Included with Instrument: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Model

6060A/AN Synthesized Signal Generator

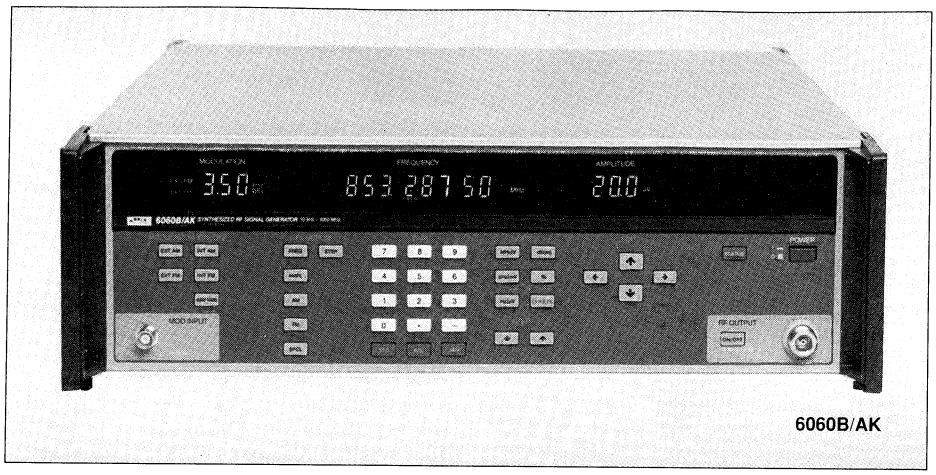
Accessories (Also see Section 20)

Y6001 Rack Mount Kit, w/24" slides
Y9100 Attenuator, 50Ω, 6 dB, BNC
Y9101 Attenuator, 50Ω, 14 dB, BNC
Y9102 Attenuator, 50Ω, 20 dB, BNC
Y9103 50Ω Feed-through Termination, BNC
Y9111 50Ω Cable, BNC, 3 ft (0.91m)
Y9112 50Ω Cable, BNC, 6 ft (1.83m)
Y9301 Min-Loss Pad, 50Ω to 75Ω
Y9307 Adapter, N to BNC, 75Ω
Y9308 Adapter, N to BNC, 50Ω
Y9315 Coaxial Cable, N Male to N Male, 6 ft
Y9316 Cap, Non-shorting, BNC
Y9317 50Ω Termination, N

PM 21XX Modular GPIB Switching System
PM 2122 50Ω coaxial switch
PM 2240 TestTeam software

6060B/AK

GPIB
IEEE-488



6060B/AK

6060B/AK Pager & Communications Testing Signal Generator

- 10 kHz to 1050 MHz
- ±1 dB Absolute Level Accuracy from +13 dBm to -127 dBm
- Residual FM <8 Hz at 500 MHz
- RFI leakage <0.5 microvolts
- Compatible with digital paging codes
- 50 location non-volatile memory

The 6060B/AK is a special-purpose version of the 6060B, that has improved noise characteristics and enhanced Frequency Modulation capabilities. It is designed for radio communications testing; in particular, applications in which digital signaling using FSK is used in addition to voice.

This enhanced modulation characteristic of the 6060B/AK enables it to work well with digital squelch and digital paging systems. It will accommodate very low rate paging codes including Motorola, Golay-Sequential Code (GSC) NEC, NTT and British-Post-Office-Code-Standardization-Advisory-Group (POCSAG).

Specifications

Technical Specifications

Frequency

Frequency Range: 10 kHz to 1050 MHz. Output frequency is displayed on an 8-digit display
Frequency Resolution: 10 Hz
Switching Speed: <100 ms typical (within ±100 Hz of selected value)
Frequency Accuracy: Referenced to internal free-air 10 MHz crystal oscillator, <±0.5 ppm/month; <±5 ppm for 25°C ±25°C (see also Options -130 and -132). Internal 10 MHz reference sinewave output signal available at rear panel

Reference Output

Frequency: 10 MHz, sinewave
Level: 0 dBm min into 50 ohms
Source Impedance: 50 ohms nominal

External Reference

Input Frequency: 1, 2, 2.5, 5, 10 MHz
Input Level: .3 to 4V pk-pk, sinewave or squarewave
Input Impedance: 50 ohms nominal

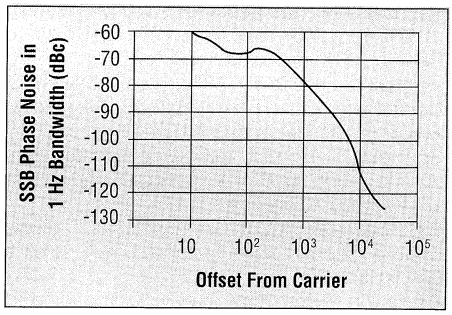
Amplitude

Amplitude Range: -127 to +13 dBm (+13 dBm peak on AM), with overrange to -147 and +19 dBm, displayed on a 3-digit display. Fixed- range output, selected by special function, allows more than 12 dB of vernier without attenuator switching
Amplitude Resolution: 0.1 dB. Annunciators for dB, dBm, V, mV, and µV provided on the display
Switching Speed: <100 msec typical (within 0.1 dB of selected value)
Amplitude Accuracy: ±1.0 dB 0.4-1050 MHz (20°C ±5°C)
Output Impedance: 50 ohms, nominal
Output SWR: <2.0; <1.5 below 1 dBm 2400 kHz
RF Leakage: <0.5 µV at carrier frequency

Spectral Purity

Spurious: <-60 dBc for offsets greater than 10 kHz, (-55 dBc <100 kHz)
Harmonics: <-30 dBc (-26 dBc <100 kHz)
Residual FM (0.3 to 3 kHz band): <8 Hz rms from 245 to 512 MHz; <16 Hz rms elsewhere
Residual FM (0.05 to 15 kHz band): <12 Hz rms from 245 to 512 MHz; <24 Hz rms elsewhere
Residual AM: 0.1% rms (-60 dBc) in 0.05 to 15 kHz band (-55 dBc <100 kHz)

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Amplitude Modulation

Depth Range: 0 to 99%, with 1% resolution (displayed on 2-digit front panel display)
Accuracy: ±(2% + 4% of setting), for 0.1 to 3 kHz rates, depths to 90%, and peak amplitude of <+13 dBm
Distortion: <1.5% THD, to 30% AM; <3% THD, to 70% AM; <5% THD, to 90% AM for <950 MHz and levels <+8.0 dBm
Bandwidth: 20 Hz to 30 kHz, 3 dB
Incidental FM: <0.3 f_m for internal rates and <30% AM

Frequency Modulation

Deviation Ranges: 100 to 999 Hz; 1 to 9.99 kHz; and 10 to 99.9 kHz (displayed on 2-digit front panel display)
Maximum Deviation: Lesser of 99.9 kHz and $2f_m f_0$ above 245 MHz, or $2f_m(f_0 + 800)$ below 245 MHz, where f_0 is in MHz and f_m in kHz (f_0-100)/3 kHz below 0.4 MHz [f_0 in kHz]
Accuracy: ±7% for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_0 <0.4 MHz)
Distortion: <1% THD for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_0 <0.4 MHz) and <100 Hz deviation
Bandwidth: (3 dB) 0.5 Hz-100 kHz for <400 kHz carrier frequency
Droop: 15% on a 10 Hz squarewave
Incidental AM: <1% AM at 1 kHz rate and deviation of 50 kHz

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Modulation Source

Internal: 400 Hz and 1 kHz, ±3% for 20°C to 30°C (add ±0.1%/°C outside this range). Selectable from the front panel
External: 1 volt peak input (MOD IN BNC) provides indicated modulation index. Input impedance = 600 ohms, nominal
Modes: INTAM; INTFM; EXTAM; EXTFM; IN TAM and FM: EXTAM and FM; and INT(AM and/or FM) and EXT(AM and/or FM), in all nine combinations. Input impedance = 560 ohms, nominal, when EXTAM and FM are both enabled
Recommended Digital Interface: Encoder output should idle at 0V, and swing ±1 volt when paging

Sub-Harmonic External Reference

Input: 1, 2, 2.5, 5, and 10 MHz, 0.3 to 4V p-p sine or squarewave into 50 ohms (nominal)
Input Connector: BNC on rear panel

Non-Volatile Memory

Description: Up to 50 front panel control settings can be retained for 2 years. Battery power is used when the 6060B/AK is in standby or the power cord is not attached.

Reverse Power Protection

Protection Level: Up to 50 watts from a 50 ohm source or 50V dc, from 10 kHz to 1050 MHz (dc blocking capacitor at output)
Trip/Reset: Flashing RFOFF annunciator indicates a tripped condition. Pushing RFON/OFF button on front panel will reset the output. Protection is not provided when the instrument is in off.

Option Specifications

All options are factory installable only.

High Stability Reference Option (-130)
Aging Rate: $<\pm 5 \times 10^{-10}$/day, after 21 days
Temperature Stability: $<\pm 2 \times 10^{-10}$/°C. Oven remains powered during standby
Installation: Mounts inside rear panel; includes auxiliary power supply

Mid Stability Reference Option (-132)
Aging Rate: $\pm 5 \times 10^{-7}$/mo, after 21 days
Temperature Stability: $\pm 1 \times 10^{-7}$ (0° to 50°C)

IEEE-488 Compatible Interface Option (-488)
Functions: All front panel controls except the power switch are programmable via the IEEE-488 interface. Instrument status is also available remotely. The 6060B/AK supports the following IEEE-488 functions SH1, AH1, T5, L3, SR1, RL1, PP0, DC1, DT1, C0, E2

Rear RF Output and MOD Input Option (-830)
Description: Moves front panel RF OUTPUT and MOD INPUT connectors to the rear panel

General Specifications

Temperature: 0 to 50°C, operating; -40 to 75°C, non-operating
Humidity: 1 to 95% RH to 30°C; 0 to 75% RH to 50°C, operating
Altitude: 3,050m (10,000 feet), operating
Shock and Vibration: Per MIL-T-28800C, except spectral purity may be degraded; 5 to 15 Hz at 0.06 in; 15 to 25 Hz at 0.04 in; and 25 to 55 Hz at 0.02 in
EMI: Radiated emissions induce <0.5 µV at output frequency into a 1 inch diameter, 2 turn loop, 1 inch from any surface as measured into a 50 ohm receiver. Also compliance with the following standards: CE03, MIL STD 461B Power and interconnecting leads, 0.015 to 50 MHz; RE02, MIL STD 461B 14 kHz to 10 GHz, method; RE02-1 and RE02-2 of MIL STD 462; FCC Part 15 (j), Class A;
Power: 100V, 120V, 200V, 240V ac ±10%, 47 to 63 Hz, <180 VA; <15 VA standby with Option -130
Size: 55.3 cm L x 43 cm W x 13.3 cm H (21.8 in L x 17 in W x 5 in H)
Weight: <15.9 kg (35 lb)

Included with Instrument: Manual, power cord, serialized and dated calibration certificate

Ordering Information

Model

6060B/AK Signal Generator

Options

-130 High Stability Reference
-132 Mid Stability Reference
-488 IEEE Interface
-488K IEEE-488 Interface
-830 Rear Output and Modulation Input

See option compatibility chart at the beginning of this section.

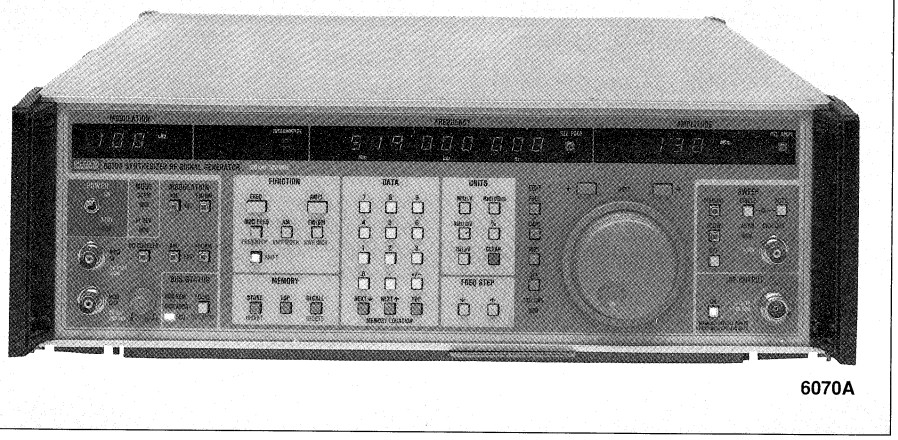
Accessories (Also see Section 20)

Y6001 Rack Mount Kit, inc. 24" slides
Y9100 Attenuator, 50Ω, 6 dB, BNC
Y9101 Attenuator, 50Ω, 14 dB, BNC
Y9102 Attenuator, 50Ω, 20 dB, BNC
Y9103 50Ω Feedthru Termination, BNC
Y9111 50Ω Cable, BNC, 3 ft (0.91m)
Y9112 50Ω Cable, BNC, 6 ft (1.83m)
Y9301 Min-Loss Pad, 50Ω to 75Ω
Y9307 Adapter, N to BNC, 75Ω
Y9308 Adapter, N to BNC, 50Ω
Y9315 Coaxial Cable, N male to N male, 6 ft
Y9316 Cap, Non-shorting, BNC
Y9317 50Ω Termination, N

Synthesized RF Signal Generators

6070A & 6071A

GPIB
IEEE-488



6070A

6070A & 6071A, to 520 MHz or 1040 MHz

- Non-harmonic spurious outputs: -90 dBc to -100 dBc to 520 MHz
- Precision digital sweep
- Front panel memory
- AM, FM, øM modulation
- Responsive spin knob tuning
- Low output VSWR and optional reverse-power protection
- Relative amplitude and frequency mode

Design innovations in the 6070A and 6071A combine the precision resolution and settability of a synthesizer with the low-noise performance of the best open-loop signal generators on the market. And these two state-of-the-art instruments were developed to be competitively priced as well as cost effective in other ways.

The 6070A and 6071A are programmable and directly compatible with GPIB/IEEE-488*-1978. With them, you may make sophisticated tests and measurements rapidly and with great precision. On VHF and UHF receivers you can measure selectivity, sensitivity, intermodulation distortion, AM rejection, AGC response, audio hum, noise and distortion, and SINAD ratio. Or you can align a discriminator or check IF response using the digital sweep feature.

Spectral purity is excellent. Spurious outputs, those not related harmonically to either the carrier frequency or the power line frequency, are on the order of -90 dBc to -100 dBc to 520 MHz and -84 dBc above 520 MHz. The typical broadband noise floor is a comfortable -150 dBc per Hz, and the single sideband phase-noise is typically -138 dBc per Hz at 20 kHz offset from a 500 MHz carrier. These specifications, by any standard, reflect a truly excellent level of spectral purity.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

AM, FM, øM Modulation

Amplitude modulation depth can be set from 0% to 99.9% in 0.1% steps. External dc coupling is provided for leveling, extending bandwidths down to dc, or providing analog control of output amplitude.

Frequency or phase modulation can be set with deviations up to 1 MHz or 100 radians respectively, depending on the rf frequency. Exceptionally wide deviation is made possible by a high deviation mode that is automatically activated when required. External, dc-coupled FM is available for phase locking the instrument to another source. That extends the maximum deviation at low rates, and provides for analog sweeping with an external signal.

Simultaneous AM+FM or AM+øM is available internally or from internal-external combinations. The internal modulation oscillator covers a wide range of frequencies. It can be continually varied from 20 Hz to 200 kHz, with an overrange capability extending it from 1 Hz to 255 kHz in steps of approximately 0.1%.

The modulation oscillator output is available at a front panel connector. This provides you with an audio source separate from the rf output. Typical total harmonic distortion is 0.05%.

GPIB/IEEE-488 Interface

No option is required to make the 6070A or 6071A compatible with IEEE Std 488-1978; the capability is built in. And all of the functions that may be controlled from the front panel manually are also controllable remotely in an IEEE-488 system, except for turning power on and off and controlling the modulation signal output level. Status indicators are: Remote, Addressed, and SRQ. Interface functions are: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2.

Precision Digital Sweep

Versatile sweep modes let you characterize devices such as wideband amplifiers, narrowband crystal filters, and other rf components. Repetitive, single, or manual modes are available with either symmetrical or asymmetrical sweeps. Five sweep step intervals between 20 ms and 500 ms may be selected. A coincidental 0 to 10V staircase sweep signal is available at an output connector to drive X-Y recorders or oscilloscopes. Another rear-panel output signal provides Z-axis blanking for oscilloscopes or a pen-lift signal for X-Y recorders.

Front Panel Program Memory

Up to nine different combinations of front-panel control settings may be stored and later recalled. Up to 50 combinations may be stored in a non-volatile memory using Option -570. This feature reduces errors and saves time in making common measurements.

Responsive Spin-Knob Tuning

In addition to the simple keystroke operation and layout of the front-panel controls, a high-inertia, magnetically detented, optically coupled knob provides analog convenience when continuous adjustments are required. It may be used to select frequency, amplitude, or modulation. Each complete turn gives you 25 increments or decrements, depending on direction of rotation.

Low Output VSWR & Optional Reverse-Power Protection

The rf output impedance of the 6070A and 6071A is 50 ohms with a low source VSWR to minimize the effects of signals reflected from loads having a high VSWR. Option -870 protects the output circuits from being damaged when connected to a transceiver that accidentally transmits power.

Relative Units

A relative-amplitude mode makes it easy to compensate for cable loss, attenuation in the rf output, make linearity tests on detectors and amplifiers, and measure AGC characteristics. Output levels are selectable in 0.1 dB steps, all the way from -140 dBm to +19 dBm for frequencies up to 520 MHz (+13 dBm above 520 MHz). Flatness is typically ±0.2 dB from 200 kHz to 520 MHz, ±0.3 dB to 1040 MHz.

Besides offering 1 Hz resolution up to 520 MHz (2 Hz above 520 MHz), a relative-frequency mode allows you to display specific frequencies above and below a selected center frequency. It makes testing the frequency response of filters and IF strips easy.

Specifications

Technical Specifications

Specifications for frequencies above 520 MHz apply to 6071A only.

Frequency

6070A Ranges: 0.2 to 519.999 999 MHz
6071A Ranges: 0.2 to 1039.999 998 MHz
6070A Resolution: 1 Hz
6071A Resolution: 1 Hz (<520 MHz), 2 Hz (≥520 MHz)
Accuracy & Stability: Same as Reference Oscillator

Reference Oscillator

Internal Standard: 10 MHz quartz oscillator. Aging rate 1±0.5 ppm/month. Temperature effects: <±5 ppm 0 to 50°C instrument ambient (relative to 25°C)
Option -130: 10 MHz ovenized oscillator. (See options)
External: 1, 2, 2.5, 5, 10 MHz input. Level required is 0.3 to 4.0V pp sinewave or square wave. Input impedance is 50 ohms. External reference is automatically switched in when connected
Reference Output: 10 MHz TTL level

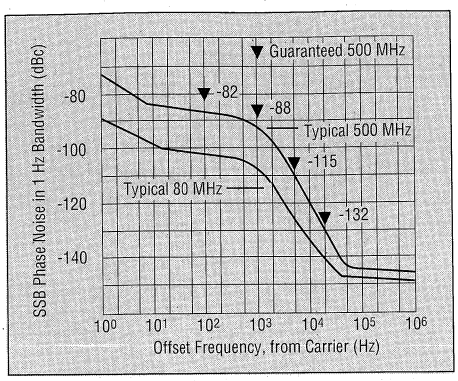
Spectral Purity

All specifications are with High Deviation mode off

SSB Phase Noise

SSB Phase Noise for CW and AM Modes (dBc/Hz)

Carrier Frequency Range	Offset Frequency, from Carrier				
	100 Hz	1 kHz	5 kHz	20 kHz	<3 MHz
0.2 to 62.5 MHz	-75	-85	-106	-123	-129
62.5 to 125 MHz	-94	-100	-125	-140	-144
125 to 250 MHz	-88	-94	-121	-138	-144
250 to 520 MHz	-82	-88	-115	-132	-144
520 to 1040 MHz	-76	-82	-109	-126	-138



Residual FM for CW and FM Modes (Hz rms)

Carrier Range	0.3 to 3 kHz bw	0.5* to 15 kHz bw
0.2 to 62.5 MHz	3.5	5.0
62.5 to 125 MHz	0.3	0.75
125 to 250 MHz	0.85	1.3
250 to 520 MHz	1.7	2.5
520 to 1040 MHz	3.4	5.0

**Typically the same for 0.02 to 15 kHz bandwidth.*

Residual AM: ≤0.02% rms (-74 dBc) in a 0.05 to 15 kHz post-detection bandwidth, referred to 100% sinewave modulation. Typically the same in a 0.02 to 15 kHz post-detection bandwidth

Spurious Signals (dBc)

Relationship to Output Carrier Frequency (f_0)	Carrier Frequency Range				
	200 kHz to 62.5 MHz	62.5 MHz to 125 MHz	125 MHz to 250 MHz	250 MHz to 520 MHz	520 MHz to 1040 MHz
Non-Harmonic <10 kHz offset	-90	-100	-96	-90	-84
550 Hz to 10 kHz offset	-70	-82	-76	-70	-64
Power Line, Display, Mechanical <550 Hz offset	-56	-68	-62	-56	-50
Sub-Harmonic $f_0/2$, $3f_0/2$, $5f_0/2$ offset	N/A	N/A	N/A	N/A	-35
Harmonic (6070A) f_0, $2f_0$, $3f_0$ offset, >+13 dBm	-30	-30	-30	-25	N/A
≤+13 dBm	-35	-35	-35	-35	N/A
Harmonic (6071A) f_0, $2f_0$, $3f_0$ offset, >+13 dBm	-30	-30	-25	-20	N/A
≤+13 dBm	-35	-35	-35	-35	-25

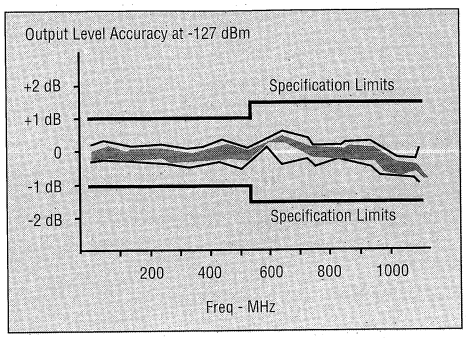
Output

Voltage Level Range: -140 dBm to +19 dBm for frequencies up to 520 MHz. Above 520 MHz (6071A), -140 dBm to +13 dBm
Resolution: 0.1 dB or 1% of voltage

Accuracy (dB)

Output	0.2 to 520 MHz	520 to 1040 MHz
+19 to +13 dBm	±1.0	N/A
+13 to -127 dBm		±1.5

20°C ±5°C



Typical amplitude data measured at -127 dBm. 75% of the units measured within the shaded area. The outer lines represent worst-case measurements.

Output Impedance: 50 ohms, nominal

SWR

Output Level	0.2 to 520 MHz	520 to 1040 MHz
≥+7 dBm	2.0	2.5
<+7 dBm	1.5	2.0

Amplitude Modulation

AM Depth: 0 to 99.9% in 0.1% steps
AM Accuracy: (Internal or External)

Carrier Range	Modulation Frequency	AM Depth	Depth Accuracy
0.2 to 5 MHz	≤1 kHz	<90%	+5%, -8%
5 to 520 MHz	≤3 kHz	<90%	±5%
520 to 1040 MHz	≤3 kHz	≤70%	±5%

AM Distortion

Carrier Range	Modulation Frequency	AM Depth		
		0 to 30%	30 to 70%	70 to 90%
0.2 to 5 MHz	≤1 kHz	<2%	<5%	<7%
5 to 520 MHz	≤3 kHz	<1.5%	<3%	<3%
520 to 1040 MHz	≤3 kHz	<2%	<3%	<5%

AM Signal Bandwidth (-3 dB)

Current Range	AM Depth	Internal or External AC Coupled	External DC Coupled
0.2 to 5 MHz	≤70%	20Hz-8 kHz	DC-8 kHz
5 to 520 MHz	≤90%	20 Hz-50 Hz	DC-50 kHz
520 to 1040 MHz	≤70%	20 Hz-50 kHz	DC-50 kHz

Incidental FM (for 30% AM): 0.3 x modulation frequency for <520 MHz; 0.6 x modulation frequency for >520 MHz

9

6070A & 6071A

Frequency Modulation

Maximum Peak Frequency Deviation (kHz)

Frequency Range	ACFM the lesser of	DCFM the lesser of
0.2 to 62.5 MHz	999 or f_m x (520-f_o)	499
62.5 to 125 MHz	199 or f_m x f_o	f_o or 99.9
125 to 250 MHz	499 or f_m x f_o	f_o or 199
250 to 520 MHz	999 or f_m x f_o	f_o or 499
520 to 1040 MHz	999 or f_m x f_o	f_o or 999

f_o + Output frequency in megahertz
f_m + Modulation frequency in kilohertz

FM Deviation Resolution: 100 Hz for <100 kHz deviation; 1 kHz for 2100 kHz deviation
FM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 50 kHz modulation rate (including flatness)

FM Total Harmonic Distortion

Output Frequency Range	DCFM Mode Off and High Deviation: Off 0.5%+	On	DCFM Mode On 0.5%+
0.2 to 62.5 MHz	0.75% per 100 kHz dev	1.5 %	1.2% per 100 kHz dev
62.5 to 125 MHz	3.0% per 100 kHz dev		(600 ÷ f_o) % per 100 dev
125 to 250 MHz	1.5% per 100 kHz dev		
250 to 520 MHz	0.75% per 100 kHz dev		
520 to 1040 MHz	0.375% per 100 kHz dev		

f_o = Output frequency in megahertz

FM Signal Bandwidth (-3 dB): 20 Hz to 250 kHz internal or ac coupled external. DC to 250 kHz dc coupled external
Center Frequency Accuracy (DCFM Off): Same as reference oscillator

Center Frequency Accuracy (DCFM On)*

Output Frequency Range	Initial Accuracy	Typical Stability
0.2 to 62.5 MHz	±1 kHz	50 Hz/min
62.5 to 125 MHz	±250 Hz	12.5 Hz/min
125 to 250 MHz	±500 Hz	25 Hz/min
250 to 520 MHz	±1 kHz	50 Hz/min
520 to 1040 MHz	±2 kHz	100 Hz/min

** Auto-CAL upon initialization*

Incidential AM: ≤0.5% (-52 dBc) for deviations up to 50 kHz at 1 kHz rate (single sideband) component referred to sinewave modulation

Phase Modulation

Deviation and Distortion

Output Frequency Range	Max Peak Deviation Radians Off	Total Harmonic Distortion Per Radian of Deviation With High Deviation Mode On	
0.2-62.5 MHz	99.9	0.5+(0.75x10^{-5}xf_m)%	1.5 %
62.5-125 MHz	19.9	0.5+(3.0x10^{-5}xf_m)%	
125-250 MHz	49.9	0.5+(1.5x10^{-5}xf_m)%	
250-520 MHz	99.9	0.5+(0.75x10^{-5}xf_m)%	
520-1040 MHz	99.9	0.5+(0.375x10^{-6}xf_m)%	

f_m = Modulation frequency in hertz

øM Resolution: 0.01 radian for <10 radians, 0.1 radian for 210 radians
øM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 3 kHz modulation rate (including flatness)
øM Signal Bandwidth (-3 dB): 0.02 to 12 kHz internal or ac coupled external. DC to 12 kHz external dc coupled
Incidental AM: ≤0.5% (-52 dBc) for deviations up to 50 radians at a 1 kHz rate (single sideband component referred to sinewave modulation)

Modulation Signal Source

Modes: AM, FM, øM, AM + FM, AM +øM
Range: 0.02 kHz to 200 kHz
Frequency Accuracy: ±3% for 20°C to 30°C ambient temperature range. Add 0.1% per degree C outside that range
Total Harmonic Distortion: <0.15% from 0.2 kHz to 100 kHz; <0.2% below 0.2 kHz and above 100 kHz
Output Level: 0V to 2V peak to peak into 600Ω
Output Impedance: 600Ω, nominal via front panel BNC connector

External Modulation Input

Level: 1V peak for specified AM, FM, or øM accuracy
Impedance: 600Ω, nominal
Coupling: AC or DC

Switching Time

Frequency: <85 ms from last controller command (<35 ms for most small changes) until frequency has settled to within 100 Hz of final value. Applies to frequency changes only
Level: <50 ms from last controller command. Applies to level changes only

Frequency Sweep

Sweep Modes: Auto, Single, Manual
Sweep Functions: Symmetrical sweep, asymmetrical sweep, sweep speed
Data Entry: Sweep width, sweep increment
Sweep Speed: Approximately 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, per increment
Sweep Output: 0 to +10V, up to 1000-point stepped ramp. Available at front panel BNC connector
Penlift/Z Axis Blanking: TTL output level at rear panel BNC connector. High during sweep retrace and when sweep is off

Memory

Memory Functions: Store, recall, insert above, delete, top
Locations: 9 standard, volatile; Option-570 50 non-volatile. Front panel set-ups can be stored in each location and later recalled

Remote Programming

Interface: IEEE-488
Functions Controlled: All front-panel controls except line power switch and modulation output amplitude (MOD OUT)
Status Indicators: Remote, Addressed, SRQ.
Interface Functions: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2

Option Specifications

10 MHz Ovenized Oscillator (-130)

Aging rate <±5 x 10^{-10} per day after a 21-day warmup. Temperature effects: <±2 x 10^{-10}/°C

Non-Volatile Memory (-570)

50 locations; operational features same as standard features. Data is stored with built in battery when power is off

Rear RF Output (-830)

Type N rf output connector available on rear panel

Auxiliary RF Output (-831)

Greater than -18 dBm, available at rear panel BNC. Impedance, 50 ohms

Reverse Power Protection (-870)

Up to 50 watts from a 50 ohm source over 0.2 to 1040 MHz. Will withstand up to 50V dc

Pulse Modulation (-950)

Adds pulse modulation to 6070A only. Fast 25 ns rise/fall times with on/off ratio of 40 to 60 dB depending of carrier frequency

General Specifications

EMI: Meets MIL-STD 461A RE02 and CE03, and MIL-I-6181D Sections 4.3.1 and 4.3.2 for both narrowband and broadband tests. RF leakage: less than 3 μV is induced into a two-turn, 1 inch diameter loop 1 inch away from any surface and measured into a 50Ω receiver
Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating
Relative Humidity: ≤95% to 25°C; ≤75% to 50°C
Altitude: 110,000 feet
Power: 100, 120, 200, 240V ac ±10% 47 to 63 Hz; 125 watts typical. For 400 Hz operation consult your Fluke representative
Size: 13.3 cm H x 43.2 cm W x 54.6 cm D from front panel to rear handle (5.25 in H x 17.0 in W x 21.5 in D)
Weight: 27.7 kg (61 lb)
Safety: CSA 556B certified

Included with Instrument: Operator's manual, service manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

6070A Synthesized Sig Gen (0.2-520 MHz)
6071A Synthesized Sig Gen (0.2-1040 MHz)

Options

-130 Ovenized Reference Oscillator
-570 Non-Volatile Memory
-830 Rear RF Output
-831 Auxiliary RF Output
-870 Reverse Power Protection
-950 Pulse Modulation (6070A only)

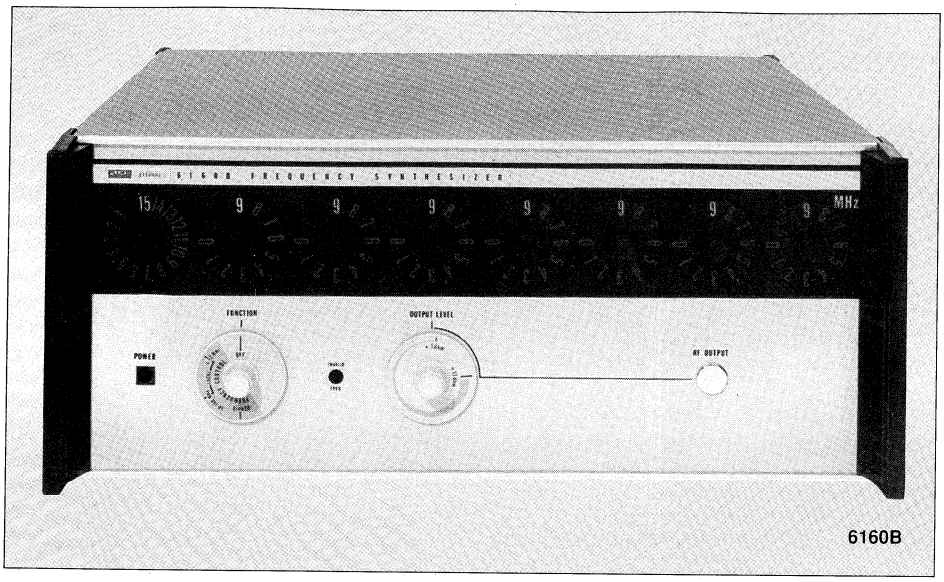
Accessories (Also see Section 20)

Y6001 Rack Mount Kit inc 24" slides
Y9100 Attenuator, 55Ω, 6 dB, BNC
Y9101 Attenuator, 50Ω, 14 dB, BNC
Y9102 Attenuator, 50Ω, 20 dB, BNC
Y9103 50Ω Feedthru Termination, BNC
Y9111 50Ω Cable, BNC to BNC, 3 ft (0.91m)
Y9112 50Ω Cable, BNC to BNC, 6 ft (1.83m)
Y9308 Adapter, N to BNC, 50Ω
Y9315 Coaxial Cable, N male to N male left
Y9316 Cap, Non-shorting, BNC
Y9317 50Ω Termination, N

PM 21XX Modular GPIB Switching System
PM 2122 50Ω Coaxial Switch
PM 2240 TestTeam Software

6160B

GPIB
IEEE-488



6160B

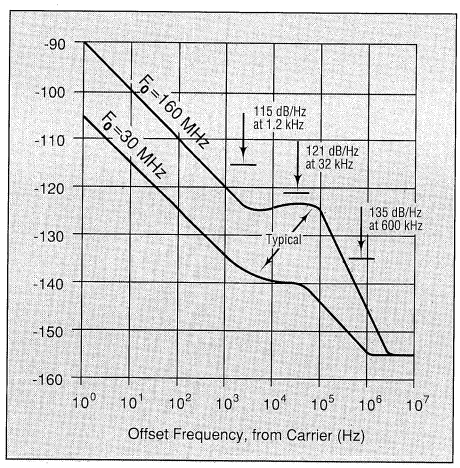
6160B Frequency Synthesizer

- High spectral purity: residual phase noise typically less than -74 dB
- Resolution: 0.1 Hz below 12 MHz; 1 Hz above
- Level flatness: ±1 dB into 50 ohms
- Switching speed: 800 µs
- Built-in BCD programming
- Optional GPIB/IEEE-488

The Fluke 6160B Frequency Synthesizer is the industry's most popular VHF synthesizer because of its high spectral purity. It produces frequencies from 1 MHz to 160 MHz in two ranges: 1 MHz to 12 MHz and 10 MHz to 160 MHz. Frequency resolution is 0.1 Hz on the 12 MHz range and 1.0 Hz on the 160 MHz range.

A unique feature of the 6160B is that the highest internally-generated frequency is that of the output VCO, i.e., 80 to 160 MHz. This makes servicing easier, and eliminates UHF EMC problems. Since the output VCO operates from 80 to 160 MHz, frequency division is employed for coverage of lower frequencies. This results in improved spurious specifications for frequencies lower than 80 MHz. Phase noise is similarly reduced for lower bands.

Built-in remote programming is DTL/TTL, BCD, positive true logic or by contact closures. Programming of frequency is via 34 parallel lines, and a remote flag and power flag are provided. Switching is fast, output level is electrically adjustable. Compatibility with GPIB/IEEE-488*-1978 is achieved using the Fluke 1120A Translator and 6XXXA-529 Interface.



** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Specifications

Technical Specifications

Parameter		
FREQUENCY		
High Band Range **Minimum Step**	10 MHz to 160 MHz 1 Hz	
Low Band Range **Minimum Step**	1 MHz to 12 MHz 0.1 Hz	
Local Control **Remote Control**	Front panel rotary switches BCD per decade, TTL, DTL positive true logic or contact closures. Logic "0" = 0 to 0.9V dc. Logic "1" = 2V to +5V dc or open circuit.	
Spectral Purity **Non-Harmonic,** **Spurious**	**MHz** 1 to 20 20 to 40 40 to 80 80 to 160	**dBc** -100 -95 -89 -83
Harmonic, **Spurious**	<-25 dBc, typically <-30 dBc	
Amplitude Noise**	<-94 dBc (typical)	
Absolute **Phase Noise****	<-62 dBc (typical)	
Residual **Phase Noise****	<-74 dBc (typical)	
Phase Noise* **Spectral Density** **1 Hz Bandwidth**	**Offset from Carrier** 1.2 kHz 32 kHz 600 kHz	**SSB Noise** <-115 dBc <-121 dBc <-135 dBc
OUTPUTS		
Main Output	Adjustable from +3 dBm to +13 dBm into 50Ω (0.3V to 001V rms) with front-panel control or external dc voltage. Level maintained ±1 dB into 50Ω	
Other Outputs	5 MHz at nominally 1V rms into 50Ω	
Output Options	Rear Panel, Opt -04	

** Noise specifications are for frequencies from 80 MHz to 160 MHz. Noise performance improves for lower frequencies.*

*** Measured in a 30 kHz band excluding the 1 Hz band centered on the signal frequency.*

MISCELLANEOUS	
Reference Frequency	External, 5 MHz at 0 dBm to +16 dBm into 50Ω
Level Control	External, 0.1 to 0.8V dc nominal into >2 kΩ produces an output level change of from +3 dBm to +13 dBm
Switching Speed	<800 µs to be within 50 Hz of final frequency (applies for frequencies from 80 MHz to 160 MHz. Improves at lower frequencies)
Internal 5 MHz Frequency Option -02, -05, or Other Source	**Option** **Aging Rate** -02 $\pm 2 \times 10^{-9}$/day -05 $\pm 5 \times 10^{-6}$/yr **Temp. Stability** 1×10^{-8}, 0°C to 50°C 1×10^{-6}, 0°C to 50°C

**Noise specifications are for frequencies from 80 MHz to 160 MHz. Noise performance improves for lower frequencies.*

*** Measured in a 30 kHz band excluding the 1 Hz band centered on the signal frequency.*

General Specifications

Altitude: To 3048 meters (10,000 feet), operating; 15,240 meters (50,000 feet), non-operating
Temperature: 0°C to 50°C, operating; -62°C to +70°C, non-operating
Relative Humidity: ≤80% to 50°C
Power: 115V or 230V ac ±10%, switch-selectable, 50 to 440 Hz. 80W
Size: 48.3 cm W x 17.8 cm H x 50.8 cm L (19 in W x 7 in H x 20 in L)
Weight: 20.5 kg (45 lb)

Included with Instrument: Manual, power cord, mating connector for programming input lines, serialized and dated calibration certificate

Ordering Information

Model

6160B* Frequency Synthesizer

Options (for 6160B)

-02* Frequency Std. 2×10^{-9}/day
-04 Rear Panel RF Output
-05* Frequency Std. 5×10^{-6}/year
-522K 1120A Interface, field installable
-529** IEEE-488 Interface

** Option -02, -05 or an external 5 MHz timebase is required. Option -02 and -05 Frequency Standards are installable at Factory*

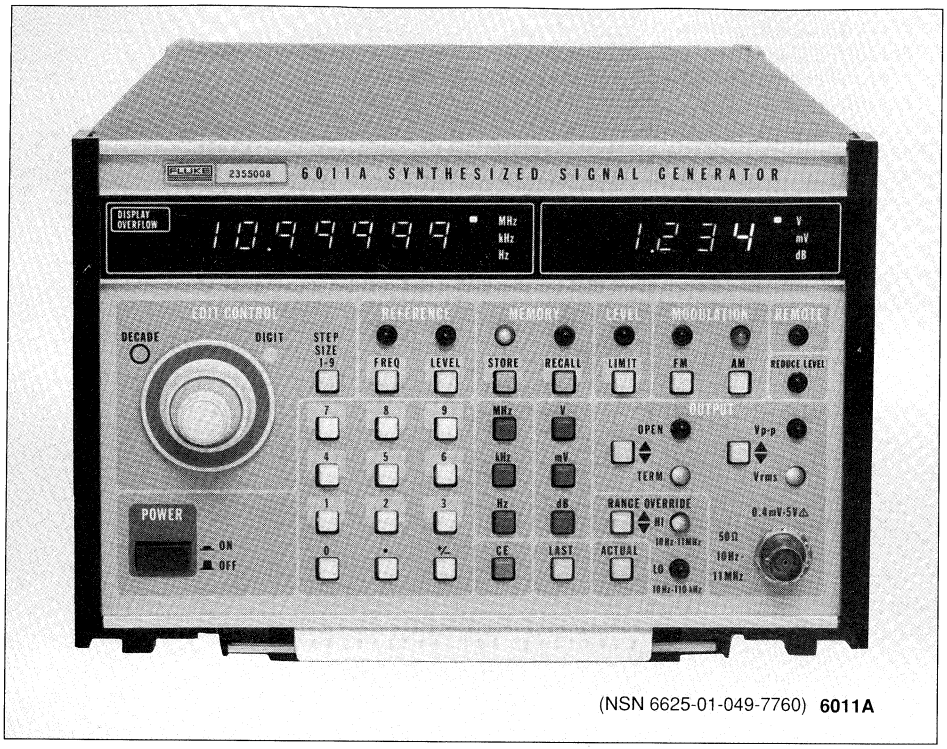
*** Requires 1120A IEEE-488 Translator. Includes 6XXXA-522K and Y7205 Cable*

Accessories (Also see Section 20)

1120A IEEE-488 Translator
Y7205 6 ft Ribbon Cable for -522K
Y9111 3 ft (0.93m) 50Ω BNC Cable
Y9112 6 ft (1.85m) 50Ω BNC Cable
M07-205-600 7" Rack Adapter
M00-280-610 24" Rack Slides (Rack Adapter required)

6011A

GPIB
IEEE-488



(NSN 6625-01-049-7760) **6011A**

6011A Signal Generator

- 0.1 Hz (7-digit) resolution to 110 kHz; 10 Hz resolution to 11 MHz
- Storage of up to 9 different frequencies
- Residual noise -50 dBc
- Harmonics -35 to -50 dBc
- Level flatness = 0.05 dB
- Frequency switching 2 ms

The 6011A has an output impedance of 50 ohms over the entire frequency range of 10 Hz to 11 MHz, selectable with 0.1 Hz (7-digit) resolution to 110 kHz, 10 Hz resolution to 11 MHz. Frequency is displayed us-ing a 7-digit LED readout. The rms output voltage into a 50Ω load ranges from 0.4 mV to 5V or 10V rms into an open circuit or high impedance load; referred to 1 milliwatt in a 50Ω load, it ranges from -55 dBm to +27 dBm.

The output may be in units of dBm, volts, or millivolts selected with 4-digit resolution using calculator-like front panel pushbuttons and displayed on LEDs. And the output level may be selected in terms of peak-to-peak voltage as well as rms voltage.

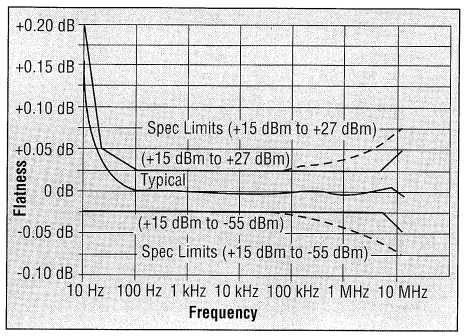
To avoid accidentally selecting an excessive output voltage, a limit may be stored in the 6011A. In addition, you may store up to nine different frequencies and/or output levels that may be recalled at random, quickly and without error — an important consideration for repetitive testing.

Selecting seven-digit frequency resolution is automatic — you don't need to select the high or low range or all seven digits when ending digits are zero. However, you may deliberately override the automatically-selected range when desirable.

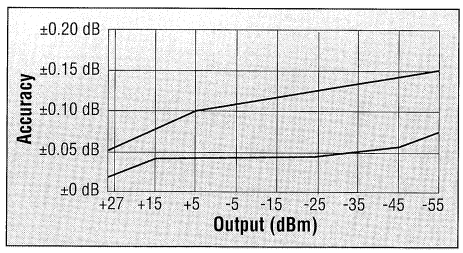
Any selected frequency may be increased or decreased in steps of practically any size, using the EDIT controls. This provides a manual sweep capability for checking frequency response, peaks, nulls, etc. A frequency or output level may be stored as a reference with other frequencies or levels added or subtracted within the instrument's range. This is useful for making relative measurements.

The 6011A can be controlled remotely and operate as part of a system. Option -05 makes the instruments compatible with GPIB/IEEE-488* and Option -06 gives them compatibility with EIA Standard RS-232-C. A seven-line ASCII bit-parallel interface is standard, when you don't order option -05 or -06. All front-panel functions are controllable remotely except for line power and open-terminated-load selection. The IEEE-488 Interface Option has the repertoire AH1, L2, RL1, and E1.

Output Level Flatness vs Frequency



Output Level Accuracy vs Level



Specifications

Technical Specifications

Parameter	
FREQUENCY	
Low Range **High Range**	10 Hz to 109.9999 kHz 10 Hz to 10.99999 MHz
Range Selection	Automatic, with manual override
Resolution	0.1 Hz in the low range 10 Hz in the high range
Display	Seven-digit LED display of frequency set by local or remote control
Annunciation	Units automatically justified in the LED display to indicate maximum resolution

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Accuracy	±3 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate	<1 part in 10^6 per day of 1 part in 10^6 per year at constant temperature
Temperature	<±2 parts in 10^6 from 0°C to +50°C. (<±5 parts in 10^7 from 0°C to +50°C with Option -01)
External Reference	Requires a 10 MHz TTL compatible square wave with symmetry between 40% and 60%. Internal reference is automatically selected in the absence of an external reference
Local Control	Keyboard selection of numerical data, magnitude (Hz, kHz, MHz) and functions. Edit control provided for modifying entry. 6011A programmable in steps of 1-9
Frequency Storage	Facility to store and recall 9 front-panel control settings including frequency, level, modulation, and output terminal parameters
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
Switching & Settling Time	Frequency settles to within 10 Hz of final frequency in low range and 1 kHz in high range in <2 ms in fixed form <34 ms in free form (excluding recall)
SPECTRAL PURITY	
Harmonic, Spurious	-30 dBc from 10 Hz to 100 Hz -50 dBc from 100 Hz to 1 MHz -40 dBc from 1 MHz to11 MHz (Except -35 dBc for output levels within 2 dB of max output from 5 MHz to 11 MHz). Total harmonic distortion from 100 Hz to 110 MHz). Total harmonic distortion from 100 Hz to 110 kHz is <0.15% (typically 0.07%) on low range and 0.3% (typically 0.1%) on high range
Non-Harmonic, Spurious	All non-harmonically related outputs <-60 dBc below output or -110 dBm whichever is greater
Phase Noise	-46 dBc as measured in a 30 kHz bandwidth excluding 1 Hz centered on the carrier, including the effects of the internal standard. Residual (excluding internal standard) is <-50 dBc. Approximately 8 dB improvement on low range
Phase Noise Spectral Density (Typical)	SSB Phase Noise at the output measured in a 1 Hz bandwidth at max output. Approx. 10 dB improvement on low range **Offset from Carrier** / **SSB Phase Noise** 20 Hz -102 dBc 200 Hz -108 dBc 20 kHz -106 dBc 1 MHz -130 dBc

AMPLITUDE	
Impedance	50Ω
Range: dBm Volts	+26.98 dBm to -55.01 dBm into 50Ω 5.000V rms to 0.3972 mV rms into 50Ω
Local Control	Keyboard selection of output level in V, mV or dBm, Voltage is selectable in terms of V rms or V p-p and terminated or open circuit. Rotary knob provided for modifying entry and is programmable in steps of 1 through 9
Resolution	0.01 dB
Accuracy	See Graph
Frequency Response	See Graph
Stability vs. Temp	Typical temperature coefficient is 0.003 dB/°C, 20°C to 30°C ±0.2 dB, 0°C to 50°C
Switching & Settling Time	To within: ±1 dB, 150 ms fixed form, ±0.1 dB, 300 ms fixed form, ±0.01 dB, 450 ms fixed form. (Add 200 ms for free form.)
Display	dB; 4-digit LED plus sign in dBm or dB with respect to a stored dBm reference. Volts: 4-digit in V p-p or V rms; open circuit or terminated or volts or dB with respect to a stored voltage reference
AM Modulation	Analog input can be used to provide amplitude modulation. Bandwidth of this input is 10 kHz and max modulation is 90%. Z in = 600Ω 9V p-p corresponds to 90% modulation
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
REMOTE INTERFACES	
Standard	Byte serial, bit parallel, seven ASCII-defined parallel lines, plus two handshake lines. Mating Connector Amphenol 57-30240. Also Option -05 and -06
OUTPUTS	
TTL Output	TTL-compatible square wave output (<0.5V to >2.4V p-p into 50Ω) at the synthesized output frequency
Reference Outputs	Derived from the synthesizer frequency reference. 1 MHz output is standard; 5 or 10 MHz available by changing internal jumper. Output is TTL-compatible square wave
Rear Panel Output	Option -04
20 to 31 MHz Tracking	Option -09

Option Specifications

High Performance TCXO Option (-01)

Frequency Accuracy: ±1.5 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate: <1 part in 10^8 per 24 hours at constant temperature, or 1 part in 10^6 per year
Temperature Dependence: <±5 parts in 10^7 from 0°C to +50°C

Phase-Lockable Input Option (-02)

Input Frequency: 1, 2, 2.5, 5, or 10 MHz
Input Level: >100 mV, <5V rms into 50Ω. May be used with either the standard oscillator or Option -01. Locking range is ±5 parts in 10^6 from frequency of internal oscillator

Frequency Modulation Option (-03)

General	High Range	Low Range
Deviation	±20 kHz	±200 Hz
Input	1V for 4 kHz ±5V max	1V for 40 Hz ±5V max
Accuracy 0 to 50°C	±1.5 kHz	±15 Hz
Rate	dc to 10 kHz	dc to 10 kHz
Linearity at Constant Temp	±1 kHz	±10 Hz
Stability at Constant Temp	±400 Hz	±4 Hz
Incidental AM Typical	<1%	<0.5%
Impedance, Input	600Ω	600Ω

IEEE-488 Interface Option (-05)

Compatible with IEEE Std 488-1978 for use in instrumentation systems. Interface functions are AH1, L2, RL1, and E1

RS-232-C Interface Option (-06)

Bit serial interface compatible with EIA Standard RS-232-C. Asynchronous data rates from 110 to 9600 baud. Either voltage-level interface or 20 mA current loop. 32-character FIFO buffer

General Specifications

Altitude: To 3048 meters (10,000 feet) operating
Temperature: 0°C to 50°C, operating; -40°C to 75°C, non-operating
Relative Humidity: ≤80% to 50°C
Power: 15V or 230V ac ±10%, 50 to 60 Hz, 100W, standard. Also 50 to 400 Hz optional and 100V ac optional
Size: 13.3 cm H x 21.6 cm W x 48.2 cm D (5.25 in H x 8.5 in W x 19 in D)
Weight: 11.4 kg (25 lb)
Safety: CSA 556B certified

Included with Instrument: Instruction Manual, power cord, serialized and dated calibration certificate

6011A

Ordering Information

Models

6011A Synthesized Signal Generator

Options (for 6011A)

-01 High Performance TCXO
-02[1] Phase Lock Input
-03*[1] Frequency Modulation
-04* Rear Panel Output
-05*[2] IEEE-488 Interface
-06*[2] EIA Standard RS-232-C Interface
-07 50-400 Hz Line Power
-08 100V, 50-60 Hz Line Power
-09* 20-31 MHz Tracking Output

** Options -01, -02, -07, and -08 are installed at factory or service center only. Order -03K, -04K, -06K, or -09K kits for customer installation*
[1] Cannot have -02 and -03 options together
[2] Cannot have -05 and -06 options together

Accessories (Also see Section 20)

Y9111 50Ω BNC to BNC Cable, 3 ft (0.93m)
Y9112 50Ω BNC to BNC Cable, 6 ft (1.85m)
M05-203-601 5¼" Rack Mount, Offset
M05-203-602 5¼" Rack Mount, Center
M05-200-603 5¼" Rack Mount, Dual
M00-203-631 5¼" Rack Mount, w/18" Slides

PM 21XX Modular GPIB Switching System
PM 2122 50Ω Coaxial Switch
PM 2240 TestTeam Software

PM 5390 & PM 5390S

GPIB
IEEE-488



PM 5390

PM 5390 and PM 5390S Programmable RF Generator

- Frequency range 100 kHz...1019.99 MHz
- Built-in GPIB/IEEE-488 interface with remote control LED indication
- Inputs for external AM and FM wideband modulation and external video source
- Push-button controlled video sound and carrier modulation
- Push-button selection of frequency, Δ frequency, sweep time, level and Δ level
- Step function settings for frequency/level, increment/decrement sweep facilities
- Keyboard facilitates swift and accurate entry or all digital parameters
- Output levels from -127 dBm to -7 dBm (PM 5390) or to +13 dBm (PM 5390S)

The PM 5390and PM 5390S, operating beyond 1 GHz, will find wide application in the generation of carrier and subcarrier frequencies for TV, radio and communications, in sensitivity tests and radiation measurements.

Sweep measurements on broadband amplifiers and IF filters, plus signal simulation such as gain/bandwidth and conversion loss or antenna gain, can easily be accommodated.

They will be of special interest for applications associated with cable TV bands, currently increasing UHF ranges and (ultimately) satellite TV. Moreover, the trend towards using programmable generators in automated testing systems, further extends their application potential.

The PM 5390 and PM 5390S are fully-programmable 1 GHz RF generators and provide AM, FM and video modulation, plus a wide range of sweep measurements and both automatic and manual frequency-stepping facilities. The output (100 kHz to 1020 MHz) is highly stable and accurate, and frequency, signal amplitude, frequency increment and sweep time can be digitally selected and displayed.

The heart of these instruments is the main RF oscillator which is used for mixing frequencies generated by voltage controlled oscillators (VCOs) under phase-locked loop control. A 5 MHz crystal oscillator provides a highly stable reference source.

The main oscillator comprises four separate voltage-controlled oscillators (VCOs) from which six discrete frequency bands are produced. Two of these are developed within the main oscillator by a frequency-mixing process. The generated bands cover the ranges 340 to 510 MHz, 510 to 680 MHz, 680 to 850 MHz and 850 to 1020 MHz. Fig. 1 shows a block schematic of this circuitry.

Frequency control is achieved by comparing the output signal from VCO1 mixed with the relevant frequency generated by oscillator VCO2 to a signal from the reference oscillator.

Signals Divided Down

Both signals are divided down to 1 kHz (the reference signal) by a fixed reference divider and the output signal by a programmable divider controlled by the microprocessor. A phase detector ensures that the signals agree in both phase and frequency.

The output from the main oscillator is then fed out to an automatic level control. Amplitude modulation can be added after this stage. Video modulation is also applied here. The final section provides fine and coarse attenuation.

The lower two frequency bands are obtained by mixing the output of the main oscillator with the 510 MHz output of oscillator VCO3. Frequency modulation is applied to this oscillator to ensure constant deviation at different output frequencies.

Standard integrated circuits are used in the phase-locked loop control system. These were developed initially for similar applications in television and broadcast work. These LSIs are designed for use in microprocessor circuits and need few peripheral components.

Careful Attention to Shielding

Particular care has been taken to ensure negligible RF interference. The RF circuitry is split into two separately shielded sections — oscillators in one part and the digital control circuitry in the other — to reduce any possible crosstalk.

As the accuracy of the output frequency is directly related to that of the crystal-controlled reference oscillator, this is contained in a specially shielded compartment in the control box. The circuitry is designed to ensure stability of better than 1 part in 10^{-6}.

Built-In Microprocessor

The built-in microprocessor enables simple and rapid selection of parameters and values via front-panel-mounted push-buttons, and permits the storage of up to 8 sets of parameters for subsequent use. All values are clearly displayed on four separate LED displays. Full remote control is assured via the integral GPIB/IEEE-488*/IEC interface.

**The terms GPIB an IEEE-488 may be used interchangeably throughout this catalog.*

9

PM 5390 & PM 5390S

Modulation

Internal and external AM and FM modulation are important features. AM modulation is effective over the full 1 GHz range, FM modulation is up to 340 MHz.

Video modulation facilities are possible over the full video band with the choice of internal or external AM or FM sound. This makes the instrument an valuable tool in, for example, video equipment production testing.

Internal or External Sweep

Single and continuous sweep modes can both be internally or externally controlled; sweep time can be varied from 0.05 to 20 seconds. Manual or automatic incremental frequency-changing is also provided in the range 1 kHz to 50 MHz, positive or negative. This latter facility is ideal for random sequence testing of TV and/or radio channels.

Extremely Wide Application Potential

The PM 5390 and PM 5390S are designed to cater for almost every possible application in industrial electronics including audio, video and communications. As such, they meet today's need for a versatile, easy-to-use RF signal source having the most comprehensive modulation facilities; with reserve performance for tomorrow's needs.

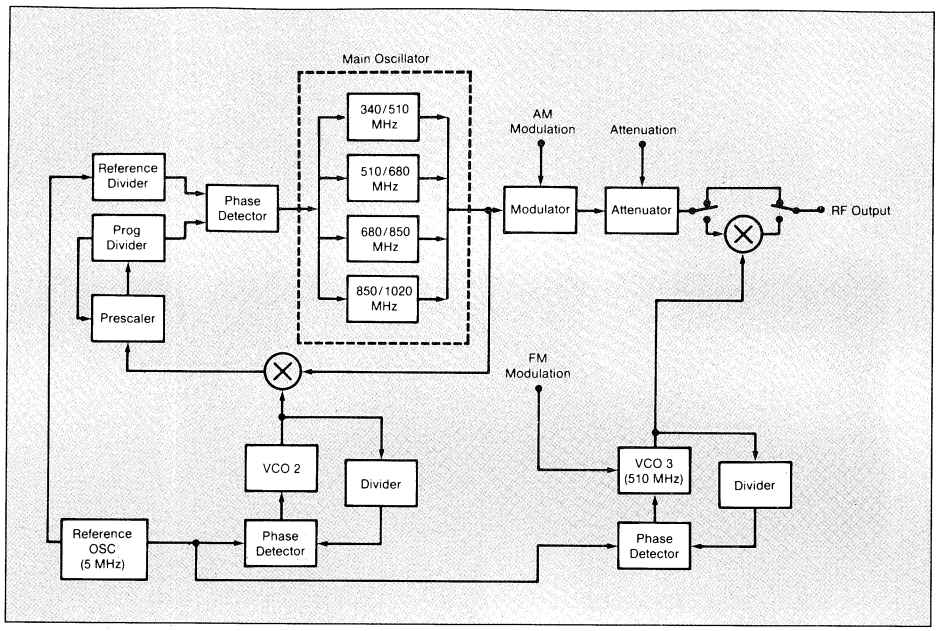


Fig. 1. The PM 5390/90S RF synthesizer functions by mixing frequencies from several oscillators derived from a 5 MHz crystal source.



Detail of the LED panel. The display is subdivided into four parts: 6 digits for the selected RF frequency, (-)4 digits for the incremental frequency, 2 digits for sweep time and 21/2 digits plus polarity indication for the output level.

Specifications

Technical Specifications

Frequency

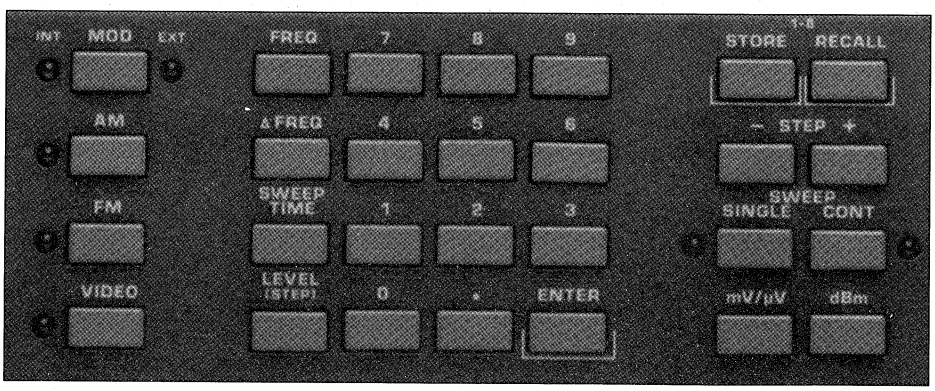
Frequency Range: 100 kHz...1019.99 MHz
Setting: Keyboard, IEEE/IEC bus
Display: 6-digits LED display
Resolution: 0.1-1000 MHz - 1 kHz;
≥1 GHz - 10 kHz
Setting Error: after 30 min. ≤-3 x 10^{-6};
after 80 min. ≤-1 x 10^{-6}

Reference Oscillator
Temperature Effect: ≤1 x 10^{-6}/K
Crystal Aging: ≤1 x 10^{-6}/month

Spectral Purity

	Output level	PM 5390	PM 5390S
harmonics	≤-7 dBm	<-30 dB	<-30 dB
		(-35 dB typ.)	(-35 dB typ.)
	to 0 dBm		-30 dB
	to + 7 dBm		<-25 dB
	to + 13 dBm		-20 dB

Non-Harmonics: <340 MHz: <-30 dB
≥340 MHz: <-40 dB (<-45 dB typ.)
Residual FM: ≤100 Hz (75 Hz typ.)
(0.3 to 3 kHz)
SSB Phase Noise: -100 dBc/Hz
(20 kHz offset at 100 MHz)
Residual AM: <0.5% typ. (10 Hz - 200 kHz)



Detailed view of control panel.

Frequency Increment (Δ FREQUENCY)

Frequency Range: 100 kHz...1019.99 MHz
Increment Range I: 1 kHz...9.999 MHz
resolution - 1 kHz
Increment Range II: 10.00...99.99 MHz
resolution - 10 kHz
Setting: keyboard, IEEE/IEC bus
Settling Time per Increment: 80...240 ms
Indication: 4 digits, LED

Output Characteristics

RF. Output
Impedance: 50Ω
Output Level (into 50Ω):
PM 5390: -127 dBm to -7 dBm
PM 5390S: -127 dBm to +13 dBm
Output Voltage rms (into 50Ω): 0.1 μV...100 mV; 0.1 μV...1V resp.
Setting: keyboard, IEEE/IEC bus
Display: 2-1/2 digits, LED
Dimension: dBm, μV, mV, V
Resolution: 1 dB

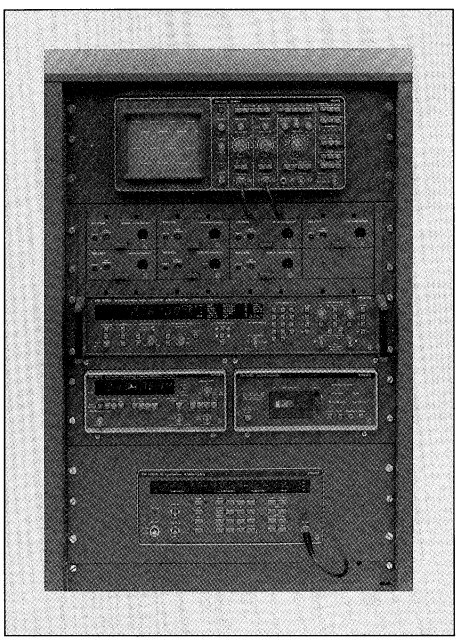
Error:	PM 5390	PM 5390S	Output Level
Setting Error incl. Frequency Response:	±2 dB	±2 dB	-7 dBm <680 MHz +13 dBm
		±3 dB	>680 MHz +13 dBm
Attenuation Error per 1 dB Step	±0.3 dB	±0.3 dB	
- Additional	±0.3 dB ±0.5 dB	±0.3 dB ±0.5 dB	<680 MHz >680 MHz transitions -6 to -7 dB and each -10 dB further

Connection: BNC output socket
Load: Short-circuit proof
Max. External Voltage: ±3.5V

Modulation

Modulation Modes: Frequency range
RF Carrier Unmodulated:
100 kHz...1019.99 MHz
Amplitude Modulation, AM:
100 kHz...1019.99 MHz
Frequency Modulation, FM: <340 MHz
Video without Sound Carrier: >30 MHz
Video Sound Carrier AM int/ext.: >30 MHz
Video Sound Carrier FM int/ext.: >30 MHz

Amplitude Modulation, Internal
Modulated Frequency Range: 100 kHz... 1019.99 MHz
RF level reduces by 6 dB



PM 5390 operating within an automatic testing set up.

Modulation Frequency: 1 kHz, sine wave
Modulation Depth: 30%
Accuracy: ≤5%
Setting: keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Amplitude Modulation, External
Modulated Frequency Range: 100 kHz... 1019.99 MHz
RF level reduces by 6 dB
Modulation Frequency: 20 Hz...20 kHz
Modulation Depth: 0-≥80%
Modulation Coefficient: 10 mVp-p/%
Connection: BNC socket
input impedance: 10 kΩ
max. external voltage: ±5V
Setting: keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Frequency Modulation, Internal
Modulated Frequency Range:
100 kHz... 339.999 MHz
Modulation Frequency: 1 kHz, sinewave
Deviation: ±25 kHz

Frequency Modulation, External
Bandwidth: 20 Hz...100 kHz
Max. Deviation: ±80 kHz (5...339.999 MHz); ≤± 10 kHz (0.1 MHz-<5 MHz)
Modulation Coefficient: 100 mV/7.5 kHz
Connection: BNC socket
input impedance: 10 kΩ
max. external voltage: ±5V
Setting: keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

Video

Modulated Frequency Range:
30...1019.99 MHz
Bandwidth: 8 MHz
Amplitude ext. CVBS-Signal: 1 Vp-p into 75Ω
polarity: negative sync. signal
modulation: negative (or positive)
Residual RF Carrier: 15%
Connection: BNC socket
input impedance: 75Ω
max. external voltage: ±5V
Setting: keyboard, GPIB/IEEE-488/IEC bus
Indication: LED

Sound

Sound Carrier Internal
Spacing of Vision/Sound Carrier: 5.5 MHz (4.5; 6; 6.5 MHz)
tolerance: <0.2%
Vision/Sound Carrier Ratio: 13 dB
Type of Modulation: FM or AM

Internal Sound Modulation
Modulation Frequency: 1 kHz, sine wave
Deviation: ±40 kHz FM mode
Modulation Depth: 30% AM mode
Setting: keyboard, GPIB/IEEE-488/IEC bus
Indication: LEDs

External Sound Modulation
Bandwidth: 50 Hz...20 kHz
Pre-Emphasis: 50µs
Modulation Coefficient FM: 100 mVp-p/8 kHz
Max. Deviation: ±75 kHz
Modulation Coefficient AM: 100 mVp-p/6%
Max. Modulation Depth: 50%
Connection: BNC socket
input impedance: 0.5 MΩ
max. external voltage: ±5V
Indication: LEDs
Setting: keyboard, GPIB/IEEE-488/IEC bus

Frequency Sweep

Within a selectable sweep time the frequency passes through a selectable range Δ FREQUENCY in 50 steps from the start frequency (FREQUENCY) to the stop frequency (FREQUENCY + Δ FREQUENCY)
During fly-back the amplitude is reduced.
Frequency Range: 100 kHz...1019.99 MHz
subrange I: 0.1 MHz...169.999 MHz
subrange II: 170 MHz...339.999 MHz
subrange III: 340 MHz...509.999 MHz
subrange IV: 510 MHz...679.999 MHz
subrange V: 680 MHz...849.999 MHz
subrange VI: 850 MHz...1019.99 MHz
Sweep Width: 50 kHz...50 MHz
Step Width: 1 kHz...1 MHz
Number of Frequency Increments per Sweep: 50
Setting: keyboard, GPIB/IEEE-488/IEC bus
Indication: 4 digits

Sweep Modes

Single Sweep: Indication - LED
Continuous Sweep: Indication - LED
Sweep Time: 50 ms...20s
resolution: 0.01s...1s
setting: keyboard, GPIB/IEEE-488/IEC bus
indication: 2 digits, LED
Flyback Time Output Sweep Voltage: 200 ms

Sweep Time Out

Amplitude: 50 steps of 10 mV each
Impedance: 10 kΩ
Max. External Voltage: ±10V

Storage of Parameter Setting

Memory Locations: 8 complete parameter settings
Storage: Buttons STORE 1...8
Store Time: min. 10 days
Battery: NiCd-cell
Setting: keyboard, GPIB/IEEE-488/IEC bus

Remote Control

Conformity: IEEE 488/IEC 625
Connection: 24-pole GPIB/IEEE-488 bus standard interface
Device Address: Address switch rear side
Remote Indication: LED, remote, front panel
Interface Functions:
AH1 acceptor handshake capabilities
L2 Listener only
RL2 Remote/Local capability
DC1 Device clear capability
Delimiters: Comma, LF (NL = New Line) EXT, ETB
Control Functions: Fully remote controllable

PM 5390 & PM 5390S

Settling Time
Interface Reaction Time: 2...20 ms typical 5 msec
Frequency Settling Time: 15...120 ms
Level Settling Time: 5 ms

General Specifications

Power Requirements

Reference Value: 220V
Nominal Values: 110V/128V/220V/238V, selectable by wiring
Nominal Operating Range: ±10% of selected nominal value
Operating Limits: ±10% of selected nominal value
Nominal Frequency Range: 50/60 Hz tolerance: ±5% of nominal frequency range
Power Consumption: 44W/53W

Environmental Capabilities

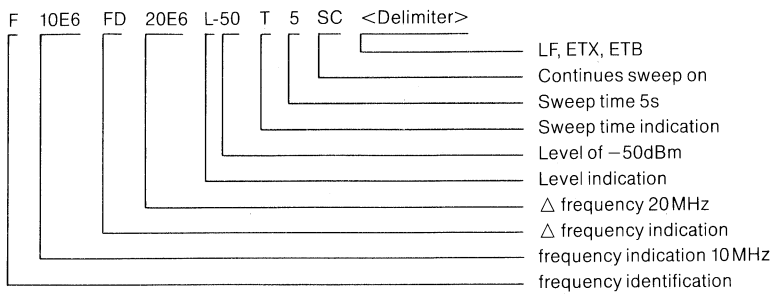
Ambient Temperature:
Reference Value: +23°C ±1K
Nominal Working Range: +5°C...+40°C
Limits for Storage and Transport: -40°C...+70°C

Cabinet
Protection Type (see DIN 40050): IP 20
Protection Class (see IEC 348): Class I, protective conductor
Line Connection: Mains connector; Shielding; RF-unit double screened

Mechanical Specifications

Size: 310 mm W x 140 mm H x 430 mm L (12.2 in W x 5.5 in H x 17 in L)
Weight: 9.9 kg (22 lb)
Included: Operating manual, power cable

PROGRAMMING EXAMPLE



Ordering Information

Models

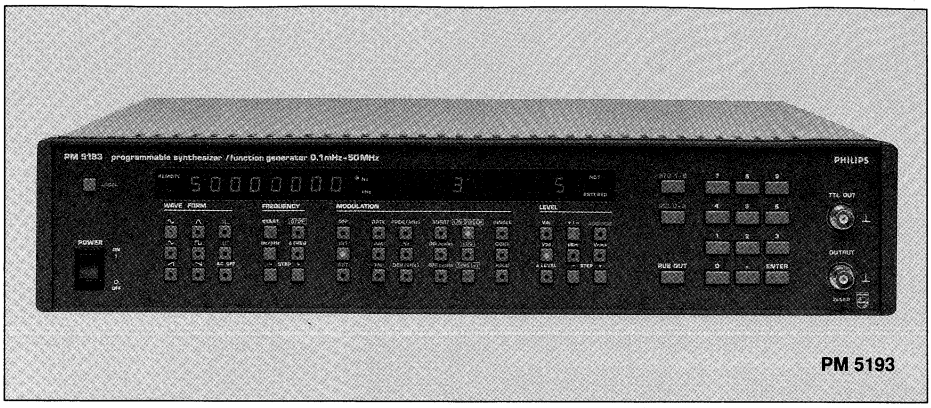
PM 5390 Programmable RF Generator 1 GHz
PM 5390S Programmable RF Generator 1 GHz

Accessories

PM 9075 Coaxial Cable BNC-BNC
PM 9585/01 50Ω Termination, 1W
PM 2295/10 GPIB/IEEE-488 Bus Cable (1 meter)
PM 2295/20 GPIB/IEEE-488 Bus Cable (2 meters)
PM 2295/05 GPIB/IEEE-488 Cable (0.5 meters)
PM 2296/50 GPIB/IEEE-488/IEC Adapter
PM 2296/60 IEC/GPIB/IEEE-488 Adapter
PM 9075 Coaxial Cable BNC-BNC
PM 9560 19-in Rackmount Adapter
PM 9585/01 50Ω Termination, 1W

PM 5193

GPIB IEEE-488



PM 5193 50 MHz Programmable Synthesizer/Function Generator

- 8 Standard waveform outputs (operator programmable)
- Wide 0.1 mHz to 50 MHz frequency range
- Maximum 20V p-p outputs plus TTL output
- Completely independent AC and DC settings
- Full 8-digit resolution with clear, unambiguous LED readout panel
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Comprehensive modulation facilities including FM, AM, GATE, SWEEP, BURST

Wherever a high-stability, high-reproducibility frequency and function generator is required for testing, production or driving frequency-dependent equipment, the PM 5193 is an unbeatable choice. Its versatile capacity for generating standard functions, plus a broad frequency range extending from 0.1 mHz to 50 MHz, cover the requirements of virtually every situation.

The PM 5193 is today's most cost-effective multi-functional combination of programmable frequency synthesizer and function generator.

11-1/2 Decade Frequency Range

The frequency range of the PM 5193 covers a full 11-1/2 decades, from 0.1 mHz to 50 MHz. And to make working with this high-precision instrument as simple as possible, no less than 8 different waveforms are directly selectable. That includes standard functions like the sine, squarewave, sawtooth and ramps, as well as important extras like pulse; both positive and negative; and haversine.

Instantly Selectable Modulation Modes

All required modulation modes are also instantly available at the touch of a button, covering AM, FM, sweep, burst and gating. Parameters like start and stop frequencies, amplitude and DC offset are easily programmable. And up to 10 complete front panel settings can be stored in non-volatile memory for instant recall whenever they are needed.

Precision and Stability

High precision and stability are essential factors in an instrument of this class. A crystal oscillator serves as a reference standard for all generated frequencies and provides an extremely high standard of accuracy. This feature, together with outstanding long-term stability ensures the extremely high level of repeatability that is one of the fundamental characteristics of the PM 5193.

Frequency resolution is a full 8 digits, so that advantage can be taken of the PM 5193's inherently high precision; useful in the identification and measurement of phenomena occurring at precisely defined frequencies.

GPIB Compatibility

Full GPIB/IEEE-488*/IEC-625 bus compatibility adds an important extra dimension to the PM 5193's versatility. All functions are remotely selectable, and all settings and status data can be transmitted to a remote controller and recalled whenever required.

The PM 5193 combines powerful user-features combined with operational simplicity. The front panel is divided into clear, separate keypad areas, and three informative LED displays show frequency, modulation parameters, output level and status, at a glance.

Local Button

The local button provides a remote lock-out facility, so that manual changes can be made to current settings.

Waveform Selection

The waveform keypad area allows selection of the PM 5193's 8 standard waveforms: sine, pulse (positive and negative), squarewave, haversine, triangle and sawtooth (positive and negative). The additional AC off button switches off AC components so that only the DC offset of a waveform (where selected) is output.

All buttons have an LED indicator to show at a glance which functions are selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Frequency Selection

Key symbol	Waveform	Max. frequency	Output V p-p (open loop)
∿	Sine	50 MHz	0...20
⊓	Positive pulse	50 MHz	1...10
⊔	Negative pulse	50 MHz	1...10
⊓⊔	Squarewave	20 MHz	0.2...20
∧∨	Triangle	200 kHz	0...20
⌒	Haversine	50 kHz	0...10
◿	Positive sawtooth	20 kHz	0...10
◺	Negative sawtooth	20 kHz	0...10

The frequency keypad area is used for precise programming of all frequency-related settings, including continuous wave frequencies, sweep start and stop frequencies, choice of Hz/kHz, and Δ frequency programmable step widths for discrete frequency steps. The preset frequency steps can then be repeated manually in either direction using the step + or - buttons.

Start and stop frequency values are programmed via the numeric keyboard, where they are input using the ENTER button. The RUB OUT key in the numeric keypad allows values to be corrected before entry.

The maximum frequency resolution is 0.1 mHz, and a total resolution of 8 digits is always available.

Sweep Modes

The PM 5193 has several sweep capabilities for testing, in a broad range of applications such as Phase Lock Loops, Amplifiers, IF units, Filters etc. All sweep parameters are programmed via the keyboard, for example start frequency, stop frequency, sweep time, linear or logarithmic, and single or continuous sweep. There are 3 sweep modes (see figure 1,2 and 3).

The PM 5193 can be programmed to have the start frequency higher than the stop frequency or vice versa.

There are 3 sweep modes. (See Fig. 1,2 and 3. The PM 5192 can be programmed for the start frequency to be set higher than the stop frequency or vice versa.

**The terms GPIB and IEEE-488 may be used interchangably throughout this catalog.*

9

PM 5193

Sweep Mode 1

Standard sweep

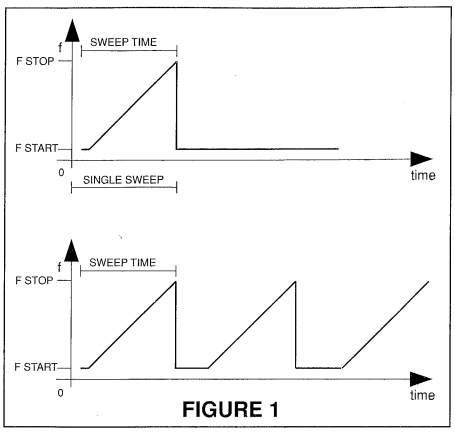


FIGURE 1

Sweep Mode 2

For single shots, when the stop frequency is reached, the output remain at the stop frequency, with no flyback, until the "single" key (T_1) is pressed. The continuous sweep is the same as in sweep mode 1.

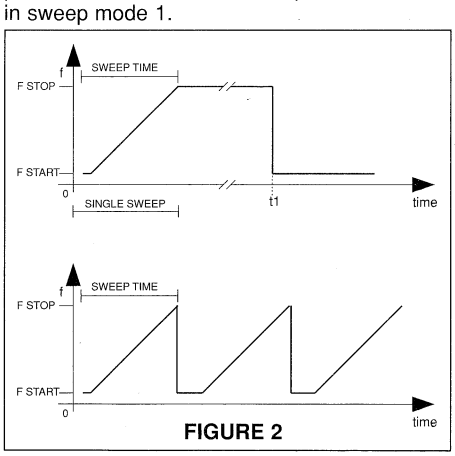


FIGURE 2

Sweep Mode 3

In this mode the frequency is increased and decreased during the double sweeptime.

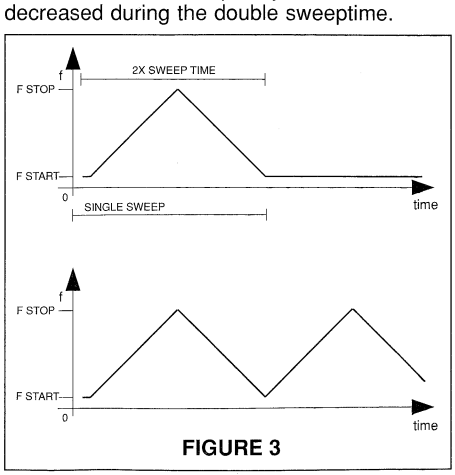
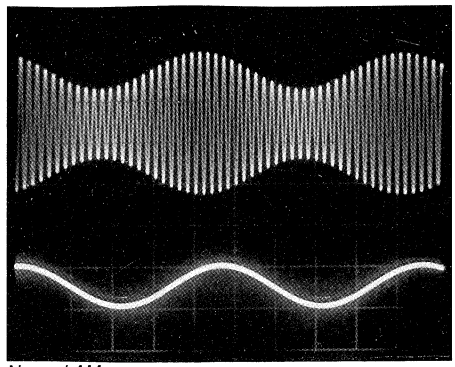
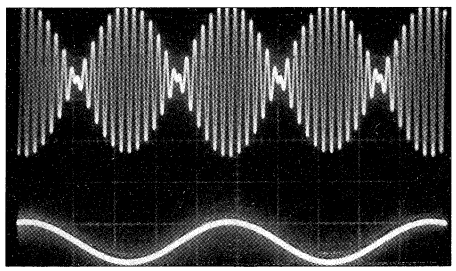


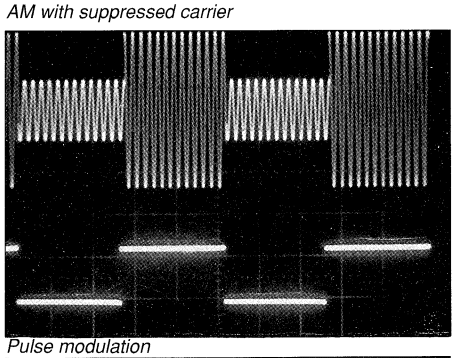
FIGURE 3



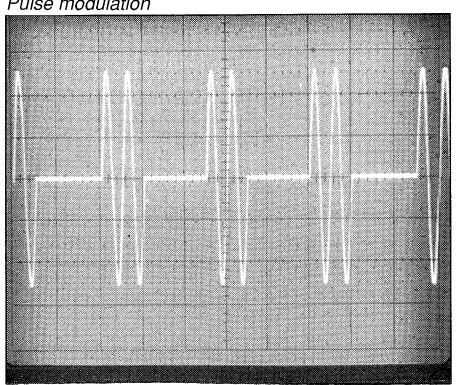
Normal AM



AM with suppressed carrier



Pulse modulation



Burst signal, programmable on/off cycles; 2 on, 3 off cycles.

With the sweep modes there are more than 20 sweep selections that can be made. The sweep range is from 1 mHz to 50 MHz with the times programmable between 10 ms...999s.

Modulation Modes

The PM 5193 has various modulation modes AM, FM, Burst etc.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superimposed sinewave (DC= -1.4V) generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave for pulse modulation. On-off amplitude ratio is adjusted using the external square wave.

Output Level Setting

Selection of output levels in Vp-p, Vrms or dBm is by means of a special keypad, and the selected output voltage is shown on the 3-digit LED display. The step function (Δ level) allows quick output-level changes in user defined steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including a TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±10V window. These settings are therefore independent of each other within this window. A warning is given by a flashing key LED if any combined AC + DC setting exceeds the maximum preset output level.

Store and Recall Functions

The store and recall buttons allow up to 10 complete front panel settings to be stored and recalled at any time. The last front panel setting is automatically stored under '0', so that work can conveniently be resumed with the same settings in the next session. Up to nine additional settings can be stored in locations 1 - 9. Settings are stored in a non-volatile memory with battery back-up, providing assured storage over an extended period.

Wide Choice of Waveforms and Modulation Modes

Setting of the output is fast, simple and extremely logical using one set of pushbuttons grouped into four function fields for waveform, frequency, modulation and output characteristics, plus a common keyboard for entry of numeric values. Each function key has a built-in LED to indicate activation.

All the selected values are displayed on a bright, clear LED display for immediate and unambiguous readout showing frequency, (8 digits), modulation parameter (4 digits) and output level or DC offset (3 digits).

Function selection can also be done remotely, for example, from a system controller, through the built-in GPIB/IEEE-488/IEC-625 interface.

PM 5193's built-in capability to operate as a

programmable "stand-alone" continuous wave pulse generator adds more versatility in everyday operation. Frequency range in this mode is up to 50 MHz, with a typical rise and fall time of 3 ns. The pulse generator can be programmed for positive or negative pulses, and the duty cycle is fixed at 50%.

Other features include AC output dimensions selectable as V p-p, Vrms or dBm; phase-continuous sweep over all 10 frequency decades; independent AC and DC settings; and a TTL output conveniently located on the front panel.

IEEE-488 Address Setting

Setting of a GPIB/IEEE-488 system address is carried out very conveniently by a direct-entry keyboard, instead of the usual DIP switches (which in many cases are inaccessibly located on a rear panel or inside the instrument cabinet). With the PM 5193, all that is necessary is to activate the "address" key. The current address is then displayed, and a new address can be programmed if required.

As well as the PM 5193's comprehensive stand-alone features, it also offers advanced facilities for operating within an automated testing system. This form of operation allows large numbers of automatic measurements to be performed continuously and with complete reproducibility, useful in quality control situations.

The instrument operates as a talker/listener, and can be remotely programmed for all manual and triggered functions, including SWEEP and (programmable) burst. Moreover, the SERVICE REQUEST function can be generated to give error indications. END messages (e.g. for SWEEP and BURST in SINGLE SHOT mode).

A pushbutton-operated remote lock-out facility allows the user to lock-out the controller when making manual changes to the current setting.

Learn & Identification Modes

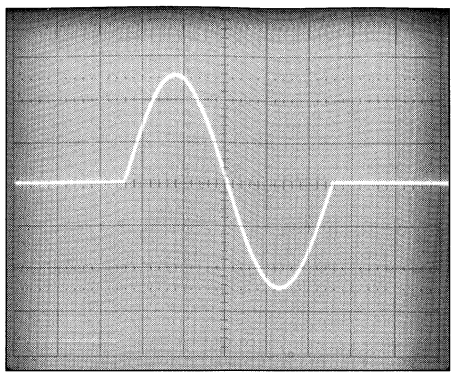
PM 5193 has additional Learn and Identification modes to facilitate programming and operation in GPIB/IEEE-488-bus environments.

Learn mode makes it possible to send a complete string of instructions representing any particular front panel settings to a controller. These settings can be reproduced simply whenever required from the controller by the transmission of the corresponding string to the PM 5193. This mode reduces programming to a minimum, and contributes to the PM 5193's ease of integration into automated measuring systems.

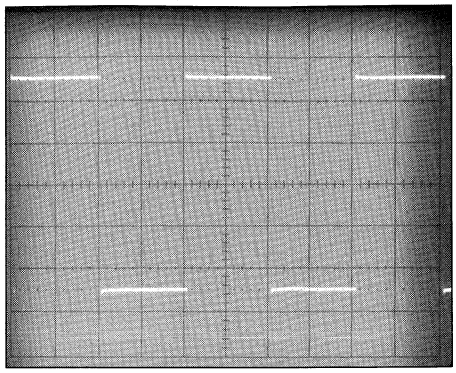
In identification mode, the PM 5193 automatically responds to an identification request from the controller by transmitting its type number and software version.

Rack Mounting Facilities

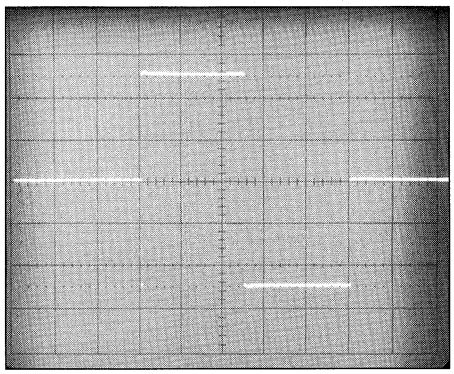
PM 5193 is supplied as standard with the necessary hardware for rack mounting, further-increasing its flexibility in use. An optional RF output can also be supplied for rack-mounted system interconnection. This will be an output on the back of the unit.



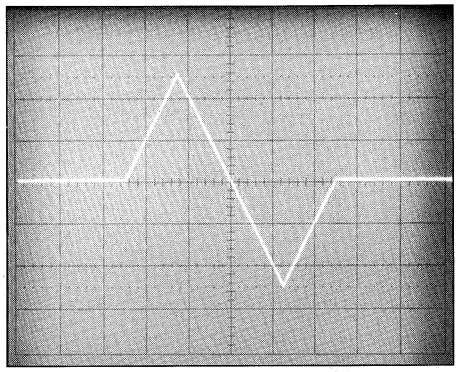
Sinewave



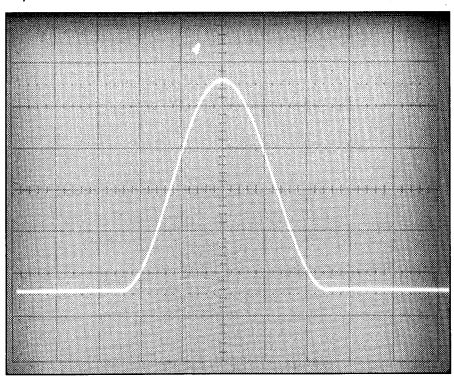
Positive and negative pulses with 3 ns transition time.



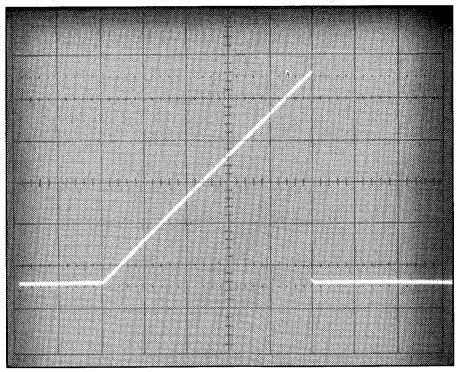
Squarewave



Triangle



Haversine



Positive and negative ramps

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of the PM 5193:

Inputs:

Ext. clock: The PM 5193S can lock-on to external 10 MHz reference signals which are applied to this BNC connector. The PM 5193 can lock onto external reference signals from other PM 5191/5192/5193 generators (8.6 MHz).

Modulation: The PM 5193's range of external modulation modes can be used by applying the modulation signal to this BNC connector.

Outputs:

Int. clock: The reference frequency of (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronisation purposes.

Modulation: The signal output from the PM 5193's programmable modulation frequency source is available on this socket for triggering purposes.

Penlift + Sweep: These two signals enable the PM 5193 to be connected directly to an X-Y recorder, for example for plotting the frequency response characteristics of filters.

GPIB/IEEE-488 Connector: For direct connection of the PM 5193 into GPIB/IEEE-488-bus-oriented measuring systems. The shielded GPIB/IEEE-488 connector provides optimal security against the disturbance of data.

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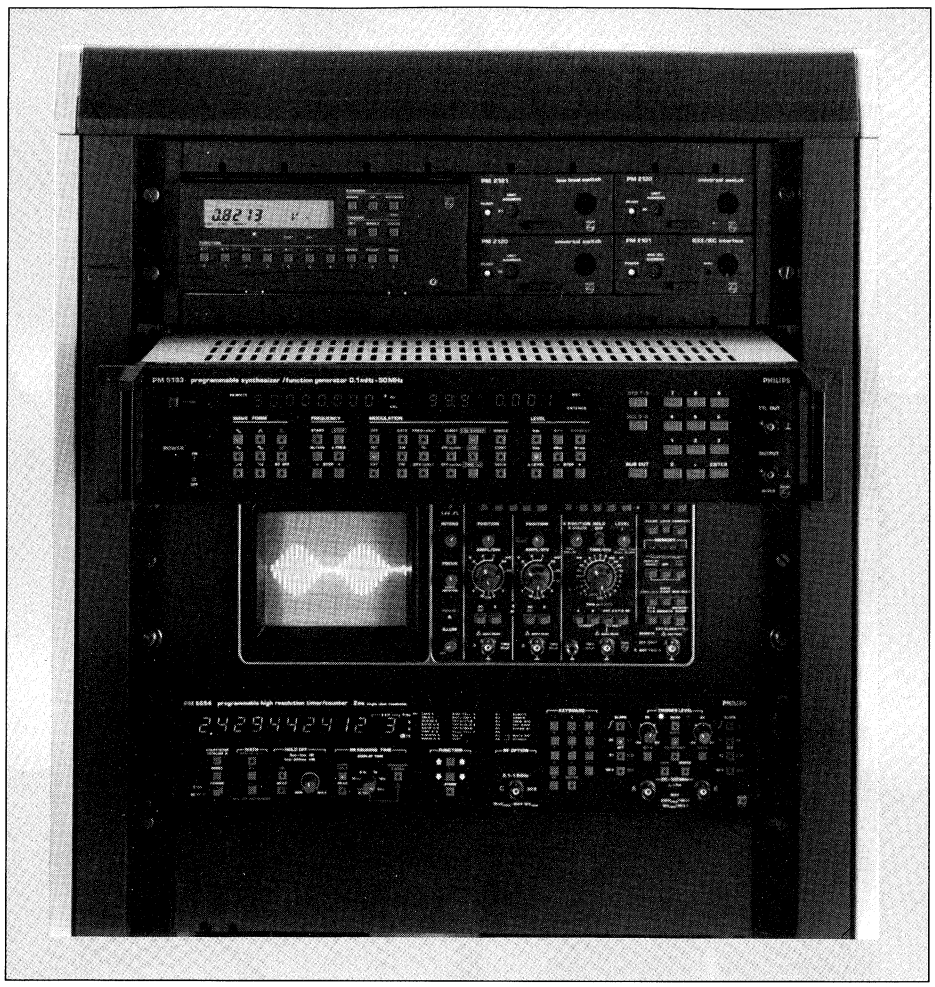
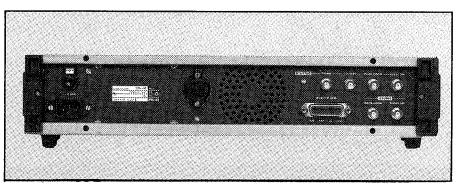
PM 5193





Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 mHz - 50 MHz
Operational Range: Sinewave 50 MHz
Positive pulse 50 MHz
Negative pulse 50 MHz
Squarewave 20 MHz;
Triangle 200 kHz;
Haversine 50 kHz
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard. Remote via IEEE-488 bus interface ± stepping function with programmable step width
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: <1 x 10^{-6}
Frequency Jitter: ,0.02%, <1200 Hz; f ≥2 MHz, LF bandwidth 10 Hz - 20 kHz
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h

Output Characteristics

Connector: BNC socket on front or rear panel
Impedance: Z_0 = 50Ω
Load Capability: Short-circuit proof
Max. External Voltage: ±12V p-p (<3 min.)

AC Voltage

Independent of DC settings within ±10V window
Ranges: I 2.1 - 20V p-p open-circuit voltage;
II 0.21 - 2.00V p-p open-circuit voltage;
III 0 - .200V p-p open-circuit voltage
Resolution: Range 1 0.1V; Range II 0.01V; Range III 0.001V
Setting: Remote or local +/- stepping Programmable step width
Alternative Settings: Vrms, dBm
Basic Setting Error: ±2% (1 Hz - 200 kHz) V p-p >2.1V

DC Voltage

Independent of AC setting within ±10V window
Range: ±10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting
Offset: <0.03V (Vac ≤2V); <0.08V (Vac >2V)
Setting: Remote or local; +/- stepping function. Programmable step width

TTL Output

Connector: BNC socket on front panel
Fan-Out: 5 TTL inputs
Level: 0/>3.5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, haversine, sawtooth (positive- and negative-going ramps), positive and negative pulse
Selection: Local via front panel keyboard. Remote via GPIB/IEEE-488 bus interface
Indication: Key LEDs

Sinewave

Frequency Range: 0.1 mHz ... 50 MHz
Output Range: 0...20V p-p

Distortion

THD: typ. 92%, <0.5% (f = 1 Hz-200 kHz)
typ. 0,4%, <0.7%, (f = 200 kHz...2 MHz)
Harmonics:<-37 dBc (f<10 MHz, Vp-p >10 mV)
Spurious: <-40 dBc (2 MHz< f <50 MHz, open circuit voltage ≥100 mV p-p, distance from carrier >15 kHz)
<-50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mV p-p)

Haversine

Frequency Range: 0.1 mHz... 50 kHz
Output Range: 0... 10V p-p
Distortion: <0.8% (output >10 mV p-p)

Squarewave

Frequency Range: 0.1 mHz - 20 MHz
Transition Times: 10 ns typically, <11.5 ns
Duty Cycle: 50%
Aberration: <2% ±3 mV range II; <2% ±20 mV range I

Triangle

Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 20V p-p
Temerature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)

Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 10V p-p

Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: <99%

Pulse

Frequency Range: 0.1 mHz... 50 MHz
Output Range: 1.0 ... 10V p-p
Rise/Fall Time: 3 ns typical, <4.5 ns
Aberration: <2% ±40 mV

Modulation

Modes: AM int. /ext., FM int./ext., lin./log. sweep, gate int./ext., burst
Internal modulation frequency programmable via keypad
Resolution: Range I (0.01 - 0.99 kHz): 10 Hz
Range II (1.0 - 9.9 kHz): 0.1 kHz
Range III (10 - 200 kHz): 1.0 kHz

Internal AM

Carrier Frequency: 0.1 mHz - 50 MHz, carrier wave: all except pulses
Modulation Frequency: 10 Hz... 200 kHz
Modulation Depth: 0 - 100%
Resolution: 1%
AM Envelope Distortion: <2% (m ≤98%); <1.5% (m <50%, fm 100 Hz - 20 kHz)

External AM

Modulation Frequency: 0 - 200 kHz
AM Envelope Distortion: 2% (m <98%); 1.5% (m<50%; fm 100 Hz - 20 kHz)

Internal FM

Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz ... 200 kHz
Deviation: 10 kHz ... 200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% (f ≤30 MHz; Df ≤100 kHz; fm ≥200 Hz... ≤50 kHz)

External FM

Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz ... 200 kHz
Deviation: 10 kHz... 200 kHz
Distortion: <1%

Sweep

Carrier Wave: All waveforms
Sweep Functions: lin./log., up/down, single/continuous, hold/release
Range: 1 mHz... 50 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms - 999s
Resolution: Max. 0.01s (3 digits)
Error: 0.1 ms, sweeptime ≤4s

Internal Gate

Non phase-coherent signal keying
Carrier Frequency: 0.1 mHz - 50 MHz (depending on waveform): carrier wave: all except pulses
Modulation Frequency: 10 Hz ... 200 kHz
Duty Cycle: 50%

External Gate

Modulation Frequency: 0 ...500 kHz; min. on/off time 2 µs

Burst

Carrier Frequency: <2 MHz (depending on waveform) all carrier waveforms
On and Off Cycles: 1...200 programmable
Burst Functions: Single/continuous
External Triggering: TTL positive edge; via modulation input
Max. Repetition Rate: 1 kHz

Video Modulation (PM 5193V only)

Carrier Waveform: Sine
Carrier Frequency: ≤50 MHz
Modulation Bandwidth (-1 dB): ≥8 MHz; carrier frequency <45 MHz
External Modulation Signal: CVBS; amplitude: 1V p-p
Max. DC Offset: ±5V
Modulation Mode: Double sideband amplitude modulation (A3F), negative poarity
RF Synchronising Level: 100%
Residual Level (white level): 11 ±3%; related to RF synchronising level
Independent Linearity Error: ≤2% between black and white level
Connector: BNC; "VIDEO IN" at rear of the instrument
Impedance: 75Ω

GPIB/IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6.
Listener Address: Programmable via keyboard, indicated by LED display
Address Range: 0...30
Service Request: Error and single end message
Remote Lock-Out: Go-to local front panel key. Device identification and learn modes provided as standard

10 MHz Output (PM 5193S only)

Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBm
Impedance: 50Ω
External Reference Input (PM 5193S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\ \text{MHz}}{N}$ N = 1,2,3...10 for Synchronisation purposes <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBm
Impedance: 50Ω

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for last setting. 9 memory locations for programmable settings.
Rear Connectors: Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation Input BNC; Clock input BNC; GPIB/IEEE-488 bus connector; Mains connector

Operating Conditions

Reference Temp: +23°C ±1°C
Operating Temp: +5°C...+40°C
Storage Temp: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 105W

Mechanical Specifications

Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 15.6 in L). Space rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)
Included with Instrument: Operating manual, programming card, rack mounting brackets

Ordering Information

Model

PM 5193 Programmable Synthesizer/Function Generator
PM 5193S Programmable Synthesizer/Function Generator with 10 MHz reference input
PM 5193V Programmable Synthesizer/Function Generator with video modulation

Option

Rear Panel Output

Accessories

PM 9581 50Ω Feed-through Termination 3W
PM 9585 50Ω Feed-through Termination 1W
PM 2295/05 GPIB/EEE-488 Cable 0.5m
PM 2295/10 GPIB/IEEE-488 Cable 1m
PM 2295/20 GPIB/IEEE-488 Cable 2m
PM 2296/50 GPIB/IEEE-488 to IEC-625 Adapter
PM 2296/60 IEC-625 to GPIB/IEEE-488 Adapter
PM 9051 BNC to 4 mm Banana Adapter

PM 21XX Modular GPIB SwitchingSystem
PM 2122 50Ω coaxial switch
PM 2132 18 GHz Switch Unit
PM 2230 Instrument Drivers Software
PM 2240 TestTeam Software
Service Manual

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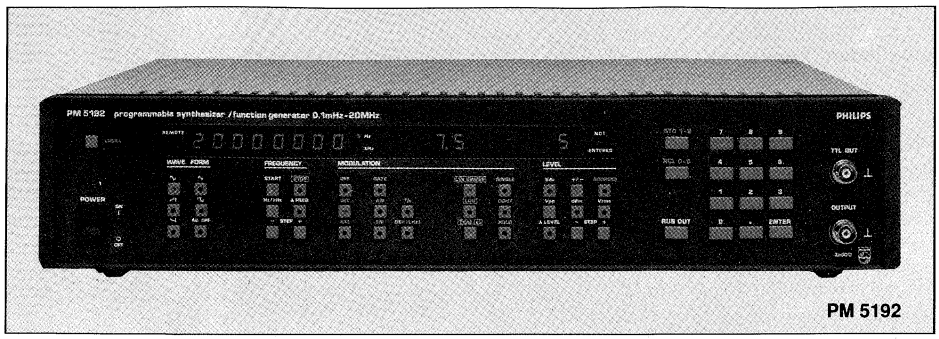
PM 5192

GPIB
IEEE-488



PM 5192 20 MHz Synthesizer/Function Generator

- Five standard waveform outputs
- Crystal-controlled precision and stability 0.1 mHz to 20 MHz frequency range
- Maximum 20 Vp-p output plus TTL output
- Completely independent AC and DC settings
- Full 8-digit resolution with clear LED read out
- Remote control of all programmable functions via GPIB/IEEE 488 Interface
- Modulation facilities include AM, FM, GATE, SWEEP

The PM 5192 is a precision frequency source with the assurance of long term stability and reproducibility. A crystal oscillator serves as a reference for the generated frequencies, ensuring that the PM 5192 will always continue to provide the selected frequency to a very high standard of accuracy.

Setting error is negligible at $<1 \times 10^{-6}$, and the exceptionally low aging figure of 1 p.p.m/year makes the PM 5192 accuracy a true reference standard for applications in R & D, production-line testing and quality control, and many other fields of engineering.

PM 5192 frequency range extends from 0.1 mHz to 20 MHz (the actual range depends on selected waveform). Output voltages are continuously adjustable up to 20 Vp-p, and can be expressed in Vp-p, Vrms or dBm.

Frequency resolution is a full 8 digits, a figure that represents only 1 Hz in 20 MHz, allowing full advantage to be taken of the PM 5192's very high precision, useful in the identification and measurement of phenomena occurring at precisely defined frequencies.

A choice of five different waveforms covers almost all standard-function requirements, with sine, square wave, triangle and sawtooth (positive and negative going).

PM 5192 Outstanding capabilities and precision are combined with an economic cost, making this instrument an attractive general purpose tool for a very wide range of different applications.

Programmable Parameters

Parameters such as start and stop frequencies, amplitude and DC offset are easily and quickly programmed using the front panel keyboard. For more convenience and time saving, up to 10 complete front panel settings can be stored in non-volatile memory for instant recall whenever required.

A sweep function, with independently programmable sweep parameters provides localisation of areas of interest, followed by close examination of particular frequency bands of interest.

Compatibility

To increase versatility still further, the PM 5192 has full GPIB/IEEE-488* bus compatibility. All functions are remotely selectable via the bus, while settings and status data can be transmitted to a remote controller and recalled whenever required.

In this systems mode, large numbers of automatic measurements can be made continuously and with complete reproducibility, excellent for quality control applications. Manual setting changes can still be made using a push button operated controller lock-out facility. GPIB/IEEE-488 addresses are set via the numeric keyboard, and can be displayed on the LED display.

Waveform Selection

The waveform keypad area allows selection of the PM 5192 five standard waveforms: sine, square wave, triangle and sawtooth (positive- and negative-going).

All buttons have an LED indicator to show at a glance which functions are selected, as well as to provide a warning of functions for which entries are incomplete.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Waveform Output Levels

Key Symbol	Waveform	Max. Frequency	Output Vp-p (open loop)
∿	Sine	20 MHz	0... 20
⊓	Square	20 MHz	0.2... 20
△	Triangle	200 kHz	0... 20
◿	Positive Sawtooth	20 kHz	0... 10
◺	Negative Sawtooth	20 kHz	0... 10

Precise Frequency Programming

A frequency keypad area allows precise programming of frequency-related settings, including continuous wave frequencies, sweep start and stop frequencies, choice of Hz/kHz, and Δ freq. programmable for discrete frequency steps.

These preset frequency steps can then be repeated manually in either direction using the step + or - buttons.

Start and stop frequency values are programmed via the numeric keyboard, where they are input using the enter button. The rub-out key in the numeric keypad allows values to be corrected before entry. The maximum frequency resolution is 0.1 mHz, and a total resolution of 8 digits is always available.

Sweep Modes

The PM 5192 has several sweep capabilities for testing, in a broad range of applications such as Phase Lock Loops, Amplifiers, IF units, Filters etc. All sweep parameters are programmed via the keyboard, for example start frequency, stop frequency, sweep time, linear or logarithmic, and single or continuous sweep.

There are 3 seep modes (see fig. 1, 2 and 3). The PM 5192 can be programmed for the start frequency to be set higher than the stop frequency or vice versa.

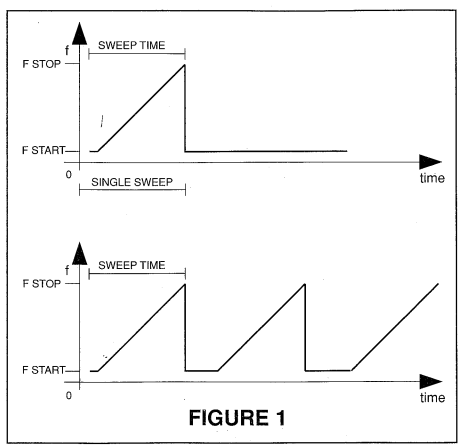


FIGURE 1

Sweep Mode 2

For single shots, when the stop frequency is reached, the output remain at the stop frequency, with no flyback, until the "single" key (T_1) is pressed. The continuous sweep is the same as in sweep mode 1.

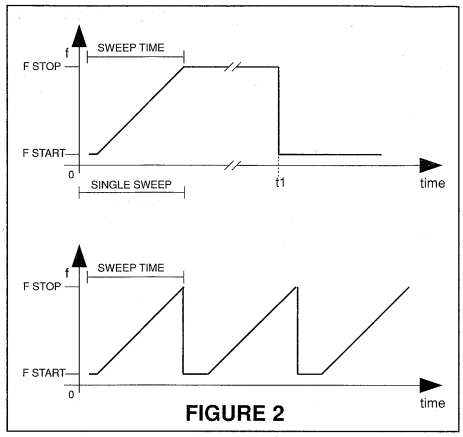


FIGURE 2

Sweep Mode 3

In this mode the frequency is increased and decreased during the double sweeptime.

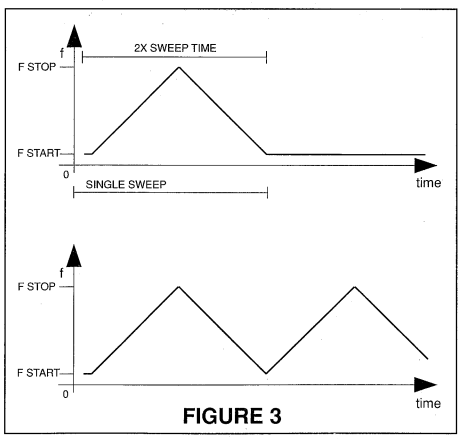


FIGURE 3

With the sweep mode there are more than 20 sweep selections that can be made. The sweep range is from 1 mHz to 50 MHz with the times programmable between 10 ms...99s.

Modulation Modes

The PM 5192 has various Modulation modes including AM, FM, lin/log sweep, etc., with AM/FM internal and external.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superimposed sine wave. With a superimposed sinewave (DC = -1.4V) Amplitude modulation with suppressed carrier can be generated. The carrier can also be modulated with an external square wave.

Output Level Setting

Selection of output levels in Vp-p, Vrms or dBm is by the use of a special keypad, and the selected output voltage is shown on the 3-digit LED display. The step functions (D level) allows quick output level changes in user defined steps. The normal maximum outputs are waveform-dependent (see table).

Signal outputs, including a TTL output are short-circuit proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±10V window. These settings are therefore independent of each other within this window. A warning is given by a flashing key LED if any combined AC + DC setting exceeds the maximum preset output level.

Store and Recall Functions

The store and recall buttons allow up to 10 complete front panel settings to be stored and recalled at any time. The last front panel setting is automatically stored under '0', so that work can conveniently be resumed with the same settings in the next session. Up to nine additional settings can be stored in locations 1 - 9. Settings are stored in a non-volatile memory with battery back-up, providing assured storage over an extended period.

GPIB/IEEE-488 Address Setting

Setting of a GPIB/IEEE-488 system address can be done locally, via the front panel. With the PM 5192, all that is necessary is to activate the 'address' key. The current address is then displayed, and a new address can be programmed if required.

Learn and Identification Modes

Learn and identification modes facilitate programming in system environments. In learn mode, instruction strings for front panel settings can be up-loaded to a controller for later recall, avoiding the need for manual re-programming. In identification mode, the PM 5192 responds to controller identification requests with its type number and software version. Rack-mounting fittings are supplied as standard, further increasing versatility in system environments.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of PM 5192:

Inputs

Ext. clock: PM 5192 S can lock on to external reference signals (10 MHz) which are applied to this BNC connector.

The PM 5192 can lock on to external reference signals from other PM 5191/2/3 generators (8.6 MHz).

Modulation: External frequencies applied to this BNC connector can modulate the carrier in any of PM 5192's modulation modes (AM, FM, gating), or can be used for trigger purposes.

Outputs

Int. clock: The reference frequency (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronisation purposes.

Modulation: The signal output from PM 5192's (1 kHz fixed) modulation frequency source is available on this socket for triggering purposes.

Penlift + sweep: These two signals enable PM 5192 to be connected directly to an X-Y recorder, for example for plotting the frequency response characteristic of filters.

GPIB/IEEE-488 Connector: For direct connection of PM 5192 into GPIB/IEEE-488 bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of GPIB/IEEE-488 data.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 20 MHz
Operational Range:
Sinewave 20 MHz;
Squarewave 20 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard. Remote via GPIB/IEEE-488 bus interface +/- stepping function with programmable step width.
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: $<1 \times 10^{-6}$
Frequency Jitter: <0.01%, <500 Hz, f≥2 MHz, LF bandwidth 10 Hz - 20 kHz
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h
Synchronisation: 2 (or more) PM 5192 generators can be synchronised by rear socket connection.

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: Zo = 50Ω
Load Capability: Short circuit proof
Max. External Voltage: ± 12 Vp-p (<3 min.)

AC Voltage
Independent of DC settings within ± 10V window
Ranges: I 2.1 - 20 Vp-p open-circuit voltage;
II 0.21 - 2.00V open-circuit voltage;
III 0 - 0.200V open-circuit voltage
Resolutions: Range I 0.1V;
Range II 0.01V;
Range III 0.001V
Setting: Remote or local +/- stepping
Programmable step width
Alternative Settings: Vrms, dBm

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PM 5192

Basic Setting Error: ±2% (1 Hz - 200 kHz), range >2.1V

DC Voltage
Independent of AC setting within ±10V window
Range: +/- 10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting
Offset: <0.03V (Vac ≤2V); <0.08V (Vac >2V)
Setting: Remote or local; +/- stepping function Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: 5 TTL inputs
Level: 0/>3.5V

Waveforms
Standard functions: Sinewave, squarewave, triangle, sawtooth (positive- and negative-going ramps)
Selection: Local via front panel keyboard. Remote via GPIB/IEEE-488 bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz ... 20 MHz
Output Range: 0... 20 Vp-p

Distortion
THD: typ. 92%, <0.5% (f = 1 Hz - 200 kHz)
typ. 0.4%, <0.7% (f = 200 kHz - 2 MHz)
Harmonics: <-37 dBc (f<10 MHz, Vp-<10 mV)
Spurious: <-40 dBc (2 MHz<f <20 MHz, open circuit voltage ≥ 100 mVp-p, distance from carrier >15 kHz)
<-50 dBc (0.1 mHz < f <2 MHz, open circuit voltage ≥100 mVp-p, distance from carrier >15 kHz)

Squarewave
Frequency Range: 0.1 mHz - 20 MHz
Transition Times: 10 ns typical, <11.5 ns
Duty Cycle: 50%
Aberration: <2% ± 3 mV range II; <2% ±20 mV range I.

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 20 Vp.p.
Temperature Coefficient: <0.1%/K
Linearity: >99%
Sawtooth (pos/neg. ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 10 Vp-p
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: >99%

Modulation
Modes: AM int./ext., FM int./ext., lin./log. sweep, gate int./ext. internal modulation frequency 1 kHz

Internal AM
Carrier Frequency: 0.1 mHz - 20 MHz
Modulation Frequency: 1 kHz
Modulation Depth: 0 - 100%
Resolution: 1%
AM Envelope Distortion: 1.5% (m<98%); 0.7% (m <50%)
Imp. of mod. source: ≤50Ω

Internal FM
Carrier Frequency: >2 MHz
Modulation Frequency: 1 kHz
Deviation: 10 kHz - 200 kHz
Resolution: 1 kHz
Modulation Distortion: <1% Df ≤100 kHz

External FM
Carrier Frequency: >2 MHz
Modulation Frequency: 10 Hz - 200 kHz
Deviation: 10 kHz - 200 kHz
Distortion: 1%Imp. of Mod. Source:≤50Ω

Sweep
Carrier Wave: All waveforms
Sweep Functions: lin./log., up/down, single/continuous, hold/release, triggered
Range: 1 mHz - 20 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
Sweep Time: 10 ms - 999s
Resolution: Max. 0.01s
Error: 0.1 ms, sweep time <4s

Internal gate
Non-phase-coherent signal keying
Carrier Frequency: 0.1 mHz - 20 MHz (depending on waveform)
Modulation Frequency: 1 kHz
Duty Cycle: 50%

External Gate
Modulation Frequency: 0 - 500 kHz; min. on/off time 2 µs

10 MHz Output (PM 5192S only)

Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBM
Impedance: 500Ω
External Reference Input (PM 5192S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\ MHz}{N}$ N = 1,2,3,... 10 for synchronisation purposes

GPIB/IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 - 30
Service Request: Error and single sweep end message
Remote Lock-Out: Go-to local front panel key Device Identification and learn modes provided as standard

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for current setting, 9 memory locations for programmable setting
Rear Connectors: Modulation output BNC; **Sweep output BNC:** Pen-lift output BNC; Clock output BNC; Clock input BNC; IEEE-488 bus connector; Line connector

Operating Conditions

Reference Temp: +23°C ± 1°C
Operating Temp: +5°C... +40°C
Storage Temp: -20°C... +70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 100W

Mechanical Specifications

Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 16.9 in L)
Rack mounting facility standard (2 units high)
Weight: 10.5 kg (23 lb)
Included: Operating manual, power cord, rackmount brackets, programming card.

Ordering Information

Model

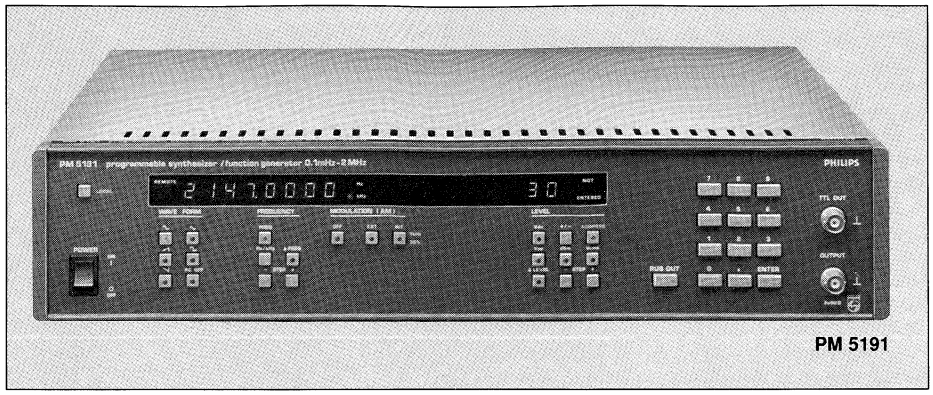
PM 5192
PM 5192S

Accessories

PM 9613 Rack slide kit
PM 9581 50Ω Feed-Through Termination 3W
PM 9585 50Ω Feed-Through Termination 1W
PM 2295/05 IEEE Cable 0.5m
PM 2295/10 IEEE Cable 1m
PM 2295/20 IEEE Cable 2m
PM 9051 BNC to 4 mm Banana Adaptor
PM 21xx Modular GPIB Switching System
PM 2122 50Ω Coaxial Switch
PM 223x Instrument Driver Software
PM 2240 TestTeam Software
PM 2296/50 IEEE-488 to IEC625
PM 2296/60 IEC625 to IEEE488
Service Manual

PM 5191

GPIB IEEE-488



PM 5191 2 MHz Synthesizer/Function Generator

- Five standard waveforms: sine, square, triangle and pos./neg. sawtooth
- Crystal-controlled precision and stability covering 0.1 mHz to 2.147 MHz
- Maximum 30V peak-to-peak output and TTL output
- Completely independent AC and DC settings within the ±15V window
- Full 8-digit resolution with clear LED read-out
- Remote control of all programmable functions via GPIB/IEEE-488 interface
- Internal and external AM modulation

The PM 5191 is a precision frequency source with the assurance of long term stability and reproducibility. A crystal oscillator serves as a reference for the generated frequencies, ensuring the PM 5191 will always continue to provide the selected frequency to a very high standard of accuracy. Distortion is typically a low 0.35% from 1 Hz to 200 kHz. The PM 5191 also offers excellent phase noise of -80 dBc/Hz. Setting error is negligible at $<1 \times 10^{-6}$ and the low aging figure of <1 ppm/year makes the PM 5191's accuracy a true reference standard for applications in R & D, production line testing and quality control, and many other fields of engineering. The PM 5191's frequency range extends from 0.1 mHz to 2.147 MHz (actual range depends on selected wave- form). Output voltages are programmable up to 30V pp and can be expressed in Vpp, Vrms or dBm.

Frequency resolution is a full 8 digits, with a maximum resolution of 0.1 mHz allowing full advantage to be taken of PM 5191's very high precision, useful in the identification and measurement of phenomena occuring at precisely defined frequencies.

A choice of five different waveforms covers almost all standard function requirements, with sine, square wave, triangle and sawtooth (positive and negative going). The PM 5191's outstanding capabilities and precision are combined with an economic cost, making this instrument an attractive, general purpose tool for a very wide range of different applications.

Auto-Store

All parameters like frequency, amplitude and DC offset are easily and quickly entered using the front-panel keyboard. Also the current setting is stored in non-volatile memory, and can be used again after switching on the instrument.

GPIB/IEEE-488 Compatibility

The PM 5191 has full GPIB/IEEE-488*/IEC-625 bus compatibility. All functions are remotely selectable via the bus, while settings and status data can be transmitted to a remote controller and recalled whenever required.

In this system mode, large numbers of automatic measurements can be made continuously and with complete reproducibility, for excellence in quality control applications. IEEE-488 addresses are set via the numeric keyboard, and can be displayed on the 3-digit LED display.

Waveform Selection

The waveform keyboard area allows selection of PM 5191's 5 standard waveforms: sine, square wave, triangle and sawtooth (positive and negative going).

All buttons have an LED indicator to show at a glance which function is selected, as well as to provide a warning of functions for which entries are incomplete.

Waveform Output Levels

Key symbol	Waveform	Max. frequency	Output Vpp (open loop)
∿	Sine	2.147 MHz	0...30
⊓	Square	2.147 MHz	0...30
△	Triangle	200 kHz	0...30
◺	Positive sawtooth	20 kHz	0...15
◿	Negative sawtooth	20 kHz	0...15

Precise Frequency Programming

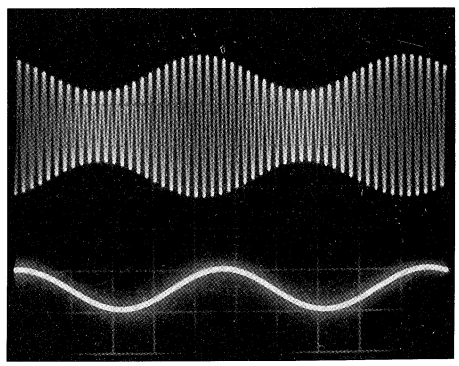
A frequency keypad area allows precise programming of frequency-related settings, choice of dimension (Hz/kHz) and frequency programmable widths for discrete frequency steps. User defined frequency steps can be repeated manually in either direction using the step + or - buttons. Frequency values are programmed via the numeric keyboard, using the ENTER button. The RUB-OUT key on the numeric keypad allows values to be corrected before entry.

Modulation Modes

The PM 5191 has an internal amplitude modulation with a modulation frequency of 1 kHz.

In AM external mode the carrier can be modulated with a frequency between DC and 200 kHz. This DC coupled modulation input allows modulation of the carrier not only with a sinewave but also with a square wave, triangle or superposed sine. With a superposed sinewave (DC = -1.4V) you can generate Amplitude Modulation with suppressed carrier.

The carrier can also be modulated with an external square wave, giving pulse modulation. On-off amplitude ratio is adjusted using the external square wave.



Amplitude modulation

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog*

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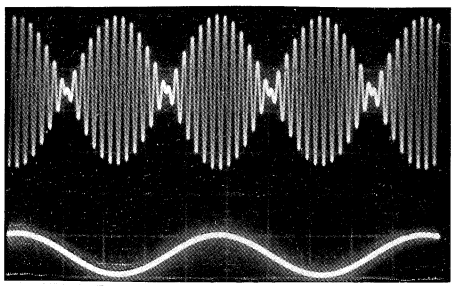
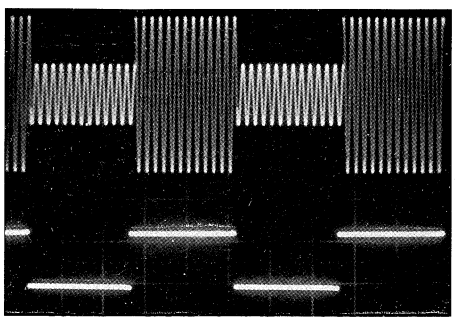
PM 5191



Amplitude modulation with suppressed carrier



Amplitude modulation with squarewave signal

Output Level Setting

Selection of output levels in Vpp, Vrms or dBm is by means of the keypad, and the selected output voltage is shown on the 3-digit LED display. The step functions (Δ level) allow quick output-level changes in presettable steps. The nominal maximum outputs are waveform-dependent (see table).

Signal outputs, including TTL output, are short-circuit-proof and located on the front panel.

Specially developed circuitry prevents any interaction between AC and DC settings within a ±15V window. These settings may therefore be independently programmed. A warning is given by a flashing key LED if any combined AC and DC setting exceeds the ±15V window.

IEEE-488 Address Setting

Setting of an IEEE-488 system address can be done locally, via the front panel. With PM 5191, all that is necessary is to activate the 'address' key. The current address is then displayed, and a new address can be programmed if required.

Learn and Identification Modes

Learn and identification modes facilitate programming in system environments. In Learn mode, instruction strings for front panel settings can be up-loaded to a controller for later recall.

In identification mode, PM 5191 responds to controller identification requests with its type number and software version. Rack mounting hardware is supplied, increasing versatility in system environments.

Rear Panel Connection Facilities

A number of additional connection facilities are provided on the rear panel of PM 5191:

Inputs:

Ext. clock: PM 5191SM can lock onto external reference signals (10 MHz) applied to the BNC connector. The PM 5191M can lock onto external reference signal from other PM 5191/2/3 generators (8.6 MHz)

Modulation: External frequencies can modulate the carrier (AM).

Outputs:

Int. clock: The reference frequency of (10 MHz or 8.6 MHz) is available at the int. clock connector. This frequency can be used for synchronization purposes, for example with other generators PM 5193 and/or PM 5192.

Modulation: The signal output from PM 5191's internal modulation frequency source is available at this socket for triggering purposes.

IEEE-488 connector: For direct connection of PM 5191 into IEEE-488 bus-oriented measuring systems. The shielded IEEE-488 connector provides optimal security against disturbance of IEEE data.

Specifications

Technical Specifications

Frequency Characteristics

Nominal Range: 0.1 mHz - 2 MHz
Operational Range: Sinewave 2.147 MHz;
Squarewave 2.147 MHz;
Triangle 200 kHz;
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
Setting: Local via front-panel keyboard.
Remote via IEEE bus interface +/- stepping function with programmable step width
Resolution: 8 digits; >0.1 mHz
Display: 8-digit LED display, Hz/kHz dimension LEDs
Setting Error: <1 x 10^{-6}
Temperature Coefficient: <0.2 p.p.m./K
Aging: <1 p.p.m. per year
Drift: <0.3 p.p.m. in 7h
Phase Jitter RMS: <3 mrad
Phase Noise: < - 80 dBc/Hz (1 kHz from carrier)

Output Characteristics

Main Output
Connector: BNC socket on front or rear panel
Impedance: Z_o = 50Ω
Load Capability: Short-circuit proof
Max. External Voltage: ±15V p-p (<3 min.)

AC Voltage
Independent of DC settings within ±15V window
Ranges: I 3.1 - 30V p-p;
II 0.31 - 3.00V;
III 0 - 0.300V
Resolutions Ranges: I 0.1V;
Range II 0.01V;
Range III 0.001V
Setting: Remote or local +/- stepping
Programmable step width
Basic Setting Error: ±2.5% (1 Hz - 200 kHz)
(0.31 - 3.00v)

DC Voltage
Independent of AC setting within ±15V window
Range: +/- 10V open-circuit voltage
Resolution: 0.1V
Error: ±2% of setting ±40 mV
Setting: Remote or local; +/- stepping function.
Programmable step width

TTL Output
Connector: BNC socket on front panel
Fan-Out: 5 TTL inputs
Level: 0/5V

Waveforms

Standard Functions: Sinewave, squarewave, triangle, sawtooth (positive- and negative-going ramps)
Selection: Local via front panel keyboard. Remote via IEEE bus interface
Indication: Key LEDs

Sinewave
Frequency Range: 0.1 mHz...2.147 MHz
Output Range: 0...30V p-p
Distortion
THD: <0.35% (1 Hz< f <200 kHz, open circuit voltage >10 mV p-p)
Harmonics: <-35 dBc (200 kHz< f, open circuit voltage ≥10 mV p-p)
Spurious: <-40 dBc (0.1 mHz< f, open circuit voltage >31 mV p-p, distance from carrier >15 kHz)

Squarewave
Frequency Range: 0.1 mHz - 2.147 MHz
Transition Times: <35 ns
Duty Cycle: 50%
Output Range: 0-30 p-p
Abberration: <2% ±3 mV range II;
<2% ±20 mV range I

Triangle
Frequency Range: 0.1 mHz - 200 kHz
Output Range: 0 - 30V p-p
Temperature Coefficient: <0.1%/K
Linearity: >99%

Sawtooth (pos/neg ramps)
Frequency Range: 0.1 mHz - 20 kHz
Output Range: 0 - 15V p-p
Temperature Coefficient: <0.1%/K
Flyback Time: <1 µs
Linearity: >99%

Modulation

Internal AM
Carrier Frequency: 0.1 mHz - 2 MHz
Modulation Frequency: 1 kHz
Modulation Depth: (30 ±2)%
Modulation Distortion: <0.6% (sinewave modulation)

Modulation Output: 0.3V eff ±3%
External AM
Modulation Frequency: 0 - 200 kHz
Modulation Distortion: <1.5% (depth <98%) <0.7% (depth <50%)

10 MHz Output (PM 5191S only)
Protection: Short-circuit proof, max. external voltage 10V
Frequency: 10 MHz (squarewave)
Level: Typ. 2 dBm >0 dBm
Impedance: 50Ω

External Reference Input (PM 5191S only)
Maximum Voltage: ±5V
Waveform: sine or square
Frequency: $\frac{10\ MHz}{N}$ N = 1,2,3...10 for synchronization purposes
Lock-In Time: <2s
Lock-In Range: ±0.1% - a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
Level: 0 - 20 dBm
Impedance: 50Ω

IEEE-488 Bus Remote Control

Control Capability: All signal functions and characteristics
Interface Functions: AH1, L4, RL1, SR1, SH1, T6
Listener Address: Decimal programmable via keyboard, indicated by LED display
Address Range: 0 - 30
Service Request: Error message
Remote Lock-Out: Go-to local front panel key
Device Identification and learn modes provided as standard

General Specifications

Miscellaneous

Non-Volatile Memory: 1 memory location for current setting
Rear Connectors: Modulation output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE bus connector; Mains connector

Operating Conditions

Reference Temp.: 23°C ±1°C
Operating Temp.: 5°C...40°C
Storage Temp.: -20°C...+70°C

Power Requirements

Line Voltage: 100, 120, 220, 240V, tolerance ±10%
Line Frequency: 50 - 60 Hz, tolerance ±5%
Power Consumption: 100W

Mechanical Specifications

Size: 105 mm H x 440 mm W x 430 mm L. (4.1 in H x 17.3 in W x 16.9 in L)
Rack mounting facility standard (2 units high)
Weight: 10 kg (22 lb)
Included: Operating manual, line cord, rack-mounting brackets.

Ordering Information

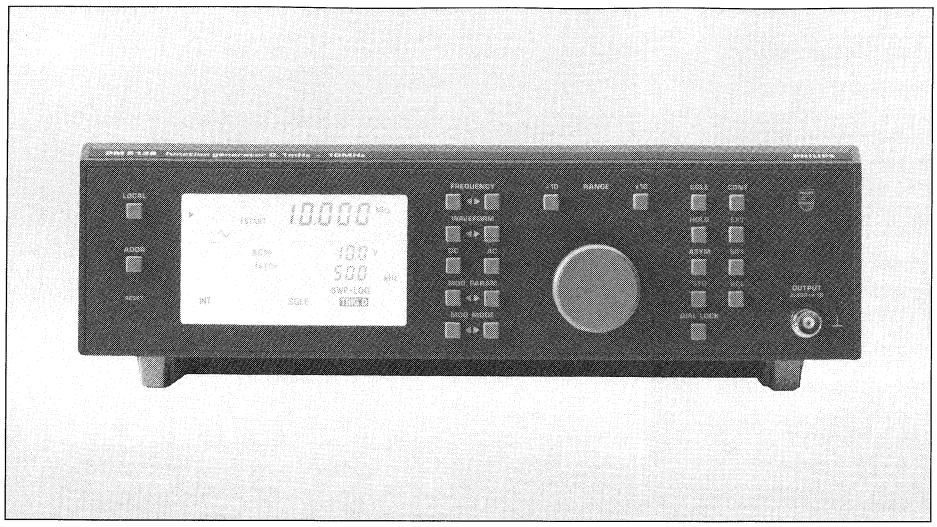
Model

PM 5191 Synthesizer/Function Generator
PM 5191S (with 10 MHz ref. input)

Accessories

PM 9581 50Ω Feed-Through Termination 3W
PM 9585 50Ω Feed-Through Termination 1W
PM 2295/05 IEEE Cable 0.5m
PM 2295/10 IEEE Cable 1m
PM 2295/20 IEEE Cable 2m
PM 2296/50 Bus Adapter, GPIB/IEEE to IEC
PM 2296/60 Bus Adapter IEC to GPIB/IEEE
PM 9051 BNC to 4 mm Banana Adapter
PM 21xx Modular GPIB Switching System
PM 2122 50Ω Coaxial Switch
PM 223x Instrument Drivers Software
PM 2240 TestTeam Software

PM 5138



PM 5138 10MHz Function Generator

- Large backlit Liquid Crystal Display (LCD).
- Wide frequency range 0.1 mHz — 10 MHz.
- Sine, square, triangle, positive or negative pulses and ramps.
- Arbitrary waveforms for instruments with GPIB/IEEE - 488* interfaces.
- Output level 1 mV — 20 Vp-p.
- Internal & external modulation modes AM, FM, PSK, sweep, burst and gate.
- GPIB/IEEE - 488* controllable.

The PM 5138 is a sophisticated high performance instrument, which introduces new concepts of waveform generation and frequency synthesis. It embodies a wide range of features in a single instrument. The PM 5138 is menu driven, controlled by fingertip action control pushbuttons and a large rotary control to provide precise settings for all numeric values.

Versatile Outputs

The PM 5138 produces outputs of sine, square, triangular, positive or negative pulses or positive or negative ramp waveforms. The duty cycle is infinitely variable between 1 and 99%. The frequency range of the instrument is between 0.1mHz and 10 MHz. Frequency selection is achieved using the front panel pushbuttons x10 and ÷10 for coarse selection and using the large rotary control to provide for precise adjustment.

The settings of all controls are displayed on a large backlit LCD. This gives the operator an immediate readout of all vital parameters and reduces any operating errors to a minimum. The large display covers all aspects of the instrument settings, including frequency, output voltage, waveform detail, amplitude, offset, duty cycle and modulation.

Operation of the PM 5138 is simple. To change a setting all that is required is to select the appropriate menu line and depress the corresponding pushbutton. In each case the selected menu line is indicated by an arrow on the LCD.

Liquid Crystal Display (LCD)

The full LCD is shown in the photograph. Features available can be stepped through by operating the appropriate pushbuttons which are then highlighted in sequence on the display. Any invalid selection is immediately indicated by an error message which indicates that a mistake has been made.

Operation

The five menu lines enable the operator to select any frequency from 0.1 mHz to 10 MHz and to select any of the seven standard waveforms. Alternatively a user-defined arbitrary waveform function can be used. The high resolution (see specification) is precision controlled by rotating the large rotary numeric setting control. This control sets numeric values for frequency, output level, offset and modulation depth. The five digit display resolves down to 0.1 mHz in the lowest frequency range. The continuously variable output voltage can be adjusted up to 20 Vp-p and fed via the BNC output on the front panel. Nine specific function pushbuttons, located on the right hand side of the PM 5138, allow control of single or continuous triggering for burst or sweep, hold/release or external modulation triggering, variable assymetry (duty cycle) control or 50% pushbutton for rapid symmetrical setting, store and recall pushbuttons for nine front panel settings and a dial lock pushbutton which disables the rotary numeric setting control.

The PM 5138 gives the operator a degree of precision which is usually unavailable in a general-purpose function generator. Frequency setting error is accurate, 2 p.p.m (parts per million). Equally important is reproducibility, to enable the selected test signal to be reproduced exactly at any time. The PM 5138 has an exceptional long term frequency stability, with a temperature variation of only 0.2 p.p.m/ °C. Phase noise and residual FM are also very low. This ensures a clean and stable test signal every time.

Memories

The instrument has 9 + 1 non-volatile memories for complete front-panel settings. Nine of these settings can be selected instantly at the touch of a button. The tenth is reserved for the last instrument setting, which is automatically recalled on switch-on. The memories are activated using the store and recall pushbuttons.

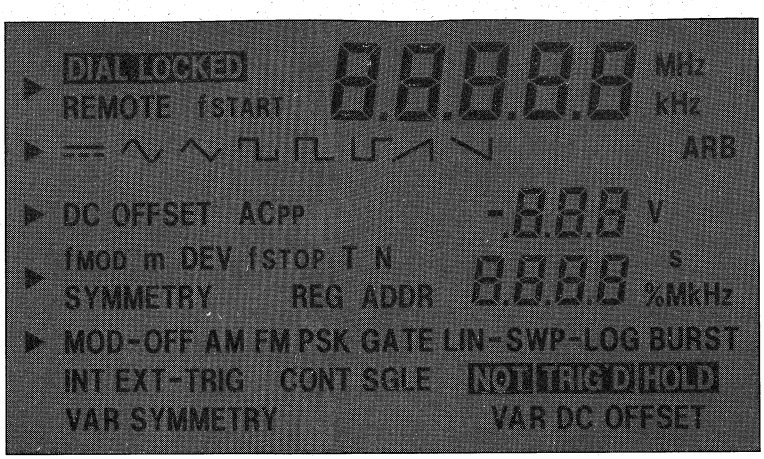
The PM 5138 provides the answer to virtually every test situation, with a choice of seven instantly selectable standard waveforms. These functions are menu-selected from the front panel, or remotely selected via the GPIB/IEEE-488.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

The frequency display shows settings with up to 5-digit accuracy, plus special function indication.

AC or DC offset voltages can be precisely and independently adjusted using the numeric setting rotary control.

A wide choice of modulation modes are available, each of which can be combined with any waveform selection, including 'arbitrary'.

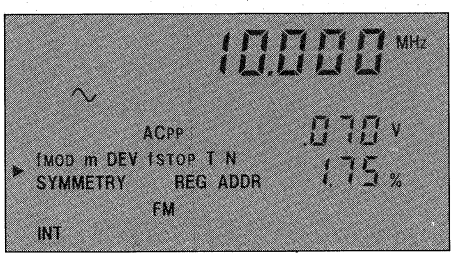


Complete LCD Display.

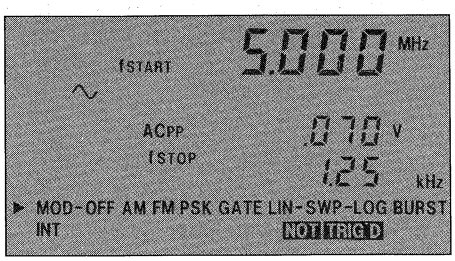
The PM 5138 offers seven instantly selectable standard waveforms plus a user-definable 'arbitrary' function.

Modulation depth for AM and frequency deviation for FM are freely programmable. Duty cycle can be adjusted from 1 to 99% at up to 20 kHz, and from 20 to 80% at up to 5 MHz.

Modulation Modes



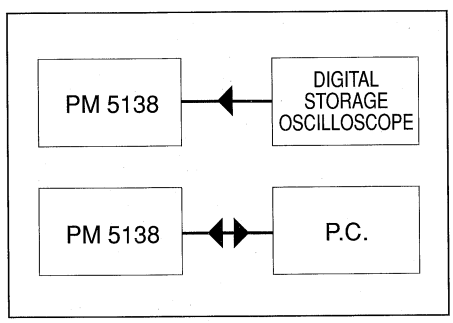
The PM 5138 offers a versatile choice of modulation modes, all of which are instantly selected from the modulation modes menu line. These include AM, FM, PSK (phase shift keying), bursts, gating and linear or logarithmic sweeps. All waveforms can be modulated, including the user-defined arbitrary waveform function. Modulation depth for AM is adjustable from 0 - 100% with an internal modulation frequency of 1kHz. External AM from 0 - 200kHz can be applied to the BNC connector on the rear panel. FM has a deviation of 0 - 2% with an internal modulation frequency of 1kHz. External FM can be applied to the BNC connector on the rear panel and at modulation frequency between 10Hz to 100kHz.



Full programmable sweep

Arbitrary Function

Other input/output facilities on the rear panel include reference input, 10 MHz output, pen lift, sweep and TTL control. As an alternative to the wide choice of standard waveforms, the PM 5138 also offers a user-definable 'arbitrary' (ARB) function with a maximum sampling frequency of up to 20 MHz. With this function, it is possible to program the instrument for the generation of any specific waveform for example to serve as a reference for go/no go testing, or for special test purposes such as the emulation of practical or fault conditions. The desired waveform may be created in one of two ways: it can be mathematically defined on a personal computer, and then downloaded to the PM 5138 via the GPIB/IEEE-488 interface, or alternatively a signal captured by a digital storage oscilloscope can be downloaded directly to the PM 5138 without using a personal computer.



Interfacing Detail

The PM 5138/02 instrument has a built-in GPIB/IEEE-488 interface offering additional versatility and a higher resolution, via GPIB/IEEE-488, of 10 Hz in the upper two ranges. The interface allows all the instrument functions to be remotely activated from a personal computer or test system controller.It is also possible to upload settings and status data from the instrument for storage in the controller and later recall at any time.

This interface facility allows the PM 5138/02 to become an integral part of an automated test system, allowing large numbers of measurements to be performed continuously and automatically.

Technical specifications

Frequency Characteristics

Nominal range:0,1mHz... 10MHz
Operational range
sinewave: 0,1mHz... 10MHz
squarewave: 0,1mHz... 10MHz
triangle: 0,1mHz... 500kHz
positive sawtooth: 0,1mHz... 50kHz
negative sawtooth: 0,1mHz... 50kHz
positive pulse: 0,1mHz... 10MHz
negative pulse: 0,1mHz... 10MHz
Arbitrary:** 0,1mHz... 20kHz
Setting: remote or local via front panel with rotary knob, ÷10, x10 and digit select
Resolution: 4 or 5 digits, max. 0.1mHz
Display: 5 digits LCD
Setting error: $\pm 2 \times 10^{-6}$
Residual FM: 1ppm typ., <10ppm, fc<5MHz 13Hz typ., <100Hz, fc>5MHz
Temperature coefficient: 0,2ppm/°C
Ageing: <1 ppm per year
Drift: <0,3ppm in 7 hours
Synchronisation: 2 (or more) generators can be synchronised by rear socket connection.

Output characteristics

Main output

Connector: BNC socket on frontpanel
Impedance: Zo = 50Ω

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Function Generator

PM 5138

Load capability: short circuit proof
Max. external voltage: ±15V p-p <3 min.
AC voltage: Independent of DC setting within ±10V window
Ranges (open circuit)
range I: 0 - 0,200V p-p
range II: 0,20 - 2,00V p-p
range III: 2,0 - 20,0V p-p
Resolution
range I: 1 mV
range II: 10 mv
range III: 100 mv
Setting: remote or local via front panel with rotary knob, ÷10 x 10
Basic setting error: ±2%, fc<200kHz
DC voltage: independent of AC setting within ±10V window
Range: ±10V open circuit
Resolution: 0,1V
Error: ±2%
Offset error: ±30mV
Setting: remote or local via front panel with rotary knob

TTL output

Connector: BNC connector at rear panel
Fan-out: <4 TTL inputs (Z_o = 50Ω)
Level: 0/5V

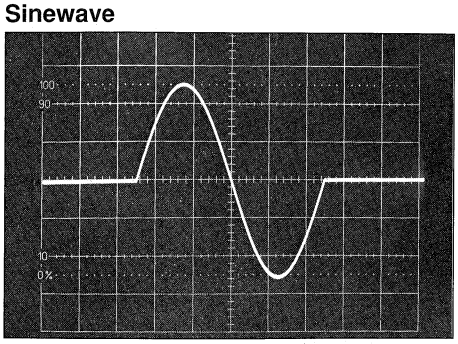
Waveforms

Standard functions: sine wave, square wave, triangle, positive and negative ramps (sawtooth), positive and negative rectangular pulse or arbitrary**
Selection: Remote or local via waveform menu with "waveform" keypair
Indication: LCD

Symmetry

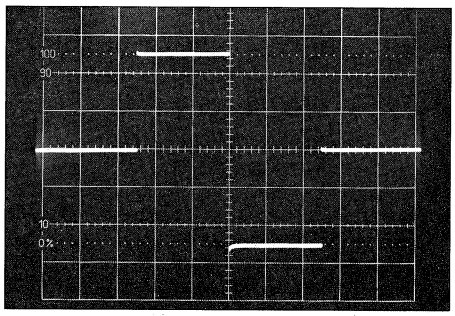
Range: 1 - 99%, fc<20KHz
Resolution: 1%
Waveforms: sine, square, triangle and pos./neg. rectangular pulses
Range: 20 - 80%, fc<5MHz
Resolution: 1%
Waveforms: Square and pos./neg. rectangular pulses
Setting: remote or local via front panel with rotary knob

Sinewave



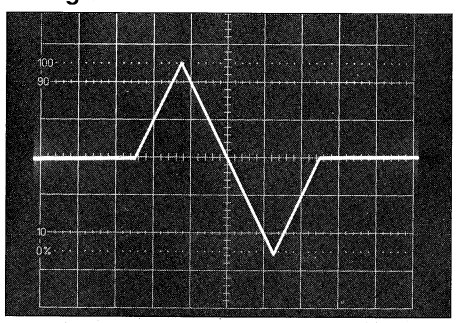
Frequency range: 0,1mHz - 10MHz
Output range*: 0 - 20V p-p
Total harmonic distortion: typical 0,1%, <0,5% (fc<1MHz, output>10mV)
Harmonics:
<-43dBc, fc: 500kHz - 5MHz
(V out <0,7xU range max)
<-38dBc, fc: 5MHz - 10MHz
Subharmonics: <-70dBc, fc<5MHz
<-40dBc, fc>5MHz
Non harmonics:
<-50dBc, fc<0,5MHz
<-40dBc, fc 0,5MHz... 5MHz
<-36dBc, fc>5MHz
Phase noise (1 kHz dist. fc):
< -90 dBc/Hz, fc < 5 MHz
< -80 dBc/Hz, fc > 5 MHz
Symmetry: 1 - 99%, resolution 1%, fc<20kHz

Squarewave



Frequency range: 0,1mHz - 10MHz
Output range*: 0 - 20V p-p
Transition times:
12 ns typical, fc <20kHz
25ns typical, fc:
20kHz - 2MHz
12ns typical, fc>2MHz
Symmetry: 1 - 99%, res. 1%, fc<20kHz
20 - 80%, res. 1%, fc<5MHz
Aberration: <2% (output ≥10mV p-p)

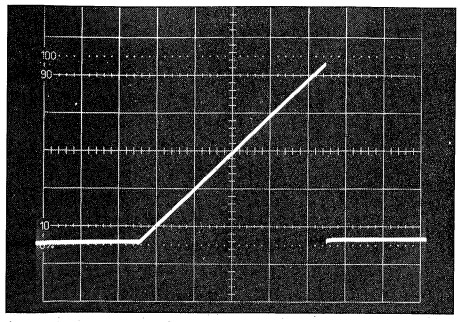
Triangle



Frequency range: 0,1mHz - 500kHz
Output range: 0 - 20V p-p
Linearity error: <0,2% (fc<20kHz)
Symmetry: 1 - 99%, resolution 1%, fc<20kHz

**At open output*
***Instruments with GPIB/IEEE-488*
fc = carrier frequency

Sawtooth

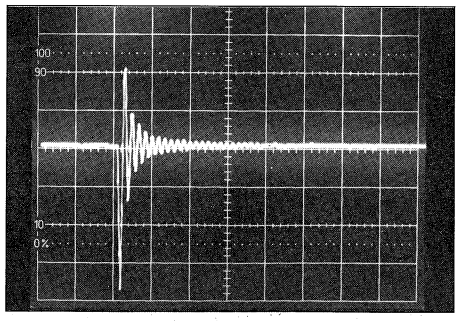


(pos./neg. ramps)
Frequency range: 0,1mHz - 50kHz
Output range: 0 - 10V p-p
Linearity error: <0,2% (fc<20kHz)

PULSE

(positive or negative)
Frequency range: 0,1mHz - 10MHz
Output range*: 0 - 10V p-p
Transition times:
12ns typical, fc<20kHz
25ns typical, fc 20kHz - 2MHz
12ns typical, fc>2MHz
Symmetry: 1 - 99%, res. 1%, fc<20kHz
20 - 80%, res. 1%, fc<5 MHz
Aberration: <2% (Output≥10mV p-p)

Arbitrary

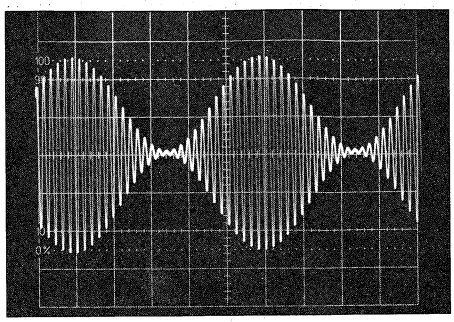


Frequency range (with 1024 samples):
0,1mHz - 20kHz
Maximum sample frequency: 20,48MHz
Sample addresses (x): 1024 (10 bits)
Sample levels (y): 1024 (10 bits)
Programmable: via GPIB/IEEE-488 with a PC or direct with a DSO, without a PC

Modulation

Modes: AM int./ext.
FM int./ext.
gate int./ext.
PSK int./ext.
burst int./ext.
sweep int./ext.
Internal modulation frequency: 1kHz
Mode setting: remote or local via modulation mode menu with "mode" keypair
Parameter setting: remote or local via modulation parameter menu with "param"keypair and

Internal AM

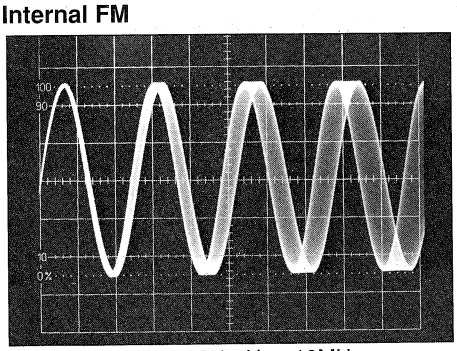


Carrier frequency: 0,1mHz - 10MHz
Carrier waveform: all (including arbitrary for GPIB/IEEE-488 instr.)
Modulation frequency: 1kHz
Modulation depth: 0 - 100%, resolution 1%
Envelope distortion: 0.15% typical, m ≤ 90%, fc<1MHz

External AM

Modulation frequency: 0 - 200kHz
Modulation depth: 0 - 100%
Envelope distortion: 0,15% typical, m = 90%, fc<1MHz

Internal FM



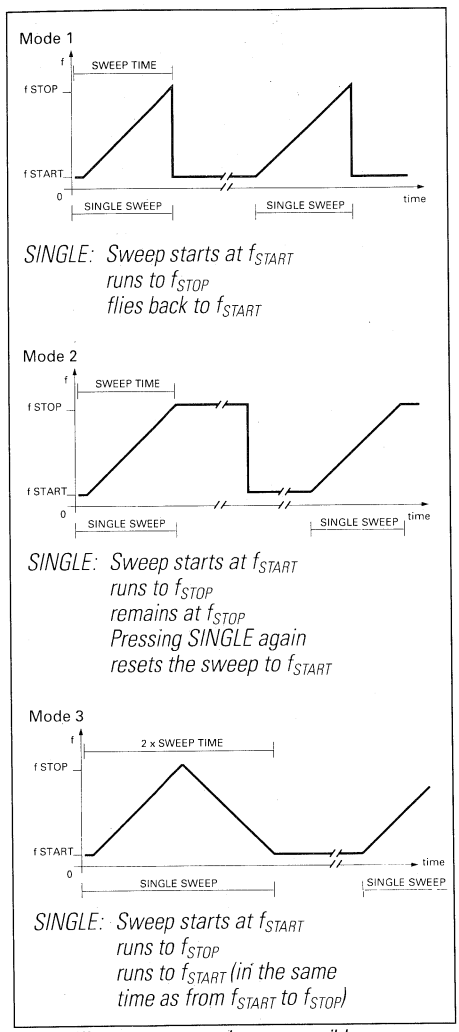
Carrier frequency: 0,1mHz - 10MHz
Carrier wave: all (including arbitrary for GPIB/IEEE-488 instr.)
Modulation frquency: 1kHz
Deviation: 0 - 2% resolution 0,01%
Modulation distortion: 0,2% typical, DEV = 1%

External FM

Carrier frequency: 0,1mHz - 10MHz
Modulation frequency: 10Hz - 100kHz
Deviation: 0 - 2%

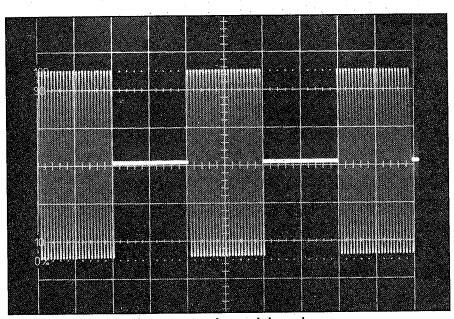
Sweep

Carrier wave: all (including arbitary for GPIB/IEEE-488 instr.)
Sweep functions: Linear or logarithmic up/down, single/continuous
Sweep range: 1mHz - 5MHz range 1, 50kHz - 10MHz range II phase continuous independent setting of start and stop frequencies within range I or range II. Max. frequency depends on selected waveform
Sweep modes: 3
Sweep time: 0,01 - 1000s in 3 ranges, max. resolution 10ms



Three different sweep modes are possible

Internal gate

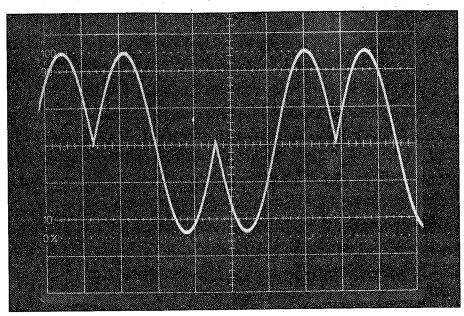


Non-phase coherent signal keying
Carrier frequency: 0.1 mHz - 10 MHz
Carrier waveforms: all (including arbitrary for GPIB/IEEE-488 instr.)
Modulation frequency: 1kHz
Duty cycle: 50%

External Gate

Modulation frequency: 0 - 200kHz (TTL signal)

Internal PSK

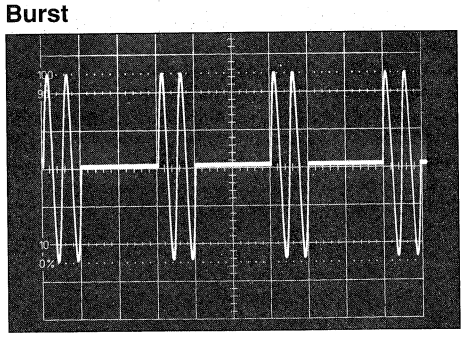


Phase shift keying (o/π)
Carrier frequency: 0,1mHz - 10MHz
Carrier waveform: sine wave - square wave - triangle
Modulation frequency: 1kHz
Duty cycle: 50%

External PSK

Modulation frequency: 0 - 200kHz

Burst



Phase coherent signal keying
Carrier frequency: 0,1mHz - 2MHz
Carrier waveforms: all (including arbitrary for GPIB/IEEE-488 instr.)
On cycles: 1 - 2000, resolution 1 cycle
Trigger frequency: 1kHz
Burst functions: single or continuous
External triggering: via modulation input BNC
Max. frequency: 200kHz

GPIB/IEEE-488 bus remote control

Control capability: all functions and characteristics
Interface functions: AH4, L4, L1, SH1, T6, SR1, RL1

**At open output*
***Instruments with GPIB/IEEE-488*
fc = carrier frequency

9

PM 5138

Address: programmable with rotary knob on front panel
Address range: 0 - 30 and listen only mode
Remote lock-out: go to local via front panel key "local" device identification and learn mode provided as standard

Miscellaneous

Non-volatile memory: 1 memory location for current setting
9 memory locations for programmable settings
1 memory location for one complete arbitary waveform**
Rear connectors: Modulation input BNC
modulation output BNC
reference input BNC
10MHz output BNC
penlift output BNC
sweep output BNC
TTL output BNC
GPIB/IEEE-488 connector**
mains connector

Mechanical Specifications

Dimensions: 105 x 315 x 405mm (H x W x D)
Weight: 6,7kg
Operating conditions
Reference temperature: 23°C ± 1°C
Operating temperature: 5°C - 40°C
Storage temperature: -40°C - +80°C
Power reqirements: 100, 120, 220, 240V, ±10%
Line frequency: 50 - 60Hz ±5%
Power consumption: 45W

**At open output*
***Instruments with GPIB/IEEE-488*
fc = carrier frequency

Ordering Information

Models

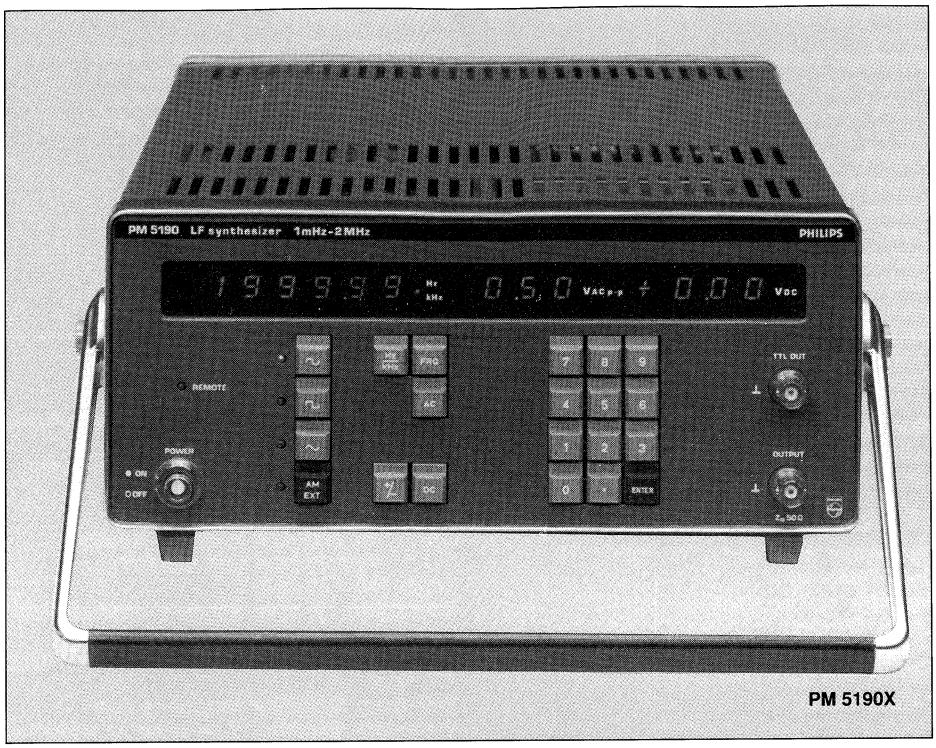
PM 5138/01: 10MHz Programmable Function Generator
PM 5138/0.: 10MHz Programmable Function Generator with GPIB/IEEE - 488

Acessories

PM 9563: 19 inch Rackmount for PM 5138
PM 9581/01: 50Ω feedthrough termination 3W
PM 9585/10: 50Ω feedthrough termination 1W
PM 2295/05: GPIB/IEEE-488 cable 5m
PM 2295/10: GPIB/IEEE-488 cable 1m
PM 2295/20: GPIB/IEEE cable 2m
PM 2296/50: GPIB/IEEE-488 to IEC-625 adaptor
PM 2240/02: TestTeam GPIB/IEEE-488 software
PM 223X: GPIB/IEEE-488 Instrument driver software

PM 5190 & PM 5190X

GPIB IEEE-488



PM 5190X

PM 5190/90X 2 MHz Synthesized Function Generator

- Sine, triangle, square waveforms
- 0.001 Hz...2.147 MHz frequency range
- Max 20V p-p output and separate TTL output
- Extremely accurate frequency setting to within $\pm 1 \times 10^{-6}$
- External AM facility
- Very high short- and long-term stability
- Fast feather-touch parameter selection

These microprocessor-based synthesizers include many unique features that lift it into a special class of medium-priced signal sources for most professional applications, including instrument calibration. Features include $\pm 1 \times 10^{-6}$ frequency setting error and an ageing characteristic of $<1.5 \times 10^{-6}$/year, clearly demonstrating the inherently high accuracy and stability of this instrument.

It will thus be of interest to design or research laboratories seeking such a highly accurate, stable signal source in the range 0.001 Hz to 2.147 MHz for both routine bench use and inclusion in automatic test systems. Its high-grade, virtually zero-error performance, plus simplicity and speed of operation make it equally attractive for use in advanced educational programs.

The output frequency of the crystal controlled oscillator is shown on a bright 6-digit LED display together with the AC (2 digits) and DC (2 digits) outputs. DC polarity is also displayed.

In addition, the preselected waveforms and external amplitude modulation characteristics are indicated on this panel.

The user has a choice of sine, square and triangle waveform outputs which are available from a 50Ω front panel socket (BNC connector).

In addition, there is an adjacent TTL socket. External amplitude modulation signals, from 0...<90% modulation depth can be connected via a rear input socket.

A very clear, simply designed front panel makes operation extremely easy. Fast selection of the desired parameters is assured by 'feather-touch' input push buttons. An 'erase' facility allows equally fast correction of any input errors.

Maximum AC output, for all waveforms is 19.9 Vpp. A DC offset voltage of up to 9.9V max. is available for setting this output to the desired DC level, up to 19.9V total amplitude. Voltage levels can be set in minimum increments of 1 mV.

All functions are fully remotely controllable via the built-in IEC-bus interface, or via the GPIB/IEEE-488 (a PM 2296/60 adapter is required). This enables the PM 5190X to be used within an automatic testing system.

All these comprehensive facilities are contained in a very compact, portable package.

Typical applications in an automated system include, for example:

- Accurate testing of audio filters when checking bandpass curves.
- As a standard, when checking servo motor speed control systems or for audio/video tape stress testing, etc.

Also, when employed as a signal source for calibrating instruments (e.g. frequency meters) its highly accurate and stable output signal may be used.

The PM 5190X features an ENTER button. This enables the user to set up the next frequency, before actually applying it at the output. This is useful for e.g. checking the servo-loops and phase-locked loops.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 1 mHz...2.147 MHz
Measuring Range: 1 mHz...2.147 MHz for sine and square wave;
1 mHz...<100 kHz for triangle wave

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 6-digit 7-segment LED display;
6 decimal points;
2 LEDs for dimension Hz, kHz
Setting Error: $\pm 1 \times 10^{-6}$ at 23°C
Temperature Coefficient: $<1 \times 10^{-6}$/K
Ageing: $<1.5 \times 10^{-6}$ per year

Waveforms

Sine wave
Square wave
Triangle wave
All time-symmetrical
All with or without DC offset
DC voltage without AC

Selection
Local: Via front panel keyboard
Remote: Via IEC bus interface
Indication: LEDs for the selected waveforms

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

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PM 5190 & PM 5190X

Sine Wave

Total Harmonic Distortion: <0.4% (1 mHz... 50 kHz);
<1.5% (50 kHz...2.147 MHz)
Non-Harmonic Components at max. Amplitude: <-46 dB
Phase Noise: <-50 dB within 30 kHz bands, centered to the output frequency; (frequencies <50 kHz)

Square Wave

Rise Time, Fall Time: <50 ns
Duty Cycle: 50%
Tolerance: <0.5% (f + 1 kHz)
Tilt: <3% (f <100 kHz)
Overshoot: <3%

Triangle Wave

Frequency Range: 1 mHz...<100 kHz
Linearity: >99% for frequencies <10 kHz

Modulation

Mode: Amplitude modulation, external
Indication: LED
Carrier: Sinusoidal and triangular waveform
Frequency: >10 Hz
Modulation Frequency: DC...20 kHz
Modulation Coefficient: 0.1V per 10% AM
Modulation Depth: 0...90%
Connector: BNC socket AM EXT (rear side)
Input Impedance: 20 kΩ
Max. External Voltage: ±30V
Reference Potential: External contact of BNC socket

Output Characteristics

Connector: BNC socket (front side)
Impedance: 50Ω ±2%
Short-Circuit Proof: Yes
Max. External Voltage: ±15V
Reference Potential: External contact of BNC socket

AC Voltage (p-p)

Range: 19.9 V open circuit
Sub-Ranges:
I .000...0.199 V
II 0.00...1.99 V
III 00.0...19.9 V

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 2 digit, 7-segment LED
Setting Error: 3% for amplitude 2.0V <19.9V for frequencies <100 kHz
Temperature Coefficient: 0.1%/K

DC Offset Voltage

Range: 0...9.9 V
Sub-Ranges:
I .000...0.099 V
II 0.00...0.99 V
III 00.0...09.9 V

Sub-Range Selection: Determined by sub-range setting
Mimimum Increments:
1 mV in sub-range I
10 mV in sub-range II
100 mV in sub-range III
Polarity: Positive or negative selectable via keyboard

Setting
Local: Via front panel keyboard
Remote: Via IEC bus interface
Display: 2-digit, 7-segment LED, decimal point, position determined by AC decimal point setting
Setting Error: 4% (10%...100% of each sub-range)
Temperature Coefficient: <0.1%/K (10%... 100% of each subrange)
Max. DC Voltage Setting: Depending on AC voltage setting: DC indication ≤100 - (AC indication)/2; decimal points ignored

TTL Output

Connector: BNC socket TTL OUT
Duty Cycle: 50%
Fan Out: 10 TTL inputs
Level: Standard TTL-level

Out-of-Range Indication

Display flashes if,
- frequency setting >2147 kHz
- frequency setting >100 kHz for triangle
- frequency resolution <1 mHz
- DC voltage exceeds max DC voltage setting

Remote Control

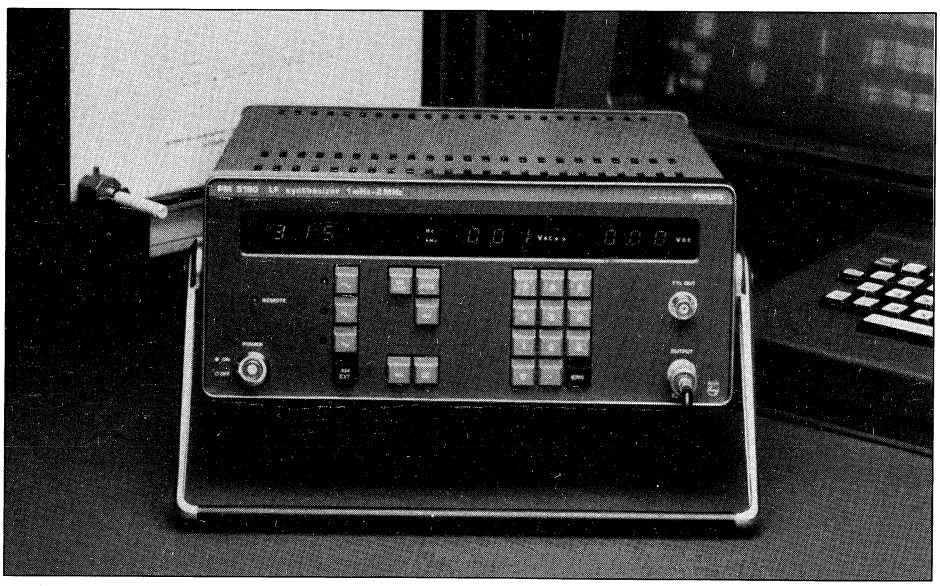
Conformity: IEC-625: interface system of programmable measuring apparatus
Interface: Built-in IEC bus interface
Remote State Indication: Front panel LED
Programmable Parameters:
- frequency
- AC voltage
- DC voltage
- waveform

Response Time:
- 4 ms for waveform
- 10 ms for AC voltage
- 7 ms for frequency
- 12 ms for DC voltage

IEEE/IEC Interface Data
An IEC-625 interface is supplied, being built into the instrument, with rear access
Connector: 25-pole IEC standard connector
Interface Functions:

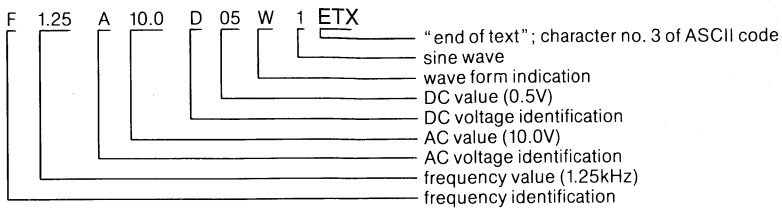
AH1	Acceptor handshake
L2	No additional functions possible
RL2	Remote/local total capability

Code: ISO 7-bit code
Connector: 25-pole standard interface connector (rear side)
Max. External Voltage: -0.5...+5.5V, standard TTL level
Reference Potential: Measuring earth
Connector Housing: Connected to protective conductor



Automatic measuring and plotting of frequency response is made easier using the PM 5190X.

PROGRAMMING EXAMPLE



General Specifications

Power Requirements

Voltage: 110, 120, 220, 238V ±10%
Power Consumption: 47W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Range: +5°C...+40°C
Limits for Storage and Transportation: -40°C...+70°C
Size: 310 mm W x 140 mm H x 365 mm L (12.5 in W x 5.5 in H x 14.5 in L)
Weight: 6 kg (13.2 lb)
Included: Instruction manual, attached line cord

Ordering Information

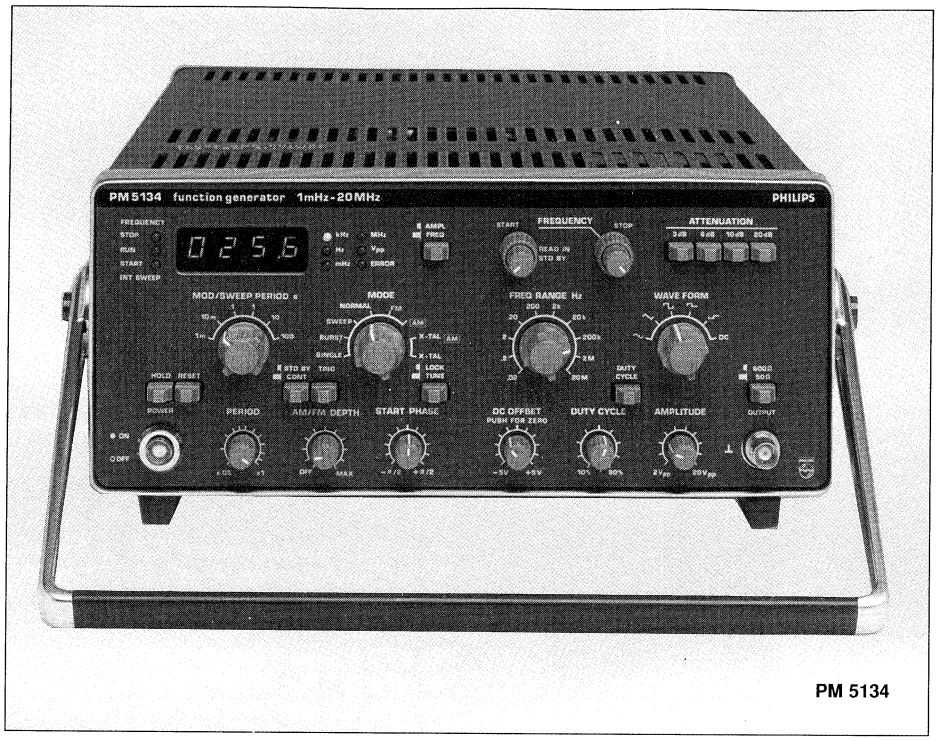
Model

PM 5190 LF Synthesizer with RUB OUT facility
PM 5190X LF Synthesizer with ENTER facility

Accessories

PM 9075 Coaxial Cable BNC BNC
PM 9480 IEC Bus Cable (1 meter)
PM 9481 IEC Bus Cable (2 meter)
PM 9482 IEC Bus Cable (4 meter)
PM 9560 19-in Rackmount Adapter
PM 9551 50Ω...600Ω Impedance Adapter
PM 2296/60 IEC-625/GPIB/IEEE-488 Adapter
PM 2296/50 GPIB/IEEE-488/IEC-625 Adapter
PM 21xx Modular GPIB/IEEE-488 Switching System
PM 2122 50Ω Coaxial Switch
PM 2240 TestTeam Software
PM 2295/10 GPIB/IEEE-488 cable (1m)
PM 2295/20 GPIB/IEEE-488 cable (2m)
PM 2295/05 GPIB/IEEE-488 cable (0.5m)

PM 5134



PM 5134

PM 5134 20 MHz Function/Sweep Generator

- Sine, square and triangle waveforms, plus pos./neg. pulses, DC
- 0.001 Hz...20 MHz frequency range in 7 sub-ranges
- 20V p-p output and separate TTL output
- Normal or high accuracy crystal controlled operation
- Internal or external sweep and AM/FM modulation facilities
- Burst and single-cycle with variable start phase
- Stepped and variable attenuation over 60 dB range

The PM 5134 is an easy-to-use, yet extremely sophisticated function generator embodying an unusually wide range of facilities in a single instrument.

It will produce sine, square and triangle waveforms as well as positive and negative pulses and DC. The duty cycle is variable between 10% and 90%.

The wide, 1 mHz to 20 MHz frequency range is divided into 10 sub-ranges, which are selected by means of a rotary switch with an overriding coarse/fine adjustment. This fine adjustment, combined with the 3-digit LED display, gives an immediate, highly accurate readout of the selected frequency. Set up procedures are greatly simplified compared with the traditional setting, and any human errors (like parallax) are eliminated.

In addition, the 3-digit display can be used to monitor the open-circuit output voltage by depressing a push-button. Also, when used in the sweep mode, the start, stop and run frequencies are indicated by separate LEDs. Moreover, an error warning lamp automatically indicates any incompatible set-up conditions.

The high, nominal accuracy (see technical specification) of ±2% ±1 digit, can be further improved to $\pm 5 \times 10^{-6}$ by operating the instrument in the crystal-controlled mode. This facility is useful, for example, for identical repetitive measurements requiring high accuracy, or for narrow band filter tests. The crystal AM mode offers a stable carrier wave. One particular application is when using a 10.7 MHz carrier frequency to check that the discriminator section of a radio is suppressing the AM waveform.

The continuously variable 20V p-p max. output (10V p-p pulses) is available at the front-panel mounted socket; there is a push-button choice of 600Ω or 50Ω output impedance. Output attenuation is selectable in any combination of 3-6-10-20 dB push-buttons with an overriding continuous 20 dB control.

Sweep and AM/FM modulation facilities include single and continuous operation. The single sweep can be triggered either manually, or electronically from an external source. The sweep period is continuously adjustable between 5ms and 100s. The START and STOP frequencies are non-interactive and can be set independently of each other. A HOLD facility allows a sweep to be stopped at any desired frequency useful for checking phenomena occurring during a sweep by means of a push-button. An interrupted sweep is continued by simply releasing the HOLD button. If required, a sweep can be reset to the start frequency using the RESET button.

The generator offers an internally or externally controlled burst or single-cycle signal. The start/stop phase is continuously adjustable between -90° and +90°.

The internal AM is adjustable between 0 and 100% modulation depth. The modulation frequency can be set over a wide range from 10 mHz to 20 kHz. The AM facility can be used with crystal control, if desired. External AM inputs in the range from DC to 20 kHz can be applied via a rear-mounted BNC socket.

The internal FM can be adjusted, continuously, between zero and ±10% frequency deviation.

Other input/output facilities available on the rear panel include a TTL output and pen-lift control.

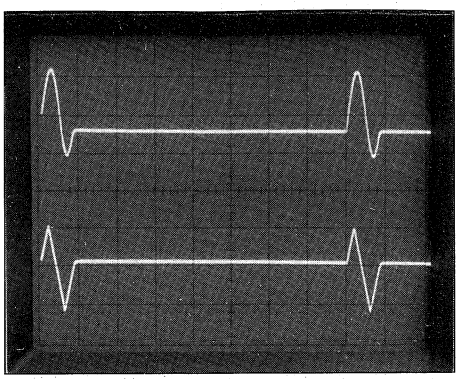
The design of the PM 5134 has resulted in a clean, simple fron-panel layout which allows the operator to quickly become familiar with all control functions. Its overall versatility makes it suitable for a very wide range of applications within research design or educational organizations. The instrument also occupies minimal bench space, and is short-circuit proof.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 1 mHz...20 MHz
Display: 3 digits; 7-segment LED; 4-dimension LEDs mHz, Hz, kHz, MHz.
Setting Error: ±2% ±1 digit (1 mHz...2 MHz) ±5% ±1 digit (2 MHz...20 MHz): For X-tal mode, $\pm 5 \times 10^{-6}$
Temperature Coefficient: $<1.0 \times 10^{-3}$/K (20 MHz range excluded): For X-tal mode, $<2 \times 10^{-6}$/K
Short Term Drift: (<15 min) $<1 \times 10^{-3}$ (1 mHz...2 MHz) $<4 \times 10^{-3}$ (2 MHz...20 MHz): For X-tal mode, $<1 \times 10^{-6}$/K
Long Term Drift: (<7h); $<3 \times 10^{-3}$. For X-tal mode $<5 \times 10^{-6}$
<10%...>90% continuously variable (20 MHz range excluded)



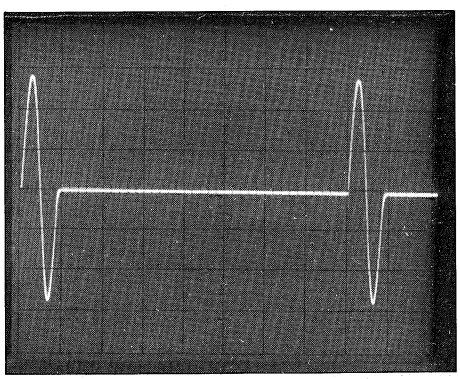
Repetitive single sine wave and triangle shown with different start phase

Waveforms: Sine wave, square wave, triangular wave, positive pulse, negative pulse (with or without DC offset), DC voltage without AC

Output

AC Voltage

Max. Open Circuit Voltage: 20V p-p (10V p-p for pulse)



Repetitive single sine wave signal

Indication Open Circuit Output Voltage: Alt. mode frequency display
Attenuation: 3, 6, 10, 20 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes

DC Voltage
Offset Voltage: -5...+5V (open circuit)

Sine Wave
Total Harmonic Distortion: <0.5% (1 Hz...200 kHz); <3% (1 mHz...2 MHz)
All harmonics more than 26 dB below fundamental (1 mHz..20 MHz)
Frequency Response of Amplitude: <0.1 dB (0.1 Hz...200 kHz);
<0.5 dB (1 mHz...2 MHz);
<1.5 dB (1 MHz...20 MHz, for max. amplitude)

Triangle Wave
Linearity: 99% (<100 kHz)

Square Wave
Rise and Fall Time: <18 ns (into 50Ω)
Overshoot and Ringing: <3%

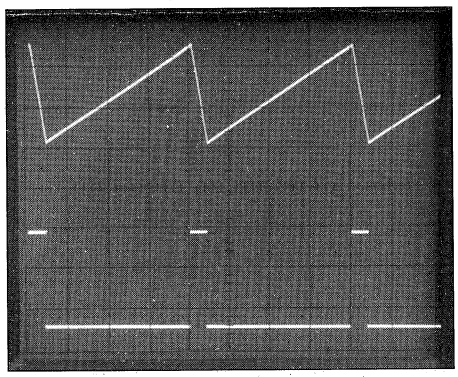
Positive/Negative Pulses
See Square Wave

TTL

Duty Cycle: As main output
Fan Out: 5 TTL inputs
Level: High >2.4V; low <0.8V
BNC socket at rear

Sweep Facilities

Internal Sweep
Characteristics: Linear
Max. Sweep Range: 2 decades
Mode: Single or continuous
Indication: $3^1/_2$ digits, 7-segment LED, 3 LEDs STOP, RUN and START
Period Time: 5ms... 100s Continuously adjustable in 4 sub-ranges



Variable duty cycle shown in triangular and square wave signals

Control Functions: HOLD, RESET, TRIG (manually) and electronic triggering
Frequency Control Voltage at Modulation Output: 0...5V (dependent on start and stop frequency)
External Sweep/FM
Input: BNC socket at rear
Characteristics: Linear
Voltage vs. Frequency Characteristic: 1V/0.2 max. frequency of selected subrange
Max. Sweep Range: >$2^1/_2$ decades for subranges above 2 Hz
Input Resistance: 5 kΩ
Max. Sweep Rate: 200 Hz ($1^1/_2$ decades range)
Sweep Voltage: Sawtooth, duty cycle 90%

Burst Facilities

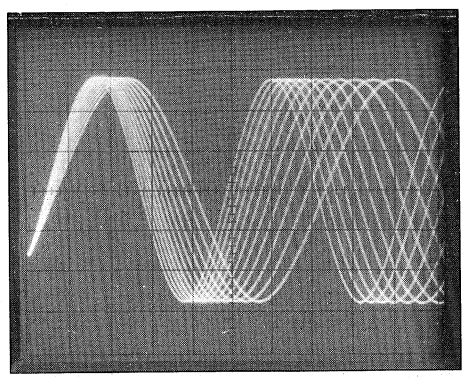
Internal Burst
Continuous Operation
On/off Ratio: Approx. 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 0.05 ms... 100s continuously adjustable in 6 sub-ranges
Single Opertaion
Duration: See continuous Operation, Repetition time
Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90°... +90° (-π/2...+π/2), continuously adjustable
External Burst
Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/High-Transition
Stop: High/Low Transition. (When output signal reaches START-PHASE)
Max. Control Frequency: 2 MHz
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

Single Facilities

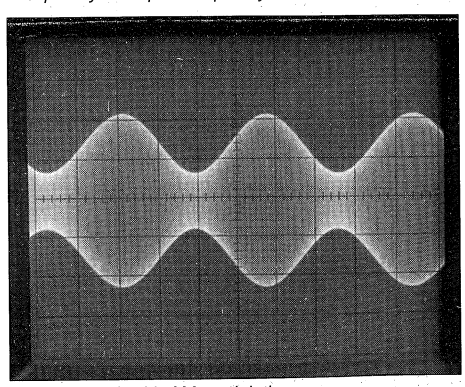
Continuous Internal Signal Operation: same as internal burst
Repetition Time: 0.05ms...100s continuously adjustable
Single Operation: same as internal burst
External Single
Input: TRIG & BURST

Modulation

FM Internal



Frequency sweep or frequency modulation



Carrier wave with AM modulation

Modulation Waveform: Sine wave
Deviation: Approx. 0%...10%
Continuously adjustable
Modulation Frequency: 0.01 Hz... 20 kHz
Continuously adjustable in 6 sub-ranges

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PM 5134

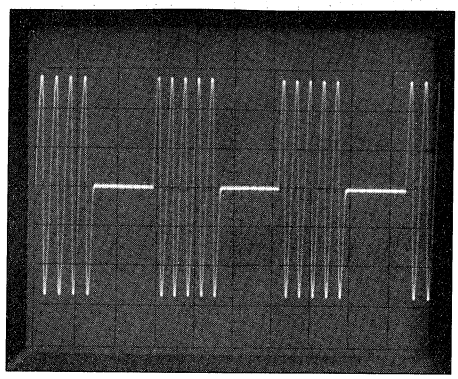
Modulation Voltage: 3V p-p available at modulation output

FM External
Input: SWEEP/FM BNC socket at rear
AM Internal
Modulation waveform: Sine wave
Modulation Depth: 0...<100% Continuously Adjustable
Modulation Frequency: See internal FM
Modulation Voltage: See internal FM

AM External
Input: BNC socket at rear
Modulation Waveform: Arbitary with spectral components up to 20 kHz
Modulation Depth: 0...<100% Continuously adjustable
Modulation Frequency: DC to 20 kHz
Modulation Voltage: 2V p-p for 50% AM

Cystal Mode
Frequency Lock: Freezes the momentary frequency display (frequency setting inhibited)
Accuracy: $\pm 5 \times 10^{-6}$

Crystal AM Mode
See crystal mode with additional facilities of internal and external AM



Burst signal

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 55W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Mechanical Specifications

Size: (wxhxd) 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.15 in H x 15.4 in L)
Weight: 6.5 kg (14.3 lb)
Included with instrument: Instruction manual, attached line cord

Ordering Information

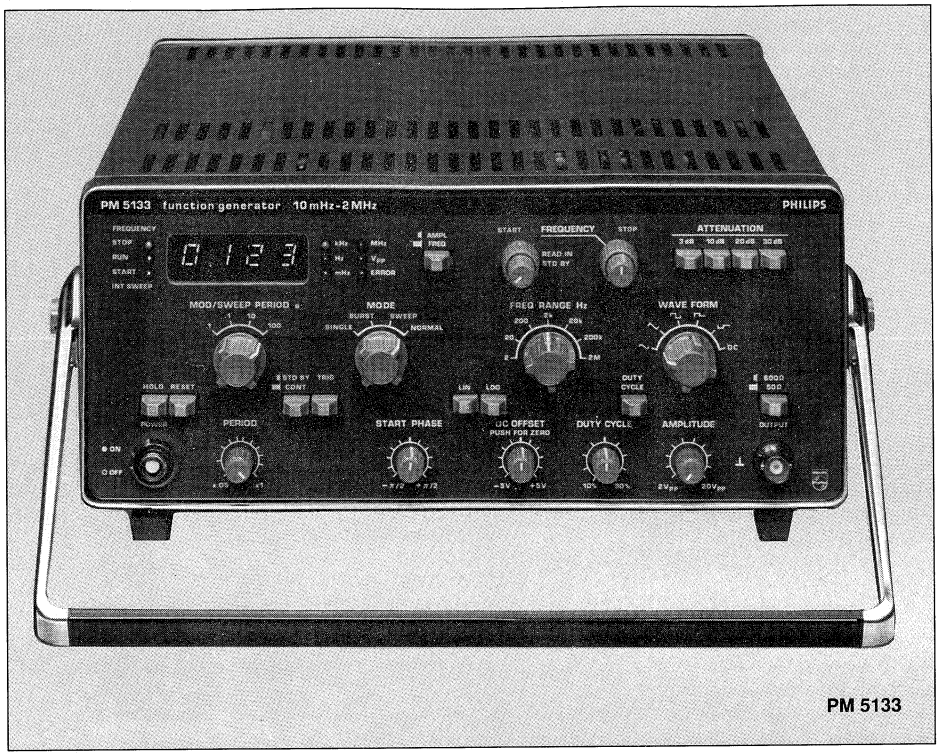
Model

PM 5134 Function Generator

Accessories

PM 9051 Adapter BNC/4 mm
PM 9075 Coaxial Cable BNC
PM 9560 19 in Rackmount Adapter
PM 9581/01 50Ω/3W termination

PM 5133



PM 5133 2 MHz Function/Sweep Generator

- Sine, square, and triangular waveforms, pos./neg. pulses, DC
- 0.01 Hz...2 MHz frequency range in 7 sub-ranges
- 20V p-p output
- Logarithmic or linear sweep with manual and electronic sweep trigger
- Internal or external sweep facility
- Single and burst with variable start phase
- Frequency and open circuit output voltage indicated on 3-digit LED display

The versatile PM 5133 function generator offers both linear and logarithmic sweep facilities in addition to a wide range of other features. Outputs include sine, triangle and square waveforms as well as positive or negative pulses, and DC, The duty cycle is variable between 10% and 90%.

The wide frequency range of 10 mHz to 2 MHz is selected by means of a 7-position rotary switch with an overriding coarse/fine adjustment. A high-precision, electronic system, using a 3-digit LED provides very accurate, clearly readable setting conditions and eliminates those human errors (e.g. parallax) likely to occur with more conventional mechanical dials. The display is also used to monitor the open-circuit output voltage, sweep limit values and incompatible set-up conditions.

The output voltage (20V p-p max., except for pulses at 10V p-p max.) is available at the front-panel mounted socket; there is a push-button choice of 50Ω or 600Ω output impedance. Output attenuation of more than 80 dB is selectable in any combination of calibrated steps of 3-10-20-30 dB with an overriding 20 dB continuous control. The output voltage level can be checked by simply depressing a push- button, and can be read on the LED display.

Linear or Logarithmic Sub-Ranges

Sweep facilities include single-shot and continuous operation, with the choice of linear or logarithmic mode. Frequency ranges are divided into either seven linear or five logarithmic sub-ranges with continuous coarse and fine adjustment. The logarithmic sweep ranges cover more than four decades, making the instrument extremely useful for sweeping within the audio range.

The single sweep can be triggered either manually, or electronically, from an external source. The sweep period is continuously adjustable between 5 ms and 100s. The START and STOP frequencies are non-interactive and can be set independently of each other. Also, a HOLD facility allows a sweep to be stopped at any desired frequency - useful for checking phenomena which may appear during a sweep - by means of a push-button.

An interrupted sweep is re-started by simply releasing the HOLD button. Again, if required, a sweep can be reset back to the start frequency using the RESET button. When used in the sweep mode, the start, stop and run frequencies are all indicated clearly on separate LEDs.

An error warning LED automatically flashes in the event of any incompatible setting made by the operator.

The generator also offers an internally or externally controlled burst, or single waveform signal, having a continuously adjustable start/stop phase, -90° and +90°.

Other input/output facilities available at the rear panel include a TTL output and pen-lift control, internal modulation voltage and frequency control voltage.

In addition, the PM 5133S version adds specific features for audio test.

The PM 5133 is designed for maximum electrical and mechanical protection. Careful attention has been given to ergonomic considerations, making the instrument easy to use. Its overall versatility makes it suitable for use within a wide range of applications such as research, design, education and manufacturing. It occupies minimal bench space and is short-circuit proof.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 mHz...2 MHz
Display: 3 digits, 7-segment LED, 4 dimension LEDs mHz, Hz, kHz, MHz.
Setting Error:
±2% ±1 digit (10 mHz...200 kHz)
±3% ±1 digit (200 kHz...2 MHz)
Temperature Coefficient:
<1.0 x 10^{-3}/K (linear mode)
<2.5 x 10^{-3}/K (log mode)
Short Term Drift: (<15 min)
<1 x 10^{-3} (10 mHz...20 kHz)
<3 x 10^{-3} (20 kHz...2 MHz)
Long Term Drift: (<7h)
<3 x 10^{-4}

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PM 5133

Duty Cycle: 50% fixed
<10%...<90% continuously variable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
DC voltage without AC
} with or without DC offset

Output

AC Voltage
Max. Open Circuit Voltage: 20V p-p (10V p-p for pulse)
Indication (EMF): Alt. mode frequency display
Attenuation: 3, 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-Circuit Proof: Yes

DC Voltage
Offset Voltage: 0...±5V (open circuit)

Sine Wave
Total Harmonic Distortion:
<0.5% (10 mHz...200 kHz)
<2% (200 kHz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (10 mHz...20 kHz)
<0.3 dB (20 kHz...1 MHz)
<1.0 dB (1 MHz...2 MHz) (Max. amplitude)

Triangle Wave
Linearity: >99% (10 mHz...100 kHz)

Square Wave
Rise and Fall Time: <60 ns
Overshoot and Ringing: <2% (max. amplitude into 50Ω)

Positive/Negative Pulses
See SQUARE WAVE

TTL
Duty Cycle: As main output
Fan Out: 20 TTL inputs

Sweep Facilities

Internal Sweep
Characteristics: Linear or logarithmic
Max. Sweep Range: 2 decades (linear mode)
4 decades (log mode)
Mode: Single or continuous
Indication: 3 digits, 7-segment LED, 3 LEDS STOP, RUN and START
Sweep Time: 5 ms...100s
Continuously adjustable in 4 sub-ranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Internal Modulation Output:
0V start frequency;
5V stop frequency
Frequency Control Voltage Output: 0...5V (depending on start- and stop-frequency)

External Sweep/FM
Input: SWEEP/FM
Characteristic: Linear or logarithmic
Linear Characteristic: 1V/0.2 max. freq.
Logarithmic Characteristic: 1V/freq. decade
Max. Sweep Range:
>2 decades (linear mode)
>4 decades (log mode)
Input Resistance: 5 kΩ
Max. Sweep Rate:
20 kHz at 1½ decade log
4 kHz at 1½ decade lin
Sweep Voltage: Sawtooth, duty cycle 90%
Pen Lift Output: BNC socket at the rear side; electronic switch, closed during the sweep, open during fly-back
max. current: 200 mA } electronic switch
output voltage: <0.7V } closed
output voltage: +20V } electronic switch
internal resistance: 100 kΩ } open

Burst Facilities

Internal Burst
Continuous Operation
On/Off-Ratio: Approx. 1:1 (last cycle ends at START-PHASE level)
Repetition Time: 5 ms...100s
Continuously adjustable in 4 sub-ranges

Single Operation
Repetition Time: See INTERNAL BURST
Triggering: Manually or electronically via TRIG & BURST input
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

External Burst
Input: TRIG & BURST
Control Voltage: TTL-level
Start: Low/high-transition
Stop: High/low transition. (when output signal reaches start phase)
Max. Control Frequency: 2 MHz
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

Single Facilities

Internal Single
Repetitive Mode: Same as INTERNAL BURST
Single Triggering: Same as INTERNAL BURST
Start Phase: -90°...+90° (-π/2...+π/2), continuously adjustable

External Single
Input: TRIG & BURST

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 38W
Frequency: 50/60 Hz

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Mechanical Specifications

Size: 310 mm W x 140 mm H x 390 mm L (12.2 in W x 5.5 in H x 15.4 in L)
Weight: 5.8 kg (14.3 lb)
Included with instrument: Instruction manual, attached line cord

Ordering Information

Model

PM 5133 Function Generator

Accessories

PM 9075 Coaxial Cable BNC
PM 9581 50Ω/3W Termination
PM 9051 Adapter BNC/4 mm
PM 9560 19-in Rackmount Adapter

PM 5133S



PM 5133S

PM 5133S 2 MHz Function/Sweep Generator

All PM 5133 features plus:

Specially adapted for Hi-Fi testing according to DIN standard 45 541

Fixed 50s sweep, 20 Hz...20 kHz selectable

Sweep started manually or by 1 kHz burst signal

26 dB attenuation facility included

The PM 5133S is an enhanced version of the PM 5133, with extra features specifically included to permit the testing of Hi-Fi equipment to DIN standards.

Used in conjunction with an X-Y recorder, it permits the frequency characteristics of, for example, record players, cassette and tape recorders, to be plotted. This instrument has wide-ranging applications in R&D and quality control. It is also ideal for use by audio service workshops — permitting them to show customers whether their equipment is performing according to specification.

The PM 5133S includes all the facilities of the standard PM 5133, plus a single sweep with fixed 50s duration. Start and stop frequencies should be set at respectively 20 Hz and 20 kHz.

The sweep is preceded by a 1 kHz burst lasting 6 seconds when manually triggered. A similar signal fed in via the TRIG and BURST input will automatically start the generator sweep (without burst), as an alternative to manual start.

With this feature it is possible to start a sweep on a record, cassette or tape (provided this is preceded by the burst) synchronously with the sweep of the generator.

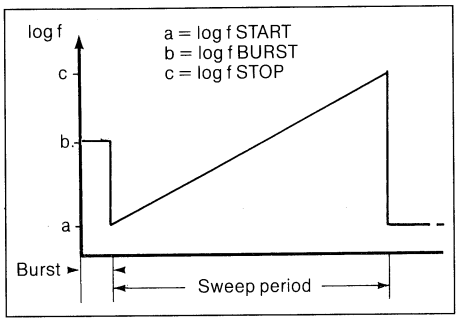
The special sweep is selected by means of the MOD SWEEP PERIOD switch (position 100s) and the PERIOD adjustment (fixed position) with the generator in the logarithmic sweep mode.

Specifications

(Additional to technical specification of PM 5133 for the special sweep).

Output

Attenuation - Fixed: 0, 6, 10, 20, 30 dB, selectabel in any combination
Sweep, Internal: 50s sweep
Mode: Single sweep with fixed period and 1 kHz burst, started by push-button TRIG;
Single sweep with fixed period, electronically started by an external 1 kHz burst applied at input TRIG & BURST
Characteristic: Logarithmic
Start Frequency: 20 Hz set by means of potentiometer START FREQUENCY
Stop Frequency: 20 kHz set by means of potentiometer STOP FREQUENCY
Burst Frequency: 1 kHz (depending on the setting of the start frequency)
Burst Period: 6s
Sweep Period: 50s ±0.2s when:
SWEEP PERIOD in pos. 100 (S);
PERIOD in fixed pos. "S"
Trigger Signal: 1 kHz ±100 Hz
Trigger Sensitivity: 0.5 Vrms
Reset Trigger: By a 1 kHz burst possible after 40s sweep period
a = log f START
b = log f BURST
c = log f STOP
Included with instrument: Instruction manual, attached power cable.



Ordering Information

Model

PM 5133S Function Generator 0.1 Hz - 2 MHz

Accessories

PM 9075 Coaxial Cable BNC
PM 9581 50Ω/3W Termination
PM 9051 Adapter BNC/4 mm
PM 9560 19-in Rackmount Adapter

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PM 5132

T&M EXPRESS LINE



PM 5132

PM 5132 2 MHz Function Generator

- Sine, square, triangular waveforms, positive- and negative-going pulses plus DC
- 0.1 Hz...2 MHz in 7 overlapping sub-ranges
- Output: 30 Vp-p (sine, triangle, square); (15 Vp-p for pulses)
- Stepped and variable attenuation over 80 dB range
- Variable DC-offset
- Internal and external sweep facility
- Variable duty cycle

The PM 5132 expands on the PM 5131 performance, for use in educational applications as well as the laboratory. Its output waveforms (sine, triangle, and square, plus DC) also include both positive- and negative-going pulses, with output voltage of 30V p-p for all waveforms, and 15V p-p for pulses. Duty cycle for all waveforms is variable between 10% and 90%. In addition, output impedance is switchable with a choice of 50Ω or 600Ω.

The frequency range of 0.1 Hz to 2 MHz is adjustable through 7 overlapping subranges and the vernier control allows dial settings of ±5% of frequency setting.

Sweep facilities are varied and include:

- Choice of linear single or continuous sweep
- Adjustable start frequency in the selected sub-range which is independent of stop frequency
- Maximum linear sweep range of 2 decades
- Sweep period setting between 50 ms and 100s
- Control functions with HOLD or RESET by push-button
- Electronic triggering

A pen-lift output is provided. The instrument is short-circuit proof.

Good ergonomic design makes the operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz...2 MHz
Indication: Linear dial
Setting Error: ±2%...±0.2% of max subrange frequencies
Vernier Frequency Adjustment: -5%...+5% of frequency setting
Temperature Coefficient: <0.15%/K
Short Term Drift: <0.1%, f <200 kHz (<15 min)
Long Term Drift: <0.25%, f <200 kHz (<7h)
Duty Cycle: 50% fixed
<10%...<90% continuously adjustable

Waveforms

Sine wave
Square wave
Triangular wave
Positive pulse
Negative pulse
} with or without DC-offset

DC voltage without AC

Outputs

AC Voltage
Max. Open Circuit Voltage: 30V p-p (15V p-p for pulse)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω or 600Ω selectable
Short-circuit proof: Yes

DC Voltage
Offset Voltage: -10...+10V (open circuit)

Sine Wave

Total Harmonic Distortion
<0.5% (0.1 Hz...20 kHz)
<1.0% (20 kHz...200 kHz)
<3.0% (200 kHz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (0.1 Hz...20 kHz)
<0.3 dB (0.1 Hz...1 MHz)
<1.0 dB (0.1 Hz...2 MHz)
Linearity: <99% (0.1 Hz...100 kHz)

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: As main output
Fan Out: 20 TTL inputs

Pen Lift

Sweep Output

Internal Sweep

Characteristics: Linear
Max. Sweep Range: 2 decades
Mode: Single or continuous
Period Time: 50 ms...100s
Continuously adjustable in 3 subranges
Control Functions: HOLD, RESET, TRIG (manually and electronically)
Frequency Control Voltage: 0...5V (depending on start- and stop-frequency)

External Sweep
Input: SWEEP TRIG
Characteristic: Linear
Max. Sweep Range: 2 decades
Input Resistance: 47 kΩ
Max. Sweep Frequency: 15 kHz approx.
Sensitivity: 5V for maximum range

General Specifications

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Power Consumption: 25W
Frequency: 50...100 Hz

Operating Conditions

Reference Value: +23°C +1°C
Nominal Operating Range: +5°C...+40°C
Limits for Storage and Transportation: -40°C...+70°C
Dimensions: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 5 kg (11 lb)
Included with instrument: Instruction manual, attached line cord

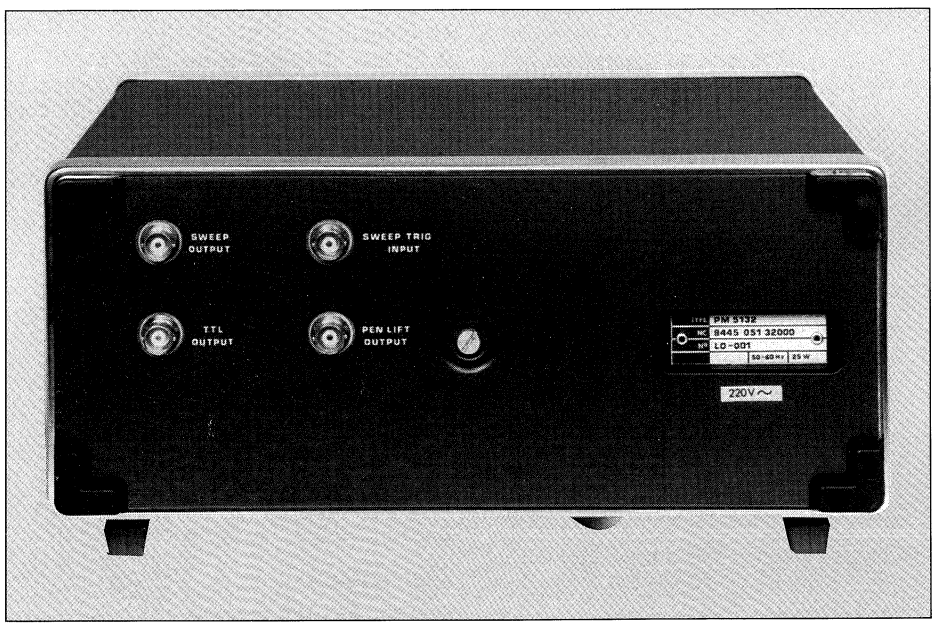
Ordering Information

Model

PM 5132 Function Generator

Accessories

PM 9075 Cable BNC-BNC
PM 9560 19-in Rackmount Adapter



Rear view of PM 5132 showing location of sweep, TTL and pen lift outputs and the sweep trigger input.

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PM 5131

T&M EXPRESS LINE



PM 5131

PM 5131 2 MHz Function Generator

- Sine, square, triangular waveforms
- 0.1 Hz...2 MHz frequency range in 3 logarithmic sub-ranges
- Max. 30 Vp-p output and separate TTL output
- Stepped & variable output attenuation over 80 dB range
- Logarithmical sub-ranges
- Variable DC offset
- Internal & external sweep facility

The PM 5131 function generator is designed for applications extending from educational to the broad general purpose area. It features a high 30V p-p output voltage, DC level ranging from 0 to +10V, and facilities for both internal and external sweep. This latter feature covers the audio frequency range in a single sweep.

Output attenuation can be set over a wide range, either in calibrated steps of 10 dB to a maximum of 60 dB, or in combination with the 20 dB continuous attenuator.

Sine, triangle, and square waveforms can be selected at the push of a button, and are generated in a frequency range from 0.1 Hz to 2 MHz. The frequency vernier allows the frequency setting to be varied from –20% to +20%. DC voltage can also be selected, either separately without any waveform, or as an offset in combination with a waveform.

The PM 5131 also provides a 3 1/3 decade internal sweeping facility with adjustable sweep range and a variable sweep period from 10 to 150 seconds.

This is especially useful when sweeping in the audio range to cover the frequency range of 20 Hz...20 kHz in a single sweep. Added to the versatility of this instrument are an external sweep facility and a TTL output. Good ergonomic design makes operation simple while the instrument occupies minimal bench space.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 0.1 Hz...2 MHz
Indication: Logarithmic dial
Setting Error: ±10%
Vernier Frequency Adjustment: -20...+20% of frequency setting
Temperature Coefficient: <0.5%/K
Short Term Drift: (<15 min) <1.5%
Long Term Drift: (<7h) <3%

Waveforms

Sine wave
Square wave
Triangular wave
} with or without DC offset

DC voltage without AC

Output

AC Voltage
Max. Open Circuit Voltage: 30V p-p
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination plus 20 dB continuously adjustable
Impedance: 50Ω
Short-Circuit Proof: Yes

DC Voltage
Offset Voltage: -10...+10V (open circuit)

Sine Wave

Total Harmonic Distortion:
<0.5% (0.1 Hz...20 kHz)
<3.0% (0.1 Hz...2 MHz)
Frequency Response of Amplitude:
<0.1 dB (0.1 Hz...20 kHz)
<0.3 dB (1 kHz...1 MHz)
<1.0 dB (1 kHz...2 MHz)

Triangle Wave

Linearity: >99%

Square Wave

Rise and Fall Time: <75 ns
Overshoot and Ringing: <2%

TTL

Duty Cycle: 50%
Fan Out: 20 TTL inputs

Internal Sweep

Characteristics: Logarithmic
Max. Sweep Range: 3 1/3 decade
Mode: Single
Period Time: <10...150s
Continuously adjustable
Frequency Analog Voltage: 1V/frequency decade

External Sweep

Input: SWP VOLTAGE
Characteristic: Logarithmic
Max. Sweep Range: 3 1/3 decade
Input Resistance: 1 kΩ
Max. Sweep Frequency: Approx. 5 kHz
Sensitivity: 1V/frequency decade

General Specifications

Power Requirements

Voltage: 115, 230V ±15%
Power Consumption: 21W
Frequency: 50...100 Hz

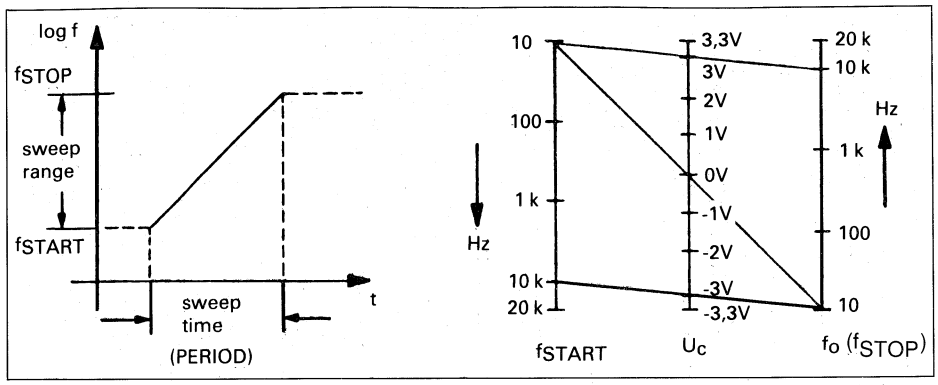
Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -4°C...+70°C

Mechanical Specifications

Size: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 4.5 kg (10 lb)

Included: Instruction manual, attached line cord.



Example of internal single sweep
Internal single sweep from the start- to the stop frequency is started by pressing the button SGLE SWEEP. The characteristic is exponential following the relation $f_o = f_{START}\ 10^{U}C$ where f_o = instantaneous signal frequency at the output; f_{START} = frequency at the beginning of the sweep represented by the frequency setting; U_c = voltage at the socket SWP VOLTAGE IN/OUT.
Thus a control voltage difference of 1V results in a frequency ratio of 10:1.
At the end of the sweep the output remains at the stop frequency which can be set by the SWP STOP/START control. Resetting the SGLE SWEEP button causes the frequency to return to the start frequency. The sweep time is adjusted with the SWP PERIOD potentiometer. Pre-adjustment of the stop frequency may be performed at the end of the sweep with minimum period, prior to setting the final sweep operation.
The example shown is for the x10k frequency range; the other two ranges should be regarded similarly, with U_c scale reading unchanged.

Ordering Information

Model

PM 5131 Function Generator

Accessories

PM 9075 Cable BNC-BNC
PM 9560 19-in Rackmount Adapter
PM 9551 50...60Ω Impedance Transformer

LF Generator

PM 5110



PM 5110 Low Distortion LF Generator

- Sine and square wave signals
- Frequency range 10 Hz..100 kHz
- 6V pk-pk output and separate TTL output
- Very low distortion 0.02%
- Attenuation switchable between fixed (20 dB) and variable (40 dB)
- Compact dimensions and low weight

The PM 5110 meets the need for a compact, economical low frequency signal generator with an outstanding low distortion down to only 0.02%. It provides a choice of sine wave and square wave outputs from a front-panel BNC connector, and also includes an additional rear-mounted TTL output, making it a versatile instrument for use in education and training. Further, its very low distortion rating makes it an ideal high-purity signal source for laboratory and service use, particularly in HiFi-related applications.

Signal amplitude is a maximum of 6V p-p for sinewaves, and 4V p-p for square waves. Attenuation is continuously variable from 0 to 40 dB at a constant 600Ω impedance; additionally, a fixed attenuation of 20 dB can be selected to simulate outputs from recorders and other equipment, for instance.

Operation is simple, thanks to the PM 5110's functional layout. A single dial adjusts frequency, with range multiplier pushbuttons giving an accuracy of better than 4%. Also, the generator weighs only 1 kg, and is very compact in size.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz...100 kHz (4 subranges, selectable by push-buttons)
Indication: Dial (1...10) LED marker
Setting Error: <4% ±1 Hz
Temperature Coefficient: <0.05%/K (1000 Hz)
Long-Term Drift: (<7h) <1.5 x 10^{-3} (1000 Hz)

Waveforms

Sine wave
Square wave

Output

Attenuation: 20 dB (±0.2 dB) calibrated step plus 40 dB continuously adjustable
Impedance: 600Ω
Short-Circuit Proof: Yes

Sine Wave

Low Distortion Mode: Total harmonic distortion 0.02% at 1 kHz; 0.03% (300 Hz...20 kHz)
Fast Settling Mode: Total harmonic distortion 0.5% (300 Hz...20 kHz); 0.7% (10 Hz...100 kHz)
Max. Open Circuit Voltage: 2V rms
Frequency Response of Amplitude: <2% (1 kHz)

Square Wave

Max. Open Circuit Voltage: 4V p-p
Rise and Fall Time: <0.5 µs
Sag: <1% (50 Hz)
Duty Cycle: 50%
Overshoot and ripple: <1.5%

TTL

Amplitude High Level: 4.5V ±0.7V
Amplitude Low Level: <0.3V
Sag: <1%
Frequency Response: 3% (1000 Hz)
Rise Time: <30 ns
Fall Time: <15 ns
Fan Out: 10 TTL inputs

General Specifications

Power Requirements

Voltage: 115, 230V ±15%
Power Consumption: 4W
Frequency: 50/60 Hz ±5%

Operating Conditions

Reference Value: +23°C ±1°C
Nominal Working Range: +5°C...+40°C
Limits of Storage and Transportation: -40°C...+70°C

Mechanical Specifications

Size: 155 mm W x 65 mm H x 180 mm L (9 in W x 4.3 in H x 8.3 in L)
Weight: 1 kg
Included with instrument: Instruction manual, power cable

Ordering Information

Model

PM 5110 Low Distortion LF Generator

Accessories

PM 9075 Cable BNC-BNC

PM 5109/PM 5109S



PM 5109



PM 5109S

PM 5109/PM 5109S Low Distortion LF Generators

- Sine and square wave signals
- 10 Hz...100 kHz frequency range
- Output voltage: 30V_{p-p} (asymmetrical), 10V_{p-p} (symmetrical)
- Low distortion 0.02%
- Symmetrical floating output
- Output level indication
- Separate TTL and DIN loudspeaker output

The PM 5109 is an RC oscillator offering a low distortion (0.02% at 1 kHz) yet high, 30V_{p-p} (open circuit) output voltage in the asymmetrical mode. It can also be used in a fast settling mode, useful for fast routine work. These features, plus the facility to select asymmetrical or dual floating symmetrical outputs, make it ideal for telecommunication applications as well as for education, R & D, manufacturing and audio equipment servicing.

Both output voltages can be attenuated by a continuous control; the asymmetrical output can also be attenuated in steps of 10 dB down to 60 dB.

Both pure sine waves or square wave signals are available at frequencies from 10 Hz to 100 kHz; output impedance is switchable for either 600Ω or 50Ω in the asymmetrical mode and 600Ω or LOW Z in the symmetrical mode (see specification).

A DIN loudspeaker connection is provided, with an impedance similar to the symmetrical low impedance output. This allows direct testing of loudspeakers, regardless of their impedance. A special TTL output for direct connection to TTL circuitry or for synchronization purposes, is also provided.

The open circuit output is monitored by a meter on the front panel and the output range in use is indicated by the appropriate LED, from the seven provided.

PM 5109S For additional applications where the symmetrical output is not required, the economical PM 5109S version is available.All other specifications are the same as PM 5109.

Specifications

Technical Specifications

Frequency and Characteristics

Nominal Range: 10 Hz...100 kHz
(4 subranges, selectable by push-buttons)
Indication: dial (1...10)
Setting Error: <±5% ±1 Hz
Temperature Coefficient: <0.05%/K
Long Term Drift (<7h): <1.5 x 10^{-3}
Short Term Drift (<15 min): <0.5 x 10^{-3}
Duty Cycle: 50% fixed

Waveforms

Sine wave
Square wave (output B only)

Output

Separate A and B outputs selectable with push-buttons
A. Symmetrical Output: (4 x 4 mm banana connector on front panel) (PM 5109 only)
a. 2x 300Ω
b. 300Ω + 300Ω
c. 2 x low Z
d. low Z + low Z
} not grounded

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PM 5109/PM 5109S

B. Asymmetrical Output:
(BNC connector at front panel)
a. 600Ω
b. 50Ω

Loudspeaker Output: (DIN connector at rear panel) Only active when output Ad is selected
TTL Output: (BNC connector at rear panel)
Open Circuit Output Voltage: (RMS)
0.03...3.16V (output A)
0.1...10V (output B)
Indication: Meter (7 ranges indicated by LED)
Attenuation: 10, 20, 30 dB calibrated steps selectable in any combination (output B only) plus 30 dB continuously adjustable

Sinewave

Total Harmonic Distortion
(for output Aa, Ab, and B)

- low distortion mode
<0.7% (20 Hz...100 kHz)
<0.03% (300 Hz...20 kHz)

- fast settling mode
<1.5% (10 Hz...100 kHz)
<0.5% (100 Hz...100 kHz)

Total Harmonic Distortion
(for output AC and Ad)

- low distortion mode
<0.7% (open circuit 20 Hz...100 kHz)
<0.03% (open circuit 300 Hz...20 kHz)
<0.15% (4Ω load, 20 Hz...100 kHz)

- fast settling mode
<0.5% (4Ω load, 100 Hz...100 kHz)

Frequency Response of Amplitude
±0.2 dB (1 000 Hz, outputs A & B, open circuit)
±0.5 dB (10 Hz...10 kHz, outputs Ac & Ad, 4Ω load)
- 6 dB (70 kHz, outputs Ac & Ad, 4Ω load)

Squarewave

Rise and Fall Time: <0.5 µs
Overshoot and Ringing: <2% (>20 Hz)
<1% (>50 Hz)

TTL

Level: High >2.4V; Low <0.8V
Duty Cycle: 50%
Fan Out: 20 TTL inputs

General Specifications

Power Requirements

Line Voltages: 110, 128, 220, 238V ±10%
Frequency: 50...100 Hz
Power Consumption: 17W

Mechanical Specifications

Dimensions: 310 mm W x 140 mm H x 330 mm L (12.2 in W x 5.5 in H x 13 in L)
Weight: PM 5109: 6.5 kg (14.3 lb);
PM 5109S: 5 kg (11 lb)
Included with instrument: Instruction Manual, line cord

Ordering Information

Models

PM 5109 RC Generator with Output Monitor and 2 Outputs
PM 5109S RC Generator Single Output

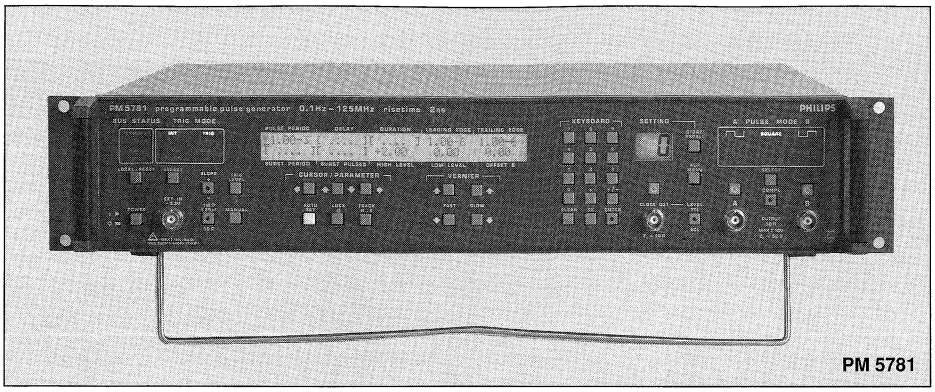
Accessories

PM 9075 Coaxial Cable BNC-BNC
PM 9560 19-inch Rackmount Adapter

PM 5781

GPIB IEEE-488

NEW



PM 5781 125 MHz Programmable Pulse Generators

- Wide frequency range 0.25 mHz...125 MHz
- Amplitude 0.2V...10V into 50Ω
- Dual pulse outputs
- Excellent 50Ω backmatching absorbs reflections
- Rise- and falltimes 2 ns...100 ms
- Preset burst with external or internal burst generator
- External triggering, gating and shaping
- Single/double pulse, squarewave and constant duty factor
- High performance interface IEEE-488.2
- Alphanumeric LCD display for easy operation and programming

The PM 5781 is a fully programmable pulse generator, designed primarily for automatic test systems applications.This instrument's easy operation with built-in microcomputer convenience also makes it very attractive for manually operated, semi-automatic benchtop applications.

The high speed, wide amplitude range and functional versatility of the PM 5781 enable it to handle virtually any analog and digital circuit testing. Fast digital circuitry such as TTL, BiCMOS or ECL is easily handled, and the wide choice of internal/external trigger and gate functions make setting-up of special test signals unbeatably easy. For example, the preset burst function lets you set the number of pulses in a burst, the pulse repetition frequency and the burst repetition frequency, all without the need for auxiliary equipment.

Programming via the IEEE-488 bus is very simple and powerful, thanks to full implementation of the new IEEE-488.2-1987 Standard. Both generator and bus interface have been designed for high-speed bus performance.

High performance pulses

The PM 5781 offers high-speed, high-performance pulses at repetition rates up to 125 MHz, and as low as 0.25 mHz. A wide variety of application requirements can therefore often be covered by this single generator.

The PM 5781's fast output pulses have rise- and falltimes which are independently and continuously variable from 2 ns to 100 ms (10% to 90% of amplitude). The 20% to 80% transition times, as specified for ECL circuits,range from as low as 1.4 ns.

The output amplitude (into 50Ω) is variable between 0.2V and 10V, within the -10V to+10V window. In fact, pulse levels are directly defined by setting the high- and low-level values.

The internal 50Ω backmatching absorbs more than 90% of reflections from mismatched loads, thus ensuring very clean pulses, even when driving a non-50Ω load.

The PM 5781 has dual outputs for simultaneous positive- and negative-going pulses. Both outputs offer the same high-performance pulses. An additional offset facility on the B channel further enhances the versatility of the dual outputs. This offset voltage makes it possible to program bipolar pulses, for example, as well as complementary positive and negative pulses for digital applications.

To protect sensitive loads against overvoltages caused by operating or programming mistakes, limits on output values may be programmed. An additional protection facility is provided by the output disable function. This allows the programmer to prevent connection of the output signal to the device under test until all pulse parameters have been set.

To avoid damage to the generator outputs, the PM 5781 has full protection against short and open circuits, as well as against external transients applied to the outputs.

Versatile functionality

The PM 5781 offers a complete range of possible trigger and pulse mode facilities including:

- Continuous pulses: generated by the internal clock generator or triggered by an external clock signal.
- Gated pulses: produce bursts of pulses generated by the internal clock, gated by an external gate signal. The burst frequency and duration are defined by the external gate signal.
- Preset burst: in this mode, pulse bursts are generated with a pulse frequency and duration defined by the PM 5781. The number of pulses in each burst is selectable from 1 to 9999. The burst repetition period can be triggered from an external generator, but can also be generated internally in the PM 5781 by a special burst-period generator. This unique feature eliminates the need for a second, external generator. This feature is particularly valuable in automated test systems, since it saves the cost, rack-space and programming effort of an additional generator.
- Single pulses: can be generated, triggered by an external trigger signal, manually or via the IEEE-488 bus.
- External duration: in this mode, the generator functions as a pulse-shaper and/or pulse booster for externally connected signals. The external signal defines the frequency and pulse duration, while the high and low levels, rise- and fall times and normal/complementary mode selection are defined by the pulse generator settings.

Pulse mode selection further includes the choice of single and double pulse, squarewave and programmable duty cycle. The latter is just one example of the PM 5781's unique TRACK function, which allows selection of pulse parameters that maintain a fixed, programmable relationship when any one of these parameter is modified.

Depending on the application, all the above pulse modes can be externally triggered in a variety of trigger modes. The selectable trigger sources are:

- Internal clock
- External clock/pulses
- Manual operation
- A variety of trigger modes via the bus

PM 5781

To facilitate correct triggering from any external input signal, the PM 5781 offers all trigger facilities, such as:
- DC...125 MHz trigger range
- + and - slope selection
- 50Ω and 1 MΩ impedance selection
- 5 V to +5 V trigger level selection

Advanced IEEE-488 bus facilities

The PM 5781 has been designed primarily for automatic test system applications, and offers advanced facilities for operation via the IEEE-488 bus. All functions and parameter values are 100% programmable.

To reduce system development time, the generator complies fully with the requirements of the new IEEE standard 488.2-1987 (Standard Codes, Formats, Protocols and Common Commands). Test programs can therefore be written quickly and efficiently, even when using the PM 5781 for the first time.

The PM 5781 offers a wide variety of features to facilitate programming and to speed up operation via the bus, for example:

- 49 complete instrument settings: can be saved in non-volatile memory. A short and simple command recalls a complete instrument setting as stored in memory, e.g. *RCL 17. The bus transaction time for this command is only a few milliseconds, after which all operating parameters are set.
- LEARN: helps the inexperienced programmer to write instrument programming codes. When the LEARN command is used, the pulse generator transmits the full string of programming commands corresponding to the current setting.
- CODES? and SYNTAX?: programming help functions. After transmitting one of these queries, the pulse generator returns headers for all codes or the syntax for a command. These functions make programming extremely easy, even without the manual or programming card.
- Debug mode: instead of showing the numerical pulse parameter values, in the debug mode the generator displays the programming string as actually received via the bus. Operating problems and failures to command the instrument via the bus, caused by hardware failure or software incompatibility, are easily detected by using this mode.
- Speed: after debugging of all programming commands, the instrument's operating speed can be improved further by disabling a number of functions such as error checking, local displays etc. In addition, the set of available bus commands and the bus interface have been optimised for very fast bus operation.

Ease of operation

The use of microprocessor power to facilitate operation has made the PM 5781 generator extremely easy to use in non-programmable applications. The clearly laid-out, uncluttered front panel, with all 10 pulse parameter values visible on the alphanumeric LCD display, further enhances ease of operation.

Function selection and parameter settings are made simple by cursor controls and keyboard entries, or by up/down vernier buttons for smaller adjustments of set values. Making a choice from the wide range of pulse and trigger modes is facilitated by key selections from a selection tree shown on the display.

But best of all - the PM 5781's microprocessor constantly keeps track of all your settings, and warns of illegal entries. The risk of conflicting combinations of pulse period, delay, duration and rise-/falltime settings usually requires all the operator's attention, and can still lead to errors. The PM 5781's microprocessor control concept completely eliminates this problem. It doesn't just warn you, it even corrects errors with the help of the green AUTOSET button.

Other powerful features are the memory save and recall facility for 49 complete instrument settings and sequence facilities. The recall of settings from memory can be sequenced; for example you can step through 4 series, each including different sequences of saved settings, using a simple NEXT command, issued either manually or via the bus.

Systems compatibility

In addition to its powerful IEEE-488 bus features, the PM 5781 has other characteristics that make it exceptionally easy to install and use in test systems, such as:

- 19"rack-mounting: hardware is included standard. The low-profile cabinet steals a minimum of your rack space - no more than 2E (89 mm/ 3.5 inch) high.
- Rear-panel input/outputs: are optionally available instead of front-panel mounted connectors.
- Wide 0...50°C ambient temperature range: allows the PM 5781 to be used even in rack configurations with many other instruments, all dissipating power without central ventilation.
- EMI: good protection against electromagnetic interference provides high tolerance to other instruments in the same rack or stack

Specifications

Technical Specifications

Specifications apply with all outputs terminated with 50Ω load resistance. Unless otherwise specified, inaccuracy specifications apply at 20°C...30°C. Use temperature coefficient derating above 30°C and below 20 °C. An "in situation recalibration" is possible for other temperature ranges through a programming procedure, available via the front panel.

Time Parameters

Specified at 50 % of pulse amplitude at minimum transition times

Pulse Repetition Period

Internal trigger mode
Range: 8.000 ns...10.00 s
Programming Resolution: 4 digits
Inaccuracy: ± 0.1% ± 0.1 ns (0°C...50°C)
Jitter$_{RMS}$: 0.1% + 50 ps for period times < 1 µs. 0.03% for period times ≥ 1 µs
Gate and burst modes
Range: 8.00 ns...10.0s *
Programming Resolution: 3 digits
Inaccuracy: ±0.3 % ±0.5 ns after the first 5 pulses in each burst
Temperature coefficient: < 0.1%/°C
Repeatability Error: 3 times better than inaccuracy
Jitter$_{RMS}$: 0.1% + 50 ps for period times < 1µs. 0.03 % for period times ≥ 1 µs.

** Using internal burst, with only 1 pulse per burst, the period range is extended up to 4000s*

Pulse Delay

Range: 8.00 ns...100 ms
Programming Resolution: 3 digits
Inaccuracy: ±0.3% ± 1 ns
Temperature coefficient: < 0.1%/°C
Repeatability Error: 3 times better than inaccuracy
Jitter$_{RMS}$: 0.1% + 50 ps

Pulse Duration

Range: 4.00 ns...100 ms.
Programming Resolution: 3 digits
Inaccuracy: ± 3% ± 1 ns
Temperature coefficient: < 0.1%/°C
Repeatability Error: 3 times better than inaccuracy
Jitter$_{RMS}$: 0.1% + 50 ps
Duty Factor: Up to 50% in normal mode. Approaching 100 % in complementary mode

Constant Duty Factor

Repetition period and pulse duration tracked
Range: 0 %...50 % in normal mode.
50 %...100 % in complementary mode

Preset Burst

Range: 1...9999 pulses in each burst
Internal Burst Repetition Period: 1 µs... 4000s
Programming Resolution: 4 digits, min. 1 µs
Inaccuracy: < 1 x 10^{-5} (0°C...50°C)
External Burst Repetition Period: > 250 ns

Transition Times

(Between 10% and 90% of amplitude)
Range: 2.00 ns...100 ms
Minimum transition time, between 20% and 80% of amplitude, is 1.4 ns.
Leading and trailing edge are independently programmable within each of the following ranges:

2.00 ns...20.0 ns	10.0 µs...200 µs
10.0 ns...200 ns	100 µs...2.00 ms
100 ns...2.00 µs	1.00 ms...20.0 ms
1.00 µs...20.0 µs	10.0 ms...100 ms

Programming Resolution: 3 digits
Inaccuracy: ±0.5% ±1 ns
Temperature coefficient: < 0.2%/°C
Repeatability Error: 3 times better than inaccuracy
Linearity Error: ±5 % for transition times longer than 20 ns

Outputs

Main Pulse Outputs

Outputs: 2 channels, A (normal) and B (complementary)
Pulse Modes: Single pulse, double pulse and squarewave
Output Mode: Normal/complementary; to make A complementary and B normal
High Level Range: - 9.80V...+ 10.0V
Low Level Range: - 10.0V...+ 9.80V
Programming Resolution: 10 mV
Inaccuracy: ±1% of progr. value ±3% of amplitude ± 40 mV
Temperature coefficient: < 0.1%/°C
Repeatability Error: 2 times better than inaccuracy
Pulse Amplitude: 0.2V...10V, being the difference between the progr. high and low levels
Offset Channel B: within ±10V
Preshoot, Overshoot, Ringing: ±5% of pulse amplitude ±10 mV
Source Impedance: 50Ω (Reflection coefficient < 0.1)
Output Disable: Output galvanically separated
Level Limit: Programmable high and low levels can be limited to preprogrammed values
Output Protection: Against short and open circuit

Clock Output

Pulse Levels:
TTL; 0V and + 2.5V into 50Ω, 0V and + 5V into high impedance
ECL; - 0.8V and - 1.7V into 50Ω
Transition Time: 1 ns (10% and 90% of amplitude)
Source Impedance: 50Ω
Output Protection: Against short and open circuit
Output Disable: Clock output galvanically separated

Burst Sync Output

Approximately - 0.4V to - 0.8V pulse from 50Ω source during the pulse burst duration

Input

External Input

Frequency Range: DC...125 MHz
Minimum Pulse Duration: 4 ns
Sensitivity: 500 mVpp
Dynamic Input Voltage Range: 10Vpp within ±10V
Trigger Level Range: - 5.00V...+ 5.00V
Programming Resolution: 10 mV
Trigger Slope: + or -
Input Impedance: 1 MΩ/45 pF or 50Ω
Max. input voltage without damage:
50Ω; 10VRMS
1 MΩ; 50VRMS at < 10 MHz,
10VRMS at > 10 MHz

Trigger Modes

Int Trig: Continuously repetitive waveform is generated
Int Gate: Internal burst generator enables the period generator synchronously. Burst duty factor 50%
Int Burst: Internal burst generator enables the period generator to provide a preprogrammed number of pulses (1...9999)
Ext Trig: Each input pulse generates a single output pulse
Ext Gate: External signal enables internal period generator synchronously
Ext Burst: Each input pulse generates a preprogrammed number of pulses (1...9999)
Ext Dur: External signal generates an output signal with same duration and repetition rate and selectable transition times and output levels
Manual: Simulates an external input signal

Features

Front Panel Displays

Alphanumeric display: A 2 lines x 40 characters alphanumeric LCD display with backlighting. The display shows 10 pulse parameters simultaneously. The display is also used for various function selection and error massages
Bus Status Display: An LED display shows Bus status; REMOTE, LLO, ADDR (listen/talk) and SRQ
Trigger Mode Display: An LED display shows trigger mode
Setting Number Display: An LCD display shows setting number
Pulse Mode Display: An LED display shows main pulse output mode

Non-Volatile Memory

Internal battery-backed RAM is used to save settings. Current setting is saved on power down
Power On: Last setting is activated when the power is switched on (Output disabled)
Settings: 49 complete instrument settings can be saved and recalled

Error Handling

Error Detection: Erroneous settings are detected and error messages are displayed
Autoset: Erroneous settings are easily corrected with the AUTOSET key

Track

A change of one pulse parameter value can automatically cause other parameters to follow proportionally. E.g. tracking of pulse period and duration results in a pulse with constant duty factor

Lock

Unintentional changes of numerical parameter-values can be prevented by the locking facility

Rear Panel Connectors

A version with all input and output connectors on the rear panel, instead of on the front panel, is also available

IEEE 488 Capabilities

All functions and parameters are programmable. The interface complies with the requirements of the IEEE 488.1 - 1987 and IEEE 488.2 - 1987 Standards. Interface Functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Address: Set via the front panel

General Specifications

Environmental Conditions

Meets environmental requirements of MIL-T-28800D Type III, Class 5 as follows

Calibration Interval: 1 year
Warm-Up Time: 30 min to reach specified performance
Ambient temperature:
Operating; 0°C...+50°C.
Non-operating; -20°C...+70°C
Altitude: < 4600 m (15000 ft)
Humidity: < 95% RH, 0°C...40°C
Vibration: Operating; 15 min along each of the 3 major axis, 10 Hz...150 Hz, 0.33 mmpp amplitude and 2 g max. acceleration
Shock: Operating; 3 shocks along each of the 3 major axis, half-sinewave, 6 ms duration and 40g acceleration pulses
Bench handling: MIL-STD-810D method 516.3, procedure VI

PM 5781

Safety: CSA Bulletin 556B certified and Philips certification to comply with IEC 348, Class 1 requirements
EMC: Meets VDE 0871 Level B, FCC Part 15J

Power Requirements

LINE: 100, 120, 220 and 240V ±10%, 48 Hz... 420 Hz, 200 VA

Dimensions and Weight

Width: 440 mm, (17.3 in), excl. 19" rack mount brackets
Height: 89 mm, (3.5 in)
Depth: 500 mm, (19.7 in)
Weight: Net 12 kg (26.5 lbs), Shipping 15.5 kg (34 lbs)

Included Accessories

1 Power Cord
1 Bench-Top Conversion Kit
1 Operator's Manual
3 IEEE 488 Pocket Guides

Ordering Information

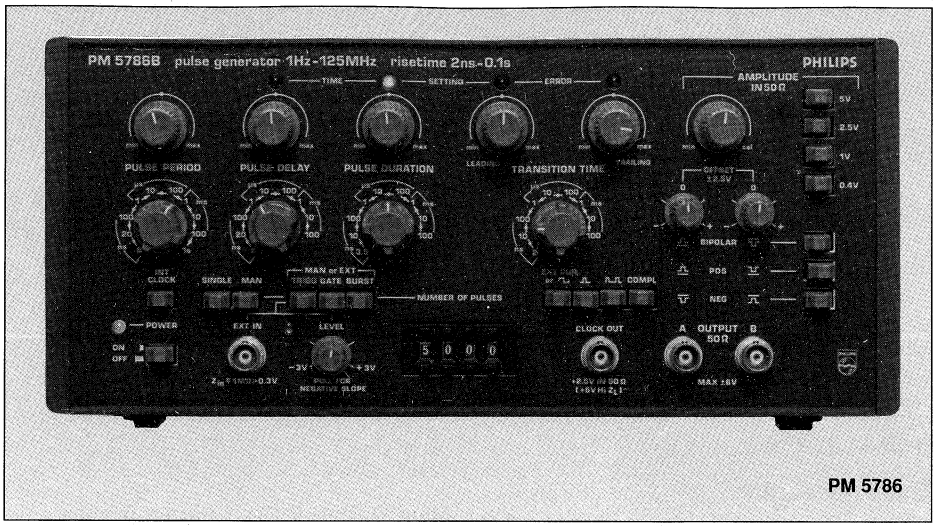
Models

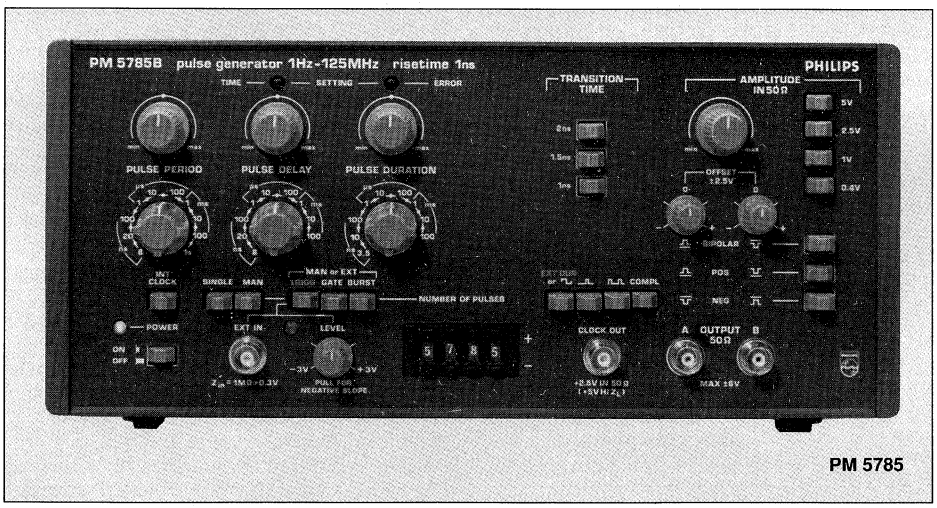
PM 5781/011 Pulse Generator with Front Panel Connectors
PM 5781/012 Pulse Generator with Rear Panel Connectors

Optional Accessories

PM 9581: 50Ω Feed-through Termination; 3W
PM 9584: 50Ω T-Piece (matched power splitter)
PM 9585: 50Ω Feed-through Termination; 1W
PM 9588: 50Ω Coaxial Cable Set (5x1 ns, 4x2 ns, 3x3 ns, 3x10 ns)
PM 2295/05: IEEE Cable, 0.5m
PM 2295/10: IEEE Cable, 1m
PM 2295/20: IEEE Cable, 2m

PM 5785 & PM 5786





PM 5785/PM 5786 125 MHz Pulse Generators

- 1 Hz...125 MHz pulse frequencies
- Rise and fall times from 1 ns
- Time-setting-error indicators
- Excellent 50Ω backmatching
- Dual outputs for simultaneous + and - pulses
- Full external control facilities
- LED indicator for correct trigger levels
- Presettable burst option

PM 5785 and PM 5786: top performance, top economy and assured time-settings.

The PM 5785 and PM 5786 have the speed and versatility to handle virtually any analog or digital circuit testing requirement. Yet, for instruments with such high performance, they are very competitively priced. Fast digital circuitry such as TTL or ECL is easily handled by both generators, and the wide choice of external trigger and gate functions make the setting up of special test signals unbeatably easy.

The difference in the PM 5785 and PM 5786 is the choice between speed and versatility in leading and trailing edge adjustment.

The PM 5785 offers the higher speed of the two. Its leading and trailing edges are equal. Pulse transition times can be selected from three values: 1 ns, 1.5 ns or 2 ns.

The PM 5786 offers a whole-spectrum of transition times from which to choose. It allows such versatility as independent and continuous variable settings of rise and fall times all the way from 2 ns ... 100 ms. In other words, the PM 5786 is best suited for high-speed general-purpose applications such as in research and development, where many different pulse response tests may need to be made.

On the other hand, the 1 ns performance of the PM 5785 is ideal for ultra high-speed testing in quality control (manufacturing), performance checks (maintenance) or testing to limits (development).

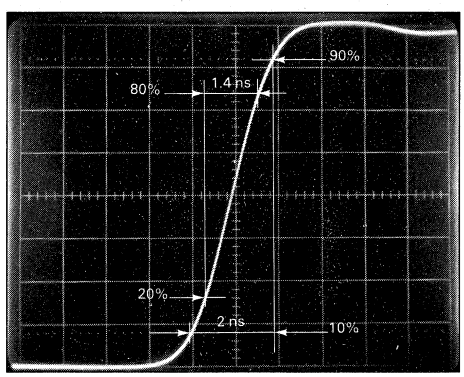


Fig. 1.

Ease of Operation

Both PM 5785 and PM 5786 offer features to simplify operation. Like the unique system of front panel time-setting-error indicator LEDs to provide clear confirmation that all time settings are correct. This prevents erroneous pulses, caused by incorrectly set pulse duration or pulse delay times (and additionally for the PM 5786, rise and fall times) with respect to pulse period.

Versatile Pulse Selection

Additional ease of use results from simple and versatile selection of the desired kind of output pulses: bipolar, positive or negative. Simultaneous positive and negative going pulses can be selected for linear applications, as well as complementary positive or negative pulses for digital applications.

This simple output selection means there is no need for time-consuming manual adjustment of inverter and offset controls. Further, logic 'O' and '1' levels can be changed without the need for interchanging cables by using the COMPL (normal/complementary) switch. The table below, shows the possible output combinations that can be selected.

PM 5785 & PM 5786

High-Speed, High-Fidelity Pulses

The PM 5785's ultra high-speed output waveforms have rise and fall times selectable from 1 ns, 1.5 ns and 2 ns, (and with the 20% ... 80% transition times for ECL testing, rise and fall times are 700 ps, 1 ns and 1.4 ns).

A choice of bipolar outputs and high-quality 4-range output attenuator in both the PM 5785 and PM 5786 make these generators very suitable for all kinds of linear applications. Very clean pulses are ensured by the PM 5786's excellent back-matching impedance that absorbs over 90% of reflections from mismatched loads, while the PM 5785 absorbs as much as 95% of reflections.

Burst Mode

The PM 5785 and PM 5786 are also available with burst mode options (PM 5785B and PM 5786B), that enable generation of bursts containing selectable numbers of pulses from 1...9999. Pre-selection of the required number of pulses is easily carried-out, using front panel digital switches. Bursts can be triggered either manually or remotely by a signal to the EXTernal INput on the front panel. The use of the presettable burst mode is particularly valuable, for testing memory circuits, shift registers, counters and other digital circuits.

Other functions which can be selected and carried out remotely through the external input include:

- Externally triggered pulses
- Externally gated pulses (gives synchronized bursts of pulses)
- Externally controlled pulse duration.

External control signals can be applied to define the start (and duration) of the various control options. Start/stop conditions can be adjusted with the EXT IN LEVEL control both to select +/- trigger slope and -3V...+3V trigger level. An LED indicates correct triggering.
For ECL testing: the minimum transition time is 1.4 ns, corresponding to 20%...80% of pulse amplitude.

External Triggering

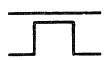
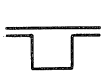
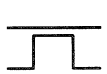
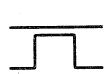
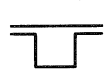
External triggering enables the PM 5785/ PM 5786 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude etc. are as set on the pulse generator. External trigger signals can vary from 0...125 MHz, or, in the double pulse mode, 0...62.5 MHz.

External Gating

The external gate mode provides external synchronous on/off control of the pulse generator. As long as the external gate signal is present, output pulses are available with the preset pulse parameters.

External Duration

This mode allows the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, DC offset, rise and fall times and normal/complementary mode selection are defined by the pulse generator settings.

Mode	Normal		Complementary	
Output	A	B	A	B
Bipolar				
Pos				
Neg				

Squarewave Mode

A 'squarewave' mode provides pulses with a constant 0.5 duty factor. This facilitates a quick method of setting the required output repetition rate, without having to consider the other time parameters.

Specifications

Technical Specifications

Time Parameters

Pulse Repetition Period: 8 ns...1s (1 Hz... 125 MHz)
Pulse Delay: 8 ns...100ms
Pulse Duration: 3.5 ns...100 ms or fixed square wave
Jitter: <0.1% of setting ±50 ps

Main Output Pulse Characteristics

Outputs: 2 channels, A and B
Transition Times: At Z_L = 50Ω
PM 5785: 1 ns, 1.5 ns or 2 ns fixed selectable, corresponding to 10%...90% of pulse amplitude. For ECL testing: 700 ps, 1 ns or 1.4 ns fixed selectable, corresponding to 20%...80% of pulse amplitude.
Transition Time Accuracy: ±10% (PM 5785)
PM 5786: <2 ns...>100 ms, continuously variable, corresponding to 10%...90% of pulse amplitude.
Pulse Amplitude: 0.2V...5V (at Z_L = 50Ω), double amplitude at open output
DC Offset: -2.5V...+2.5V (at Z_L = 50Ω), ±5V at open output
Max. Output Voltage: Pulse amplitude plus DC offset is ±6V at max. Maximum 10V open output voltage within the -6v...+6V range.
Waveform Aberrations: at Z_L = 50Ω
PM 5785: <5% ±10 mV
PM 5786: <5% ±10 mV, <10% for transition times <5 ns
Source Resistance: 50Ω ±5%
Source Impedance:
PM 5785: 50Ω ±5%
PM 5786: 50Ω ±10%
Output Protection: against short- or open- circuit and transients
Pulse Modes:
- Single pulse (delayable)
- Double pulse
- Square wave: 50% ±1% (1 Hz...1 MHz); 50% ±10% (1 MHz...125 MHz)
- Normal or complementary switchable

Output Modes:
Bipolar: simultaneously positive and negative polarity
Pos: positive polarity, normal and complementary
Neg: negative polarity, normal and complementary

External Operating Modes

TRIGG: Ext. triggered pulse repetition: DC... 125 MHz or manual single shot
GATE: Synchronous gating. Ext. input signal starts and stops the generator
BURST: Internally generated burst with digital switch selection of number of pulses: 0...9999, started by ext. input signal or manual control
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Range: DC...125 MHz; min. pulse duration 3.5 ns
Operating Input Voltage Range: 0.5...15 Vpp
Coupling: DC
Input Impedance: 1 MΩ//25 pF
Trigger Level: -3V...+3V
Trigger Slope: + and -
Trigger Indicator: Tri-state LED indicator for correct trigger level setting
Max. Input Voltage Without Damage: 260 Vrms at ≤440 Hz, declining to 15 Vpp at 125 MHz

Internal Clock Output

Main output pulse is delayable with respect to internal clock output, which can thus be used as pre-trigger
Amplitude: +2.5V into 50Ω
Output Impedance: 50Ω (typ)
Transition Time: Approx. 1 ns
Pulse Duration: Square wave, 50% ±1% (1 Hz... 1 MHz), 50% ±10% (1...125 MHz)
Output Protection: Against short- or open- circuit and transients

Time Setting Error Indicators

Warning with LED indicators for erroneous settings of too long times for pulse delay and/or pulse duration (on PM 5785 and PM 5786) as well as for leading- and trailing edge transition times (PM 5786 only).

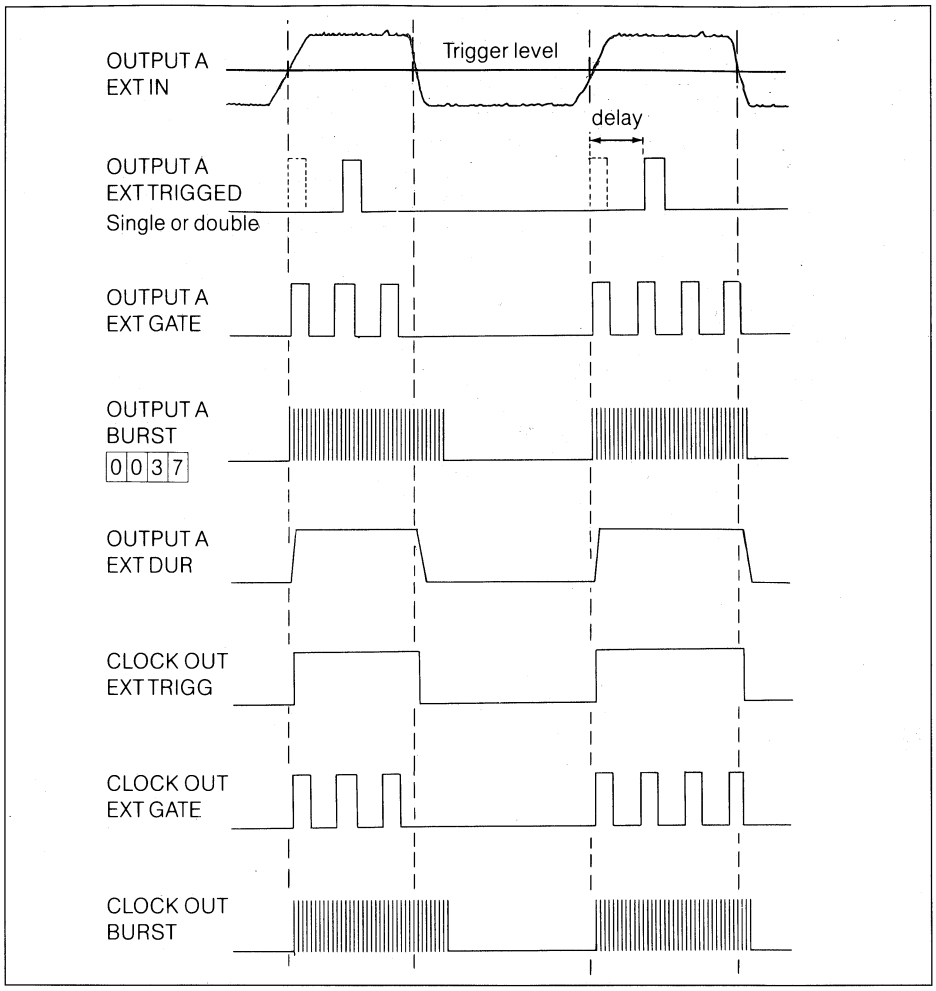
General Specifications

Power Requirements

Line: 100V, 120V, 220V and 240 Vrms ±10%; 120 VA, 50...60 Hz
Safety: According to IEC 348 and CSA 556B
Mains Interference: Below VDE 0871 (B)

Environmental Conditions

Temperature:
Rated Range of Use: 0°C...+50°C
Storage and Transport: -40°C...+70°C
Humidity:
Operating: 10...90% RH, no condensation
Storage: 5...95% RH
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) - 53.3 kN/m2
Storage: 15000m (50000 ft) - 15.2 kN/m2
Dimensions and Weight:
Size: 300 mm W x 145 mm H x 470 mm L



(11.8 in W x 5.7 in H x 18.5 in L)
Weight:
Net: 9.5 kg (21 lbs)
Shipping: 11.5 kg (25 lbs)
Included with instrument: Manual, power cord

Ordering Information

Models

PM 5785 1 ns Pulse Generator; excluding preset burst unit
PM 5785B 1 ns Pulse Generator; including preset burst unit
PM 5786 2 ns Pulse Generator; excluding preset burst unit
PM 5786B 2 ns Pulse Generator; including preset burst unit

Accessories

PM 9581 50Ω Feed-through Termination; 3W
PM 9584 50Ω T-piece (matched power-splitter)
PM 9585 50Ω Feed-through Termination; 1W
PM 9588 50Ω Coaxial Cable Set (5 x 1 ns, 4 x 2 ns, 3 x 3 ns, 3 x 10 ns)

9

PM 5716



PM 5716

PM 5716 50 MHz; ±20V Pulse Generator

- 1 Hz...50 MHz repetition rate
- 6 ns... 100 ms rise and fall times
- 2V... 20V amplitude, within the range of -20V... +20V
- Independent control for upper and lower pulse levels
- Pulse amplitude limiter to protect device under test
- Built-in 50Ω backmatch, no need for external termination
- Versatile facilities for external triggering, gating and pulse amplifying

This truly universal pulse generator has been designed to meet all MOS testing requirements as well as TTL and other HNIL circuits.

In addition, the wide range of repetition rates, delay, duration and transition time makes the PM 5716 an ideal pulse source also for analog applications.

Pulse Amplitudes to 20V

The main pulse amplitude from the PM 5716 is continuously adjustable between 2V and 20V. The pulse level setting is done with two independent sliding potentiometers with ranges from -20V to +20V. The two sliders are mechanically interlocked in such a way that they cannot pass each other and the maximum separation corresponds to a 20V pulse amplitude. (Fig. 1)

The generator has a source impedance of 50Ω and the maximum output amplitude is 20V into ≥5 kΩ . With output into 50Ω, this value is 10V. The front panel scale is graduated for both cases. The high quality output stage of the PM 5716 maintains the 20V pulse amplitude over the whole frequency range.

The PM 5716 is designed for ease of operation. The square wave pulse mode gives freedom from selecting delay and duration; the operator need only set the repetition time, amplitude and shortest transition time and the pulse output.

As shown in fig. 1, it is easy to read pulse amplitude directly from the scales and by avoiding the use of double function controls the PM 5716 further ensures convenient operation.

Amplitude Limiter

The PM 5716 has as standard an amplitude limiter to protect the device under test. (Fig. 2) When the MOS supply voltage is connected to the limiter inputs your circuits are automatically safeguarded against excessive pulse levels.

The pulse levels can not exceed the upper/lower levels of the limiting voltages. This also makes it possible to remotely control the output levels within the range set by the sliders.

Backmatched 50Ω Input

The built-in 50Ω termination in the PM 5716 is compensated for by the reactive impedance components of the output stage.

Fig. 3 which shows a 20V pulse with 6 ns rise time fed into a 1 meter open ended cable and illustrates how the internal termination absorbs the reflection. The residual reflection from the PM 5716 is guaranteed to be less than ±3% with this set-up.

This backmatch makes it possible to work with unterminated cables and high ohmic loads without spending time on checking the waveform. The benefits gained from this specially designed output are summarized as follows:

- Reflections from all kinds of mismatches are absorbed in the generator.
- It gives a better waveform, less dependent on external load
- The fixed load means protection of the output stage
- It is ideal for high ohmic loads such as MOS circuits
- There is no need for external termination – easier to use

Transition Times

In the PM 5716, the transition time is not dependent on the amplitude.

This gives freedom to vary the amplitude during a test sequence without having to check and readjust the rise and fall time.

The repetition and transition time ranges in the PM 5716 far exceed the requirements for the MOS logic of today. This makes the generator a suitable pulse source for new developments in MOS in the years to come.

Further, excellent linearity of the rise time circuit, along with minimal overshoot, contribute to its high measuring accuracy. This performance, along with a transition time starting at 6 ns, makes it an ideal test tool not only for MOS applications, but also for most other logic families, including TTL, TRL and DTL.

High Ohmic Trigger Input

In logic testing it is often desirable to trigger a pulse generator from the circuit under test. The trigger take-off must then be of sufficiently high ohmic value to avoid overloading the circuit under test. For that reason, the PM 5716 has a trigger impedance of 1 MΩ/20pF, suitable for MOS logic.

In addition, the trigger level in the PM 5716 is variable from -2V to +2V, enabling triggering from all kinds of logic and most analog sources.

Clock and Auxiliary Outputs

The auxiliary output of the PM 5716 gives a +2.5V pulse into a 50Ω load. As the source is backmatched by 50Ω a +5V amplitude across high ohmic loads is available.

The pulse always has set delay and duration

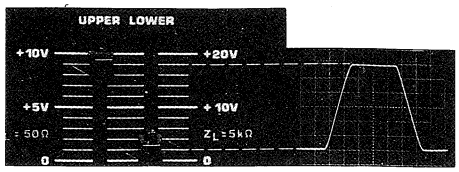


Fig. 1. Independent slide potentiometers for setting maximum and minimum pulse levels

and a 6 ns transition time.

The clock output always gives symmetrical pulses which are suitable for use as a time reference, because of the fixed duty factor.

Output Protection

The reliability of a signal source is most important. But pulse generator outputs exposed to all kind of reflections, external DC levels and transients have always been difficult to safeguard.

The PM 5716 includes an output protection system of diodes shorting any external transients applied to the internal supply voltage. In the case of external DC-levels, the whole internal voltage supply (which is floating) is shifted to avoid overload of the output transistors. The two 5V outputs are also protected with diodes against

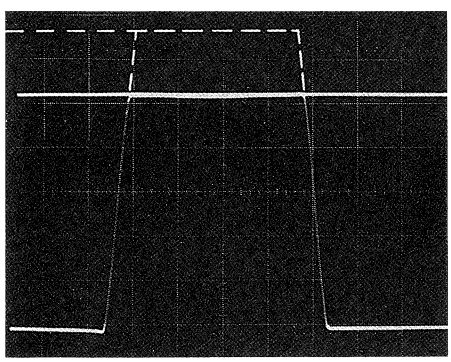


Fig. 2.Pulse limiter protects MOS circuit under test against excessive input pulse amplitudes.

Specifications

Technical Specifications

Repetition Rate

Internal: 1 Hz... 50 MHz variable in 8 ranges with continuous control within the ranges
Jitter: ≤0.1% or 50 ps whichever is greater
External: DC... 50 MHz

Pulse Delay

10 ns...100 ms. Variable in 7 ranges with continuous control within the ranges
Jitter: ≤0.1% or 50 ps whichever is greater

Pulse Duration

10ns... 100 ms. Variable in 7 ranges with continuous control within the ranges.
Jitter: ≤0.1% or 50 ps whichever is greater.
Duty Factor: More than 50%. Duty factor over 99% possible with complementary mode.

Main Output Pulse Characteristics

Amplitude: 2V... 20V between -20V and +20V with 5 kΩ load
1V...10V between -10V and +10V with 50Ω load
Rise and Fall Times: ≤6 ns... 100 ms, (at amplitude below 4V (2V) from 8 ns.
Independent continuous controls within 8 selectable ranges. The transition time remains constant when the pulse amplitude is varied.
Source Impedance: 50Ω compensated, ideal for driving MOS circuits without terminating load. A total reflection of a 6 ns rise time pulse gives less than ±3% distortion.
Waveform Aberrations: ≤5% for all transition times
Amplitude Limiter: The upper (lower) pulse level may be limited by an external DC-source to any value between +20V and -18V (+18V and -20V). With high ohmic load the max., output level is equal to the limiter levels. With 50Ω load, 50% of the levels.
The input resistance of the limiter measured between upper and lower terminals and earth is ≥1 kΩ.
Protection: Short- and open-circuit safe
Protected against external DC voltages between ±20V. Special transient protection circuits built in.
Timing: The pulse is delayed 50 ns plus set delay from an external trigger pulse.

Clock Pulse Characteristics

Amplitude: +2.5V into 50Ω and 5V into 5 kΩ
Source Impedance: 50Ω
Rise and Fall Times: Approx. 6 ns
Duty Factor: 50% ±5% (In fastest range 25 - 45% duty factor)
Protection: Short and open circuit safe, diode protection against transients
Timing: Pulse occurs approx. 35 ns plus set delay ahead of main pulse and 15 ns after external trigger pulse.

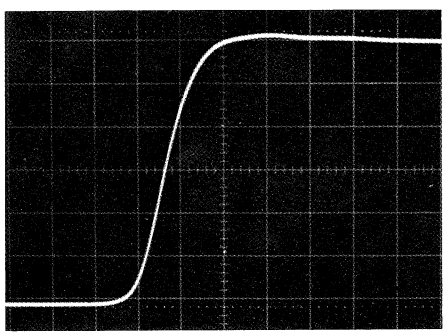


Fig 3

Auxiliary Pulse Characteristics

Amplitude: +2.5V into 50Ω and +5V into 5 kΩ
Source Impedance: 50Ω
Rise and Fall Times: Approx. 6 ns
Duty Factor: As set by 'DURATION'
Pulse Mode: Single or double pulses
Protection: Short and open circuit safe, diode protection against transients
Timing: Pulse occurs approx 15 ns plus set delay ahead of main pulse and 35 ns after external trigger pulse.

External Triggering/Gating

Electrical
Frequency Range: DC...50 MHz
Sensitivity: 200 mV
Trig Level: Variable -2V to +2V, with 10:1 probe -20 to +20V
Trig Slope: Selectable leading or trailing edge
Max. External Voltage: ±20V
Input Impedance: 1 MΩ/20 pF suitable for probes

Manual
Single shot by means of push button

Modes of Operation

1	INT CLOCK	Internal clock gives repetition rates from 1 Hz to 50 MHz.
2	MAN TRIGG	Manual trigger gives one single/double pulse with set duration or one pulse with same duration as the manual trigger pulse.
3	EXT GATE	Gated Pulses. First pulse coincides with leading/trailing edge of gate pulse.
4	EXT TRIGG	Triggering on leading/trailing edge of external pulse
5	EXT DUR	Pulses with same duration and repetition rate as external pulses.

Pulse Modes

1		Gives a square wave on main output (50% ±5%; approx 25% duty factor in fastest range). And gives single pulses with set duration on aux. output.
2		Gives single pulses with set duration on both main and aux. output.
3		Gives double pulses with set duration on both main and aux. output.
4	NORM	'Normal' gives pulses as previously described.
5	COMPL	'Complementary' gives the complement to the set pulse on main output only.

9

PM 5716

General Specifications

Power Requirements

Line Voltages: 85V...115V, 100V...130V, 200V...265V; switchable
Frequency: 50 Hz or 60 Hz solderable
Power Consumption: 90 VA

Mechanical Specifications

Size: 280 mm W x 133 mm H x 360 mm L (11 in W x 5.2 in H x 14.2 in L)
Weight: 9 kg (19.8 lb)

Ordering Information

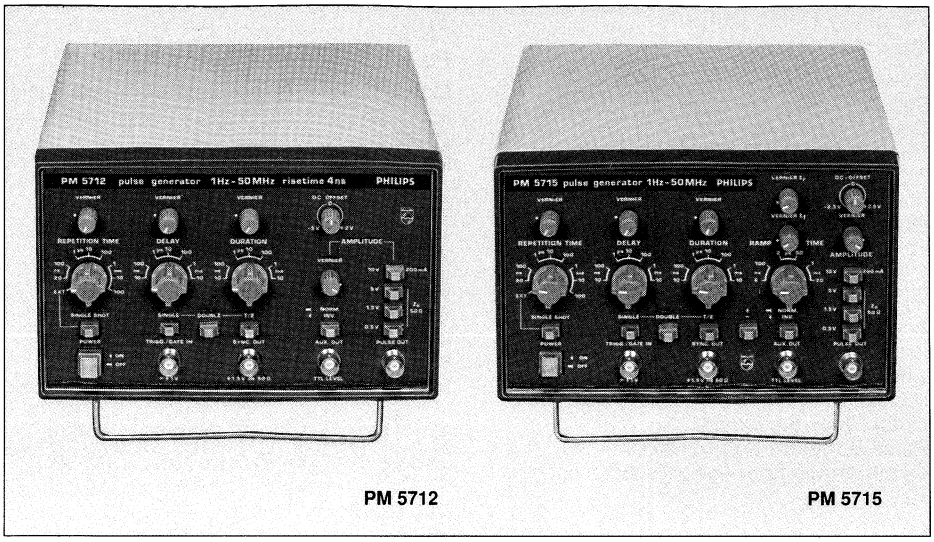
Model

PM5716/00 Pulse Generator

Accessories

PM 9581 50Ω Feed-through termination; 3W
PM 9584 50Ω T-piece (matched power splitter)
PM 9585 50Ω Feed-through Termination; 1W
PM 9588 Coaxial Cable Set (5 x 1 ns, 4 x 2 ns, 3 x 3 ns, 3 x 10 ns)

PM 5712 & PM 5715



PM 5712 PM 5715

PM 5712 & PM 5715 50 MHz Pulse Generators

Frequency range: 1 Hz ... 50 MHz

Rise/fall times: PM 5712, 4 ns fixed; PM 5715, 6 ns ... 500 ms, variable

Amplitude range: 0.2 ... 10V

DC offset: +2.5V

Facilities for: manual and ext. triggering, gating, pulse shaping

Pulse modes: single/double, norm/inverted, pos/neg

Applications

The universal 50 MHz pulse generators PM 5712 and PM 5715 have been designed for medium fast, pulse response testing applications.

They can handle virtually any analog or digital circuit testing requirement up to 50 MHz. Their speed and the wide 0.2 ... 10V output voltage range makes these generators ideal for testing of all MOS- and TTL- compatible circuits.

A second output (auxiliary output) supplies pulses, similar to the main output pulses, yet with fixed TTL-compatible levels.

The capability of producing double pulses, with variable delay, allows these instruments to be used for analysis of pulse pair resolution of digital and analog circuits.

An adjustable DC offset can be used to test circuit tolerances for variations in logic levels.

Their versatility is enhanced by extended facilities for external control of e.g. manual and external triggering, synchronous gating and external duration (pulse shaping).

PM 5712 Versus PM 5715

The main difference between the models is found in the facility for transition time setting.

The PM 5712 is primarily intended to supply pulses of positive polarity. However, negative pulses up to -5V can be generated by use of the DC offset and the normal/inverted switch.

The PM 5712 offers a fixed rise- and fall-time of 4 ns. Compared to the PM 5715, this unit is somewhat faster and is more economically priced.

This makes the PM 5712 ideal for go/no-go and performance limit tests, such as those in quality control (manufacturing) and performance checks (maintenance).

On the other hand, the PM 5715 covers a much wider spectrum of applications. It features continuously variable settings of transition times, all the way from 6 ns to 500 ms, with separate controls for rise- and fall-time.

In addition, the PM 5715 allows selection of both positive and negative pulses, over the full pulse amplitude range of -10 to +10V.

In other words, the PM 5715 is best suited for general-purpose applications such as in research and development, where a wide variety of different pulse response tests may need to be made.

PM 5712 and PM 5715

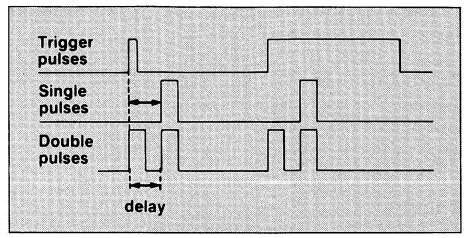
Both models offer three different pulse modes to select from:

- Single pulses
- Double pulses
- T/2 pulses

Testing of digital circuitry is facilitated by the possibility to select of either normal or inverted pulses and the variety of external control facilities.

Single Pulse Mode

In the single pulse mode, continuous pulses up to 50 MHz are generated with adjustable repetition time. Also pulse duration and delay (with respect to the sync. output) are variable.



Double Pulse Mode

In the double pulse mode, twin pulses are generated, of which the pulse pair frequency is variable up to 25 MHz. The pulse duration is commonly set for both pulses, while the delay between the pulses is variable.

Square-Wave or T/2 Mode

In the T/2 mode, the generators supply fixed square wave pulses, irrespective of the settings for pulse delay and pulse duration.

Normal/Inverted

An additional normal/inverted switch allowing the logic state of the pulses to be changed. In the normal mode, the generators can supply pulses with duty cycles of from nearly 0% to more than 50%, whilst in the inverted mode, duty cycles of nearly 100% can be obtained.

External Triggering

External triggering enables the PM 5712/ PM 5715 to operate synchronously with external clock signals. All other parameters, such as pulse duration, amplitude, etc. are set on the pulse generator. External trigger signals can vary from 0 ... 50 MHz or, when in the double pulse mode, 0 ... 25 MHz.

External Gating

The external gate mode provides an external synchronous on/off control over the pulse generator. Bursts of output pulses are supplied, only during the presence of the external gate signal. The first pulse coincides with the trailing edge of the gating signal, the last pulse is completed even if the gating signal ends during the pulse.

External Duration

Simultaneous selection of external triggering and the T/2 mode enables the generators to function as input signal conditioners. The external input signal defines frequency and pulse duration, while amplitude, DC offset, rise- and fall-time and normal/inverted mode selection are defined by the pulse generator settings.

PM 5712 & PM 5715

Specifications

Technical Specifications

Time Parameters

Pulse Repetition Time: 20 ns ... 1s (1 Hz ... 50 MHz)
Pulse Delay: 10 ns ... 100 ms
Pulse Duration: 10 ns ... 100 ms
Jitter: ≤0.1% of setting ±50 ps

Main Output Pulse Characteristics

Pulse Amplitude: 0.2V ... 10V at Z_L = 50Ω
Polarity:
PM 5715: + or - switchable
PM 5712: + only. Pulses within -5V ... +10V possible, using DC offset and norm/inv

Transition Times: Corresponding to 10 ... 90% of pulse amplitude, at amplitudes of ≤5V and Z_L = 50Ω
PM 5715: 6 ns ... 500 ms
PM 5712: 4 ns fixed

DC Offset at Z_L = 50Ω:
PM 5715: -2.5V ... +2.5V
PM 5712: -5V ... +2V

Max Output Voltage: Pulse amplitude and DC offset max. +10V
Waveform Aberrations:<±5% of set amplitude
Source Impedance: Current source of 200 mA in 10V range, terminated with internal 50Ω in 5V and lower ranges.
Pulse Modes:
- Single pulse (delayable)
- Double pulse
- T/2, 50% duty cycle, 50 ±20% duty cycle in 20 ns and 100 ns repetition range

Logic Mode: Normal or inverted
Output Protection: Against short or open circuit

Auxiliary Pulse Output Characteristics

Pulse Amplitude: TTL-compatible, +2.5V into 50Ω or +4.5V open circuit
Source Impedance: 50Ω
Pulse Modes: Single pulse, double pulse, not T/2. The pulse occurs approx. 12 ns ahead of main pulse.
Output Protection: Against short or open circuit

Sync. Output

Function: Pre-trigger output, main output pulse is delayable with respect to sync. output
Amplitude: +1.5 V at Z_L = 50Ω, +3V open circuit
Output Impedance: 50Ω
Pulse Duration: Square wave
Output Protection: Against short or open circuit

External Operating Modes

TRIGG: Ext. triggered pulses, range: DC... 50 MHz or manual single shot
GATE: Synchronous gating, external signal starts and stops the generator
EXT DUR: External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

External Input

Function: For external trigger, gate and duration
Range: DC ... 50 MHz
Coupling: DC
Input Impedance: Approx 220Ω at <1.5V, approx 800Ω at >1.5V
Trigger Level: ≥+1V
Trigger Slope: Positive
Max. Input Voltage Without Damage: ±12V

General Specifications

Power Requirements

Line: 100 ... 130V and 200 ... 260V switchable, 85 ... 115V and 170 ... 230V solderable
Line Frequency: 50 ... 400 Hz
Power Consumption: 70 VA

Environmental Conditions

Temperature Range:
Operating: 0...40°C
Storage: 0...70°
Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 4 kg (8.8 lb)
Included with instrument: Manual, power cord

Ordering Information

Models

PM 5712 Pulse Generator
PM 5715 Pulse Generator

Accessories

PM 9581 50Ω Feed-through Termination; 3W
PM 9584 50Ω T-Piece (matched power splitter)
PM 9585 50Ω Feed-through Termination; 1W
PM 9588 Coaxial Cable Set (5 x 1 ns, 4 x 2 ns, 3 x 3 ns, 3 x 10 ns)



PM 5705

PM 5705 10 MHz: 15V Output Pulse Generator

- 0.1 Hz to 10 MHz frequency range
- TTL–Compatible outputs, both normal and complimentary
- 1.0V to 15V into 50Ω for TTL, HNIL and MOS applications
- Baseline offset from 0 up to +2V
- Resettable, engraved scales
- External triggering on positive or negative slope; gating and single shot facilities

The PM 5705 is an ideal low-cost generator for a wide range of TTL MOS and HNIL applications. There are two TTL outputs, normal and complementary with sufficient power for up to 30 gates.

For MOS and HNIL logic there is a 1 to 15V output – high for this price range. For current sink applications a 50Ω internal switchable load is included.

The PM 5705 has internal triggering from as low as 0.1 Hz, thereby giving the possibility of stimulating even very slow mechanical devices. The other end of the frequency range is as high as 10 MHz. A single shot facility is also included to give even lower frequencies.

This all-round performance is complemented by a logic front panel layout and the use of engraved, resettable scales.

Ease of use is further enhanced with the square wave function, allowing pulse parameters to be set to a high degree of accuracy without employing an oscilloscope. This feature is particularly useful for educational applications. Further, when the PM 5705 is used as a clock generator, only the repetition time has to be set and the square wave push button depressed.

The baseline offset of up to 2V is an additional useful feature, used to test biased circuits and components – for example the (zero) level in TTL.

Gating facilities are also provided. Pulse bursts can be produced using a low frequency generator connected to the Trigg/Gate input. The PM 5705 can also be triggered by an external pulse source, on either the positive or negative slopes. Further, when the square-wave push-button is depressed, the Trigg/Gate input acts as a duration trigger and the pulses from TTL output 'Normal' have the same duration as the trigger pulses. With this pulse shaping facility, all kinds of waveforms can be changed into TTL pulses.

Specifications

Technical Specifications

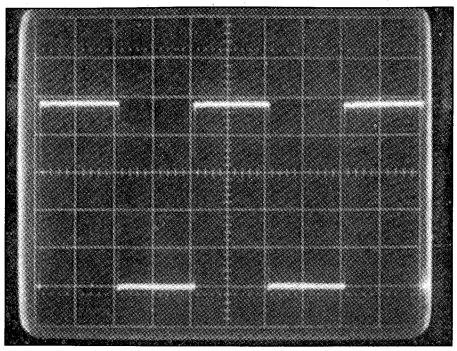
15V Pulse Output

Repetition Rate: 0.1 Hz... 10 MHz variable in 8 ranges with continuous control of the ranges. Jitter less than 0.1%
Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%
Duty Factor: approaching 100% using complementary pulse. More than 50% in normal pulse mode.
Delay: In square wave mode the positive edge of the TTL complementary is delayed from the complementary main pulse. The delay time is the set duration subtracted from half the repetition time.
Amplitude: Continuously variable from +1V to +15V into 50Ω.
Max current 300 mA
Source impedance: Voltage source with about 300Ω or 50Ω termination.
Polarity: Positive
Modes of Operation: Normal or complementary.
Baseline Offset: Continuously variable from 0 to +2V max. offset current 80 mA. Only the baseline is shifted.
Ramp Time: ≤10 ns at 5V and lower amplitudes with 50Ω internal or external termination. Typically 10 ns at 10V and 15 ns at 15V. (Typical rise time 6 ns).
Waveform Aberration: Less than ±5% between 3V and 15V into 50Ω and base line offset 0V.
Protection: Short and open circuit safe.

TTL Pulse Outputs

Repetition Rate: 0.1 Hz... 10 MHz variable in 8 ranges with continuous control within the ranges.
Jitter: less than 0.1%
Duration: 50 ns to 500 ms variable in 7 ranges with continuous control within the ranges. Jitter less than 0.1%
Duty Factor: Approaching 100% using complementary pulse. More than 50% in normal operation.
Delay: In square wave mode the positive edge of the TTL complementary is delayed from the main complementary pulse. The delay time is the set duration subtracted from half the repetition time.
Amplitude: TTL level. Fan out 30 gates. About 4.5V open circuit.
Polarity: Positive.
Modes of Operation: Normal and complementary.
Ramp Time: About 10 ns.
Waveform Aberration: Less than 5% into 50Ω.
Protection: Short and open circuit safe.
Pulse Output: 50Ω TTL linedriver with filter for waveform correction, designed for 50Ω load.

PM 5705



Fg. 1. Squarewave at 5 MHz

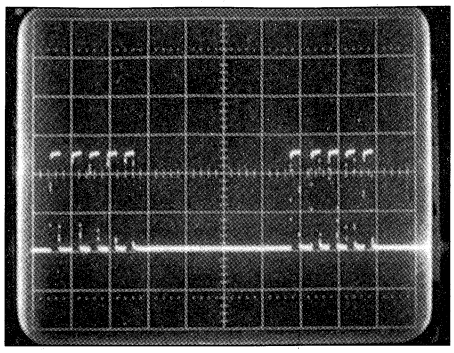


Fig. 2. Gated Pulses

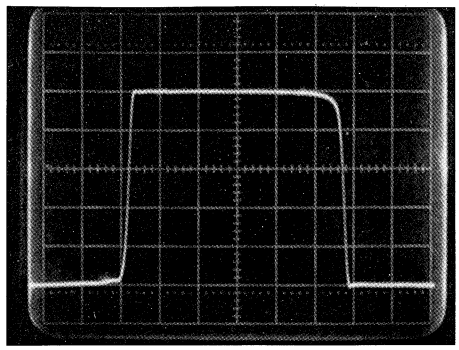


Fig. 3. TTL Output

Triggering and Gating

External Triggering and Gating

Level: > + 1V to trigger or gate the generator. Max ±20V
Slope Selection: Positive or negative slope.
Frequency: 0... 10 MHz
Input Impedance: Approx. 1 kΩ Gating signal turns the generator 'off'. First pulse coincides with trailing edge of gating pulse.
Pulse Shaping: In square wave mode with repetition time set to external the frequency and duration of the output pulse are determined by the trigger pulses.
Single Shot: Single shot facility by means of push-button. In square wave mode the TTL pulse duration is determined by the time the push button single shot is depressed.
Manual Gating: Depressing the single shot push-button inhibits pulses when the generator is internally triggered.

General Specifications

Temperature Range: 0... 40°C

Power Requirements

Line Voltage: 90... 110, 100... 130, 180... 210 and 200... 260V solderable.
Frequency: 50... 400 Hz
Consumption: 40 VA

Mechanical Specifications

Size: 210 mm W x 130 mm H x 275 mm L (8.3 in W x 5 in H x 10.8 in L)
Weight: 3.5 kg (7.7 lb)
Included with instrument: Line cable, instruction manual.

Ordering Information

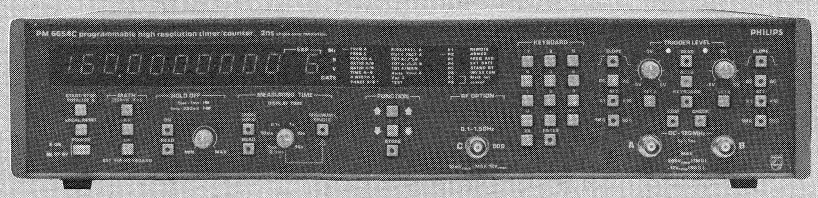
Model

PM 5705/04 Pulse Generator

Accessories

PM 9581/01 50Ω Termination
PM 9584/02 50Ω T-piece (Matched power splitter)
PM 9585/01 50Ω Feed-through termination (1W)
PM 9588/01 Coaxial Cable Set W/Calibrated Delay Timer (5 x 1 ns, 4 x 2 ns, 3 x 3 ns, 3 x 10 ns)

Counters / Timer Counters



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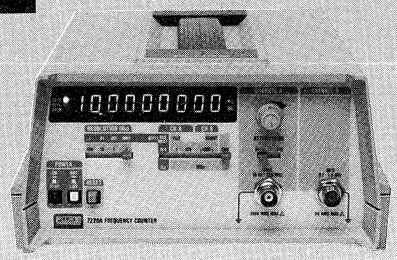

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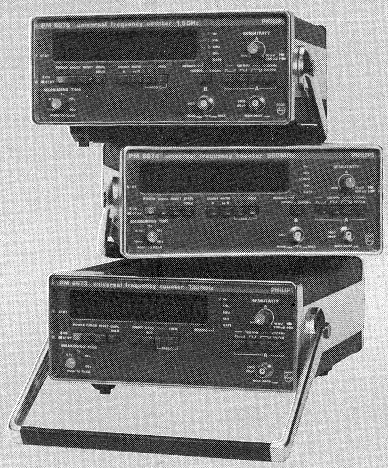

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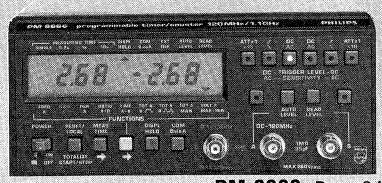

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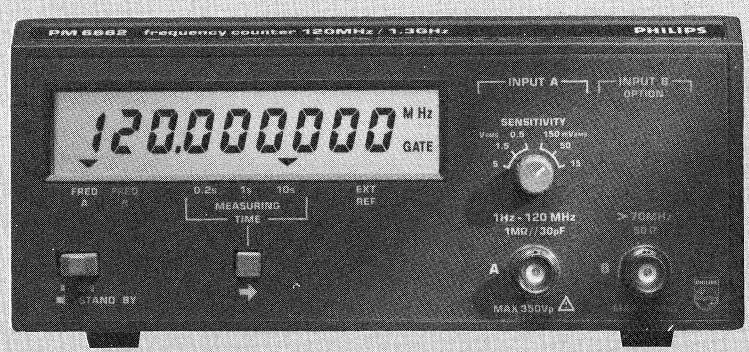
NEW



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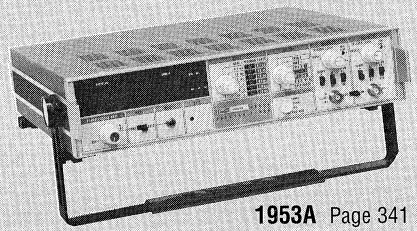

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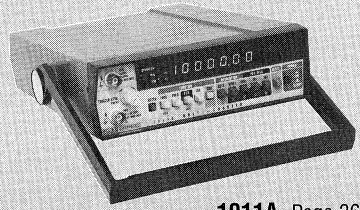

1911A Page 363

Whether you use frequency counters or timer/counters; on the bench, in the field, or in automated systems, Fluke and Philips can address your time and frequency measurement needs from economical solutions to state-of-the-art performance.

Fluke and Philips provide the broadest selection of non-microwave counters in the industry. Models range from the 1900A, with a price to suit any budget, to the high performance PM 6654C which offers 15 measuring functions and nine digits of resolution in a one second measuring time. We also offer the PM 6669, the lowest cost IEEE-488 counter available; the PM 6665, the lowest cost IEEE-488 timer/counter available; and the PM 6666, the lowest cost fully programmable IEEE-488 timer/counter available. The new PM 6662 provides superior ease-of-use, with features like AUTO DISPLAY and AUTO TRIGGER, as well as excellent stability (with Philips unique MTCXO), all combined with a very economical price. The result is one of the greatest values in counters available today. And for higher performance needs, the new PM 6677 extends the frequency range of the popular PM 6670 family to a high 2.3 GHz.

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Introduction	Page 330
Systems Counter/Timers	Page 333
Benchtop Timer/Counters	Page 343
Multifunction Counters	Page 357
High Resolution Frequency Counters	Page 365
Frequency Only Counters	Page 370

Selection Guide

Model	Frequency Range	Max Display Digits	Best Sensitivity	High Resolution Computing Counting	Frequency Period Ratio Totalizing	Single Shot Time Interval Resolution	Phase	RPM	Pulse Width	Freq Burst	Volt Max/ Min	Page No
Systems Timer/Counters												
PM 6666	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•	100 ns					•	343
PM 6652C	120 MHz/1.5 GHz	9½	20 mV	7 digits/s	•	100 ns	•	•	•	•	•	333
PM 6645C	120 MHz/1.5 GHz	9½	20 mV	9 digits/s	•	2 ns	•	•	•	•	•	333
1953A	125 MHz	9	30 mV		•	100 ns						341
Benchtop Timer/Counters												
PM 6665	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•	100 ns		•				343
7250A	80 MHz	7	10 mV		•	100 ns		(2)				348
7260A	125 MHz/1.3 GHz	8	10 mV		•	100 ns		(2)				348
7261A	125 MHz/1.3 GHz	8	10 mV		•	10 ns		(2)				348
PM 6670	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•			352
PM 6671	120 MHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		352
PM 6672	1 GHz	8	10 mV	7 digits/s	•	100 ns	•	•	•	•		352
Multifunction Counters												
1900A	80 MHz	6	25 mV		(3)							362
1910A	125 MHz	7	15 mV		(3)							363
1911A	250 MHz	7	15 mV		(3)							363
1912A	520 MHz	7	15 mV		(3)							363
PM 6662	120 MHz/1.3 GHz	9	15 mV	7 digit/s								365
PM 6669	120 MHz/1.1 GHz	9	10 mV	7 digits/s	•			•	•			365
PM 6673	120 MHz	9	10 mV	7 digits/s	•					•		357
PM 6674	550 MHz	9	10 mV	7 digits/s	•					•		357
PM 6675	600 MHz (dir. gated)	9	5/10 mV	7 digits/s	•					•		357
PM 6676	1.5 GHz	9	10 mV	7 digits/s	•					•		357
Frequency Only Counters												
PM 6667	120 MHz	7	15 mV	7 digits/s								370
PM 6668	1 GHz	7	15 mV	7 digits/s								370
PM 6677	2.3 GHz	9	10 mV	7 digits/s	•					•		357
7220A	1.3 GHz	9	10 mV	(1)						•		348

Note 1: Has optional X1000 10 Hz to 10 kHz resolution multiplier.
Note 2: Has cpm x 100.
Note 3: Except ratio.

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg Co, Inc

Selection Guide Continued

Model	Rise-Time, Duty Factor, MATH	Triggering				Options					Page No
		Adjustable Level Selection	Input Coupling	Hold-Off	External Control (Note 4)	Best Timebase	Battery	Analog Output	IEEE-488 Control		
									Partial	Full	
Systems Timer/Counters											
PM 6666		Auto, Var	ac/dc			MTCXO	•			•	343
PM 6652C	•	Auto, Var	ac/dc	•	•	Oven		•		•	333
PM 6654C	•	Auto, Var	ac/dc	•	•	Oven		•		•	333
1953A		Variable	ac/dc			Oven				•	341
Benchtop Timer/Counters											
PM 6665		Variable	ac/dc			MTCXO	•		•		343
7250A		Variable	ac			Oven	•		•		348
7260A		Variable	ac/dc	•		Oven	•		•		348
7261A		Variable	ac/dc	•		Oven	•		•		348
PM 6670		Variable	ac/dc			Oven	•	•	•		352
PM 6671		Variable	ac/dc	•	•	Oven	•	•	•		352
PM 6672		Variable	ac/dc	•	•	Oven	•	•	•		352
Multifunction Counters											
1900A			ac			RTXO	•				362
1910A			ac			TCXO	•				363
1911A			ac			TCXO	•				363
1912A			ac			TCXO	•				363
PM 6662		Auto	ac			MTCXO	•				365
PM 6669		Auto, +0-	ac			MTCXO	•		•		365
PM 6673		+0-	ac		•	Oven	•	•	•		357
PM 6674		+0-	ac		•	Oven	•	•	•		357
PM 6675		+0-	ac		•	Oven	•	•	•		357
PM 6676		+0-	ac		•	Oven	•	•	•		357
Frequency Only Counters											
PM 6667		Auto	ac			TCXO	•				370
PM 6668		Auto	ac			TCXO	•				370
PM 6677		+0-	ac		•	Oven	•	•	•		357
7220A			ac			Oven	•		•		348

Note 4: Provides 3 functions: measurement arming control, external reset, and frequency burst averaging.

Introduction

Applications for frequency and time-related measurements vary considerably. Requirements can include high-accuracy frequency calibration of RF signals, frequency measurements on noisy signals, accurate propagation delay measurements, phase shift in filters, high resolution counting on low frequency tone control signals, etc.

The instruments which perform these time-related measurements are generally known as counters. There are quite a number of names for various classes of these products which date back to the era before microprocessors were incorporated into counters. Today, there are two categories of these instruments: frequency counters and timer/counters.

Frequency Counters

A frequency counter has a single input channel, and sometimes an additional prescaled input for measuring high frequencies. The most basic units offer frequency-only measurements. Most counters offer the following functions:

- Frequency
- Period

More versatile instruments also offer:

- Totalizing (Pulse Counting)
- Frequency ratio (relative mode)
- Frequency deviation (relative mode)
- Pulse Width
- RPM (freq x 60)

Typical applications for these products range from high accuracy calibrations of telecommunications equipment (normally in the RF range) down to low-cost frequency indicators for small repair workshops and hobbyists.

Timer/Counters

In addition to the frequency measurements noted above, a timer/counter can also perform time interval measurement between two events (start and stop event). A timer/counter is therefore characterized by its dual and identical input channels, the start and stop channels (usually labeled A and B). A third input channel can be added for prescaled HF frequency measurements. Almost all counter/timers offer the following functions:

- Frequency
- Period
- Time Interval (Channel A to Channel B)
- Frequency Ratio (Channel A/Channel B)
- Totalizing

More advanced models offer a wealth of different functions, with the most common listed below:

- Pulse Width
- Rise/Fall Time
- Voltage Measurements
- Phase Delay (A to B)
- Duty Factor

Fluke and Philips Electronic Counters

Frequency Counters		Timer/Counters	
Frequency Only Counters	**Multifunction Frequency Counters**	**Bench-Top Timer/Counters**	**Systems Timer/Counters**
7220A PM 6667 PM 6668	1900A 1910A 1911A 1912A PM 6662 PM 6669 PM 6673 PM 6674 PM 6675 PM 6676 PM 6677	7250A 7260A 7261A PM 6665 PM 6670 PM 6671 PM 6672	1953A PM 6666 PM 6652C PM 6654C

Timer/counters are found in the lab or on the service bench and also in systems. These systems vary from small temporary set-ups to large ATE systems. Consequently, there is a choice between bench top and systems models. Bench top units can be equipped with a GPIB/IEEE-488* interface, allowing programming of most major functions. Systems units allow programming of all input settings, including trigger level and attenuation.

Optional Accessories

The conditions of use are important. Use in the field, on a laboratory bench or in an automatic test system require different options such as: battery supply, BCD output, analog output (for recording on a strip-chart recorder), IEEE-488 bus interface, rackmount facilities, ultra-high stability oven oscillators, etc.

In selecting a counter, the availability of a wide range of such options is of great importance especially when the type of application may change after some time in use.

Front-end Circuitry Requirements

The requirements for input signal-conditioning when making frequency and time measurements are somewhat contradictory as the following observations will illustrate.

Frequency Counting

Figure 1a shows a sinewave signal crossing the hysteresis band of the input circuit. Each period of the sinewave that crosses the hysteresis band should cause a clean pulse that can be counted by the digital circuitry.

Noise on the sinewave, however, causes the signal to pass through the hysteresis band more than once per sinewave period giving false counts. Figure 1b shows how an expanded hysteresis band can prevent this type of error.

Time Interval Measurement

Figure 2a shows a pulse, the duration of which is to be measured. Triggering at 50% of amplitude should start the time measurement at A and stop it at B.

The hysteresis of the input circuit, however, causes triggering to occur at A1 and B1. The different slopes of leading and trailing edges cause different delays, resulting in a faulty measurement. A very narrow hysteresis band as shown in Figure 2b will reduce these errors.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

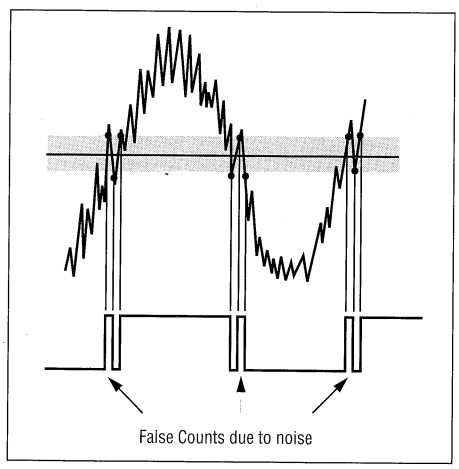


Figure 1a.

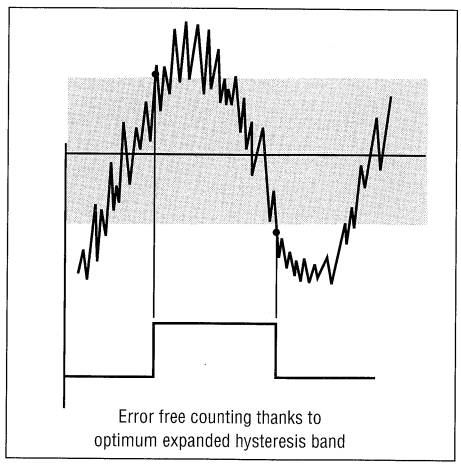


Figure 1b.

Error-Free Triggering

Figure 1b shows that "error-free" frequency counting is obtained by a wider hysteresis band or, in other words, by an attenuated input signal.

Thus for frequency measurement a continuously variable input attenuator permits optimum matching of the input signal to the counter's trigger sensitivity.

Figure 2b shows that a lower hysteresis voltage will minimize the time measurement error.

Thus a low hysteresis voltage (narrow trigger window) together with a continuously variable trigger level setting permits accurate time interval measurements.

AC-Coupling

Frequency counting on sinewaves or on generally symmetrical signals is best achieved with ac-coupled inputs. AC-coupling has no temperature drift problems, while added dc signal components are eliminated. This assures simple, stable, and thus, reliable triggering.

Frequency counters also need to measure on narrow pulses or other waveforms.

Triggering on any waveform, having any duty factor can be performed by means of a trigger level off-set in the input channel amplifier, see Figure 3.

DC-Coupling

Time interval measurements with accurately set trigger levels, or those that are waveform-independent, require dc-coupling. This might include rise time measurement on a pulse, requiring 10% to 90% level setting, or a pulse duration measurement with accurate setting of trigger levels at 50% of the pulse amplitude.

High Resolution Computing Counting

Measuring Resolution

The controlling and computing power of modern microcomputers enables frequency measurements to be made in the most logical way. The formula for computing frequency is:

$$\text{Frequency} = \frac{\text{Number of cycles}}{\text{Time}}$$

Modern microcomputer-based frequency counters do precisely that which is given in the frequency definition

1. They count the number of complete input cycles.
2. They measure the effective gate-time, which is the time duration of the totalized number of input cycles.
3. Thereafter, they compute the value of:

$$\frac{\text{Number of cycles}}{\text{Time}}$$

Finally the microcomputer computes the resolution to define the number of digits to be displayed.

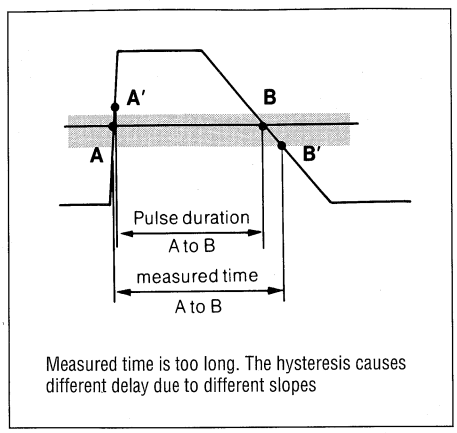


Figure 2a.

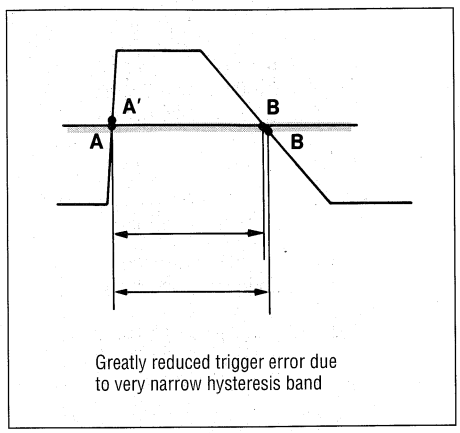


Figure 2b.

A computing frequency counter contains two counting registers. One counting register counts the number of input cycles, while the other register counts the number of 10 MHz reference clock pulses, to measure the time duration.

The required measuring time can be selected independently and can be varied continuously as well as in fixed steps.

The actual measuring time is synchronized with the input signal and is therefore exactly a multiple of complete cycles. This way, the traditional ±1 input cycle error is avoided. During the same time, the timer counter has totalized the number of 100 ns (10^{-7}s) reference clock pulses or 2 ns in the case of PM 6654C. The count error is ± one clock pulse. The total gate-time is the number of clock pulses x 10^{-7}s or x $2x10^{-9}$s for the PM 6654C.

To obtain the frequency or period value, only a simple division has to be made.

$$\text{Frequency} = \frac{\text{Counted input cycles}}{\text{Time counts x } 10^{-7}\text{s}^*}$$

$$\text{Period} = \frac{\text{Time counts x } 10^{-7}\text{s}^*}{\text{Counted input cycles}}$$

The ±1 count error is ±100 ns* (10^{-7}s).* The resolution or relative count error is:

$$\text{Rel. resolution} = \frac{\pm 10^{-7}\text{s}^*}{\text{Measuring time}}$$

**For the ultra-high resolution PM 6654C, the figure is $2x10^{-9}$s*

Note that the resolution is independent of the frequency value. When measuring, for example, a line frequency with 1s of measuring time, a readout of at least 7 accurate digits e.g., 50.78349 Hz, will result. A conventional counter would in this case only display 2 digits, e.g., 51 Hz. This is because conventional counters are not syn-

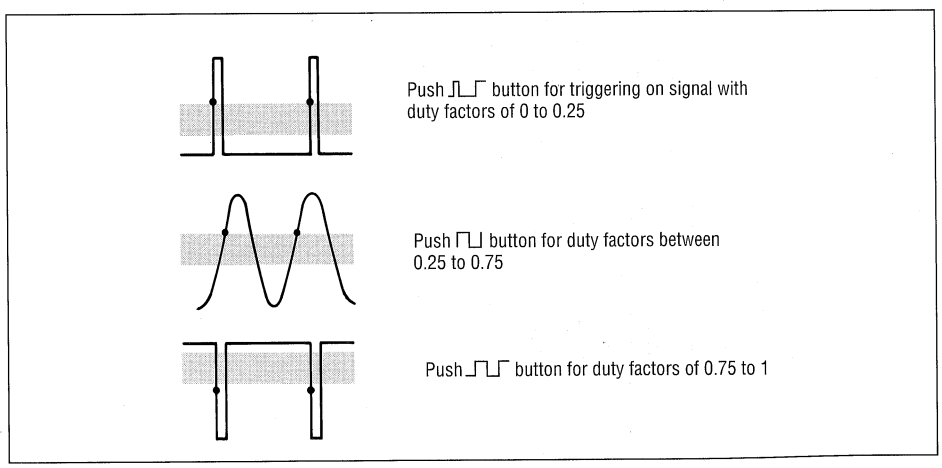


Figure 3.

Introduction

chronized with the input signal, but with the internal time base. The ±1 count error is now found in the input cycle counting register, which implies that the resolution for conventional counters is:

$$\text{Rel. resolution} = \frac{\pm 1}{\text{Frequency x gate time}}$$

One obvious advantage with microprocessor-based computing counters is thus the very good resolution even at low frequencies.

Another advantage is the possibility to mathematically process the measuring data such as displaying counts per minute (RPM) instead of counts per second, display phase delay in degrees based on the relative time delay between two signals, etc.

Crystal Oscillators

A counter's maximum accuracy is ultimately limited by its time base reference accuracy.

Depending on the application requirement, most counter models can be ordered with a choice of different crystal oscillator time base options.

The oscillator with the highest available stability (PM 9691), features a stability of $5x10^{-10}$/24h, and can be included in the high accuracy counters of the PM 667X and PM 665X Series.

Selection of Time Base Option

Depending on the application accuracy requirement, operating temperature range and tolerated recalibration interval, a suitable time base selection can be made. As general indication, one can state that the accuracy limitation, caused by the time base is as follows:

No. of Digits	Type of Crystal Oscillator	Option Numbers
5-6	Standard or Uncompensated	Standard or /.1.
6-7	TCXO w/analog Compensation	TCXO, -111, -112, /.2. or PM 9678
7-8	TCXO w/Mathematic Compensation (MTCXO) or Oven Control	MTCXO, -131, -132, -10, -20 or /.3. /.4. or PM 9607, PM 9679, PM 9690
8-9	Ultra High Stability Oven Control	/.5. or PM 9691

Time Base Inaccuracy (Relative Error):

Timebase error is determined by the summary of the following terms:

$$\frac{\partial f}{F} = \pm \frac{\partial fa}{F} \pm \frac{\partial ft}{F} \pm \frac{\partial fs}{F};$$ where

∂f : the deviation from the nominal 10 MHz crystal frequency

F : nominal 10 MHz crystal frequency

$\frac{\partial fa}{F}$: relative deviation due to aging

$\frac{\partial ft}{F}$: relative deviation due to temperature changes from calibration temperature

$\frac{\partial fs}{F}$: relative deviation due to supply voltage and/or supply mode variation

PM 6654C & PM 6652C

GPIB IEEE-488



PM 6654C

PM 6654C & PM 6652C System Timer/Counters

- High accuracy FREQUENCY AND PERIOD measurements of 9 digits in one second
- High sensitivity 1.5 GHz input with wide 10 mV rms...12V rms dynamic range
- TIME-INTERVAL resolution down to 0.5 ps averaged and 2 ns single shot
- Measuring modes incl.: Phase, Rise/Fall Time, Duty Factor, Vmax/min/pp of input
- 8 pre-programmable front panel menus: digital readout of trigger levels
- Mathematical functions
- Trigger facilities include Arming, Hold-Off, Ext. Gating and Auto Trig. Level

Introduction

Philips' PM 6652C and PM 6654C high performance, fully programmable timer/counters satisfy virtually all frequency and time measurement requirements, especially in R & D laboratories and automatic test systems applications.

The measuring functions and appearance of both instruments are the same. The difference is found in resolution, accuracy and measuring speed. The PM 6652C has a 10 MHz (100ns) clock frequency, whereas the extra high resolution PM 6654C features a 500 MHz (2ns) real-time clock resolution. Thus, the PM 6654C's measuring circuitry gives some 50 times better resolution or measuring speed than found in the PM 6652C and in most other counters on the market. Thanks to its short measuring cycle times, the extra high resolution PM 6654C is particularly well suited to high speed automatic test systems. Both the PM 6652C & 6654C timer/counters offer extremely powerful measuring capabilities. With 14 frequency, time and voltage measuring modes, 100% GPIB/IEEE-488* Bus programmability, over 400 readings/second Bus speed, 2ns single shot resolution and 1.5 GHz frequency range, the PM 6654C challenges most other timer/counters.

Voltage Measurements

Both timer/counters offer standard volt measurements: V max, V min, V dc, V pp or even V rms, whether on LF sinewaves or high speed pulses.

In combination with the time measurements: DUTY FACTOR, PERIOD, PULSE WIDTH, DELAY, RISE-AND-FALL TIME and PHASE, these PULSE VOLTAGE measurements allow automatic test systems to measure pulse and other input parameters, that could only be viewed previously on an oscilloscope.

Powerful FREQUENCY Measuring Capabilities

High accuracy FREQUENCY and PERIOD measurements can be made in a one second measuring time with resolution of 9 digits in the PM 6654C and 7 digits in the economy version PM 6652C. Both models perform advanced frequency measurements, including externally gated frequency measurements, burst frequency and multiple burst frequency average measurements on down to 200ns narrow bursts (500ns for PM 6652C).

Trigger HOLD-OFF, when activated in the FREQUENCY and PERIOD modes, acts as a digital low-pass filter to ignore noise and interference, thereby preventing erroneous measurements.

Mathematics

The MATH (mathematics) facility allows scaling and/or off-setting of measured results before display. This significantly extends the range of application by enabling calibration or unit conversion as in the following examples:

V pp measurements can be converted to V rms; frequency readings from a transducer can be calibrated as RPM, liters/s, gallons/min or m/s; phase measurements can be converted from degrees to radians and pulse reflections in faulty cables can be directly calibrated for fault location finding in meters of cable length.

The Ultimate in Time Interval Measuring Accuracy

A unique combination of high resolution, high trigger accuracy and special trigger control facilities puts these instruments among the most powerful timers on the market.

The high technology PM 6654C with its 2ns single shot resolution allows time interval measurements to be made to an accuracy and resolution well beyond those of normal timer/counters.

Repetitive signals allow significantly improved resolution by averaging of measuring results. Time intervals, pulse widths, rise and fall times can be measured this way down to sub-picosecond resolution with the PM 6654C and down to 10 ps resolution with the PM 6652C.

Trigger Accuracy

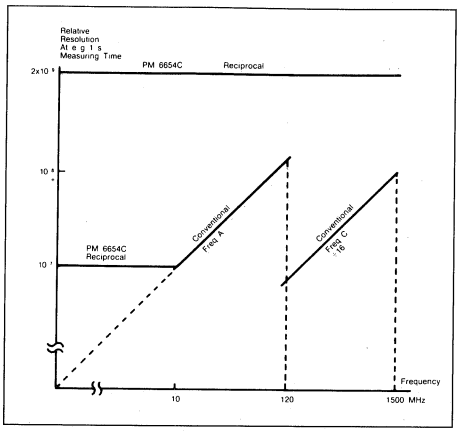
Ultimately, no timer measures more accurately than its trigger accuracy. Therefore high speed/high sensitivity input stages, high trigger level setting accuracy and shortest possible trigger delays. The PM 6652C's and PM 6654C's inputs feature very fast 1 ns rise times and 20 mV rms, sensitivity over a wide -5V...+5V dynamic range. Trigger level accuracy is assured by the digital setting and readout. At the push of a button, the counter displays, simultaneously, the set trigger

10

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 6654C & PM 6652C

levels of both the A and B channels with a 10 mV resolution. Trigger levels may be set by knob controls, keyboard entry, or automatically.



The PM 6654C benefits from the 500 MHz internal clock, by utilizing RECIPROCAL counting for all frequencies.
The PM 6652C selects, automatically, RECIPROCAL or CONVENTIONAL counting in order to achieve the highest possible resolution, for any frequency.

The Actual Trigger Points are Displayed

Automatic hysteresis compensation ensures that the actual triggering occurs at the set trigger level and is not delayed by the input hysteresis. Systematic trigger errors are thus kept to an extremely low level.

Powerful Extra Trigger Controls

The PM 6652C & 6654C provide full control over start and stop triggering. Arming and trigger hold-off enable unwanted signals to be ignored which would otherwise trigger the counter. Arming avoids false starts while a wide range variable trigger hold-off prevents false stops. The set hold-off time can be read on the display.

Designed for Ease-of-Use

For user-convenience, the PM 6652C & 6654C provide superior intelligence. Both counters contain two microprocessors, one to automate the operation and for communication with the front panel, the other for fast measuring control and data handling.

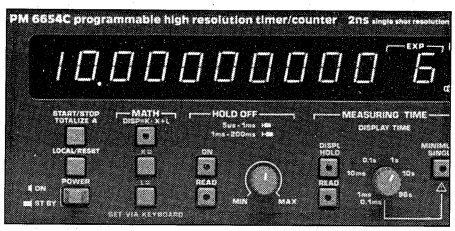
Simple Function Selection

Function selection is achieved by means of only one single control. The up/down function selector with moving cursor in the display window indicates clearly which measuring mode is selected. See figure on following page.

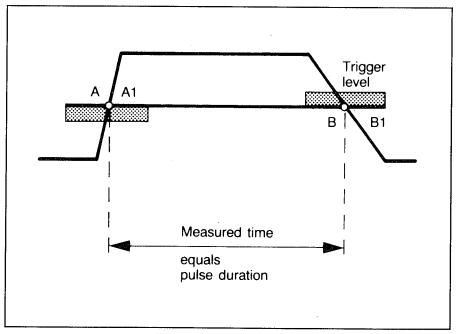
Stored Front Panel 'Menus' P1...P8

Once all front panel controls have been set, all the settings can be stored in a memory for later recall. Storage capacity for eight such pre-programmable front panel menus is provided in non-volatile (EAROM) memory. This means these programs are not lost during line voltage interruptions and no batteries are needed for memory back-up.

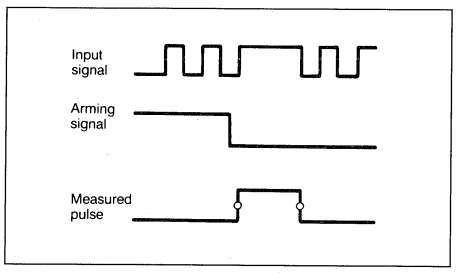
The stored programs memorize even numeric values such as trigger level voltages, measuring time and the mathematical conversion factors K and L. Recalling such programmed front panel menus is as simple as the selection of a measuring function: just pushing one button. All front panel menus can also be stored and recalled via the IEEE-488 bus.



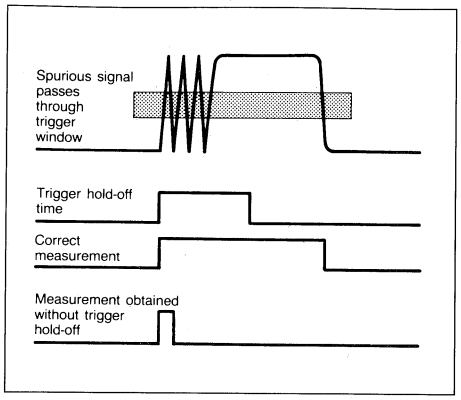
The trigger level READ function displays simultaneously the trigger levels of both the A and B channels, whether being set manually with a vernier or via the keyboard or in the AUTO trigger mode.



The PM 6652C/6654C feature hysteresis compensation. The trigger level is lowered on positive slopes and raised on negative slopes, resulting in a residual hysteresis band which is virtually 10 mV p-p.



The arming input facility prevents the counter from being triggered as long as this input is kept high. Releasing this input arms the counter, which is then ready for triggering, immediately on the first incoming signal.



Use of the variable trigger hold-off prevents false stops due to spurious signals such as ringing or relay contact bounce. It also enables time measurements to be made on double pulses, bursts or other complex signals.

Automatic Triggering

The PM 6652C & 6654C have three different trigger level setting modes:

- AUTO selection for foolproof operation and maximum convenience.
- Digital selection via the keyboard for maximum setting accuracy.
- Manual potentiometer setting for increased flexibility.

In the AUTO mode, the counter measures first the maximum and minimum voltages of the input signals. Thereafter, the microcomputer calculates the 50% values to set the trigger levels. When measuring rise or fall times, the 10% and 90% levels are calculated.

Trigger Indicators

Tri-state trigger indicator LEDs on the PM 6652C & 6654C blink to indicate that the inputs are triggered. This feature is of great help when setting the trigger levels manually or via the keyboard.

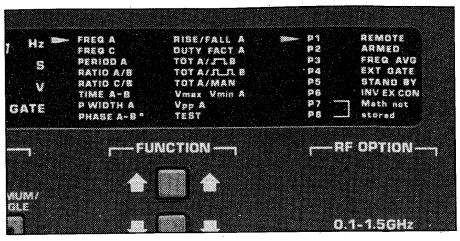
Variable Measuring Time

Another microcomputer benefit is the continuously variable measuring time, which is not limited to decade steps. It is possible, for example, to select 2.4 seconds if one second does not give sufficient resolution. This avoids the need to select a time-wasting 10-second measuring period. Pressing the READ button shows instantaneously the measuring time selected.

For a microsecond measuring time or measurements of one-shot phenomena, MINIMUM/SINGLE button is used.

Trigger Level Outputs

Trigger level outputs on the rear panel are available for readout on an oscilloscope. Set trigger levels can then be viewed with respect to the input signals. They can also be used as bus programmable DACs.



Detail of front showing up/down moving cursor fo clear indication of selected function.

Choice of Crystal Oscillators

The time base crystal oscillator determines the accuracy limit of the timer/counters. The Crystal oscillator summary shows which of the five stability versions best fits the user's requirements. The choice ranges from an economy standard oscillator to the 5 x 10^{-10}/24h high-stability ovenized oscillator PM 9691 for high accuracy measurements and fewer recalibrations. The high-stability crystal oscillators are also available as retrofittable options for later upgrading of the counter performance. By means of the external reference input, it is possible to utilize the user's own frequency standard, when available.

Powerful IEEE-488 Bus Capabilities

Both the PM 6652C and PM 6654C are fully programmable, including all front-end controls and trigger level voltages. The optional PM 9696 interface board makes the counters IEEE-488/IEC-625 bus-compatible at a small additional cost. Advanced software features are available, including bus learn mode and programmable delimiters. In addition, the high-speed dump mode allows the user to fully exploit the high-resolution / high-measuring speed of the PM 6654C, allowing up to 400 - 500 measurements per second. Pre-set limit monitoring is another useful feature, allowing the counter to SRQ when low or high limits are exceeded.

Powerful, Flexible Software for User Convenience

The PM 6652C & 6654C's bus interface fully complies with IEEE-488/IEC-625-1 hardware standards, as well as with the code and format conventions (software) of IEEE-728/IEC-625-2. To satisfy application needs for both temporary interfaced instrument clusters — and for permanent test systems, the PM 6652C & 6654C feature a flexible and powerful software approach. Three programming modes give ease and simplicity of programming and powerful, high-speed bus operation. Other friendly features include:

- Acceptance of all available input delimiters as well as output of any delimiter (hardware and/or software selectable) to suit any controller.
- In the 'normal' programming mode, only modifications to the current programming status need to be sent as program messages.
- The mnemonics used are short (maximum three characters) for maximum communication and interpretation speed — but they are easily recognized and can be sent in any sequence. For instance SM 1.5 means: set measuring time to 1.5s.
- Numerical values for trigger levels, measuring times and conversation factors K and L are accepted in all three standardized formats: NR 1, NR 2 and NR 3 (IEEE-728, IEC-625-2, ANSI-X3.42).

Built for ATE Systems

Particular system requirements are met by the inclusion of the following options: The cooling fan, PM 9612 can be built-in for operation in rack-systems, with excessive ambient temperatures. With the PM 9611, the counter is supplied wired with rear panel measuring input connectors instead of the front panel inputs. The counters can also be fitted with rack mount slide PM 9613 for quick and easy accessibility, when mounted in a rack.

Bus Learn Mode

Ease of programming is further enhanced by the bus 'learn' mode, which lets the counter write its own program messages, thereby eliminating programming errors and the need for debugging. In LOCAL mode the counter can be set manually to check whether the measurement is correctly performed. The controller can then ask the counter for the corresponding program string which can be 'copied' by the controller and used for reprogramming the counter.

High Speed Data Output

Depending on the measuring function, the PM 6652C & 6654C's high bus speed allows 30-50 measurements per second to be made when used in the normal data output mode. To record very high-speed phenomena, the high- speed dump mode enables some 400-500 measurements per second to be made. In this mode, the raw measuring data from the counting registers are output without being processed by the counter's micro-computer. The algorithms for subsequent processing in the bus controller are given in the manual. A third output data mode is for monitoring processes or for 'go/no-go' testing. It completely eliminates the need for bus communication, as long as the measurement results are within set limits. An SRQ-alarm is given by the counter as soon as a measuring result exceeds the set limits stored in the counter's memory.

System Reliability Testing

Reliable system operation is greatly enhanced by the built-in facility of both hardware and software testing. The self-diagnostic TEST 1...5 can be activated via the bus, when the counter is not busy with measurements, ensure dependable hardware performance. System hang-ups caused by, for instance, the absence of an input signal can easily be identified by the comprehensive status byte information. The PM 6652C & PM 6654C feature over 30 different status byte messages.

MATE/CIIL Interface

The counters can be equipped with a MATE/CIIL Interface, for system use in MATE (modulars ATE) environments. Via the high-level CIIL (Control Interface Intermediate Language), all counter functions are fully controlled.

The ultimate in bus operation simplicity
It is only required to manually set and store all desired timer/counter controls in one of the counter's own memory locations P1...P8, then recall via the bus the manually stored 'menu' with a ***single*** *bus command. Example command from a 1722A Instrument Controller to a PM 6652C/6654C.*

```
Print  @2  "LP3"
```

Load program 3 from PM 6652/54's own memory

PM 6652/54's set address.

Bus instruction.

Specifications

Measuring Modes for PM 6652C

Frequency A

Range: 0.1 Hz...120 MHz (0.01 Hz...200 kHz when HOLD-OFF is selected).
Typically 120...160 MHz at 50 mV sensitivity
Mode: Reciprocal below 10 MHz and when HOLD-OFF, EXT GATE or AVERAGE is selected. Conventional above 10 MHz.
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{FREQ}}{\text{measuring time}}$$ (reciprocal)

$$\frac{2.5}{\text{measuring time}}$$ (conventional)

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXTGATE, AVERAGE, ARMING

PM 6654C & PM 6652C

Frequency C Optional

Range: 100 MHz...1.5 GHz
Mode: Conventional. (Reciprocal when EXT GATE or AVERAGE is selected).
LSD Displayed:

$$\frac{40}{\text{measuring time}} \text{ (conventional)}$$

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{FREQ}}{\text{measuring time}} \text{ (reciprocal)}$$

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{time base error}$$

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING.

Period A

Range: 100 ns...10^{10}s
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s} \times \text{PERIOD}}{\text{measuring time}}$$

Resolution: 1 or 2 LSD units, LSD and resolution is 100 ns when SINGLE PERIOD is selected.
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Number of Cycles Averaged:

$$\frac{\text{measuring time}}{\text{PERIOD}}$$ or a single period

Ext. Controls: EXT GATE, AVERAGE, ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Single

Range: 100 ns...10^{10}s
LSD Displayed: 100 ns (TIME <10^3s)

$$\frac{5 \times \text{TIME}}{10^{10}}$$ (TIME ≥10^3s)

Resolution: 1 LSD unit
Accuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\text{TIME}}$$

± time base error
Min. Amplitude for RISE/FALL TIME Measurements: 500 mV pp
Ext. Controls: ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Averaged

Range:
Time Interval: 0 ns...100s
Pulse Width: 4 ns...100s
Rise/Fall Time: 8 ns...100s
LSD Displayed:

$$\frac{2.5 \times 10^{-8}\text{s}}{\sqrt{N}}$$

Resolution:

$$\frac{100 \text{ ns}}{\sqrt{N}}$$

or 1 LSD unit, whichever is greatest.
Accuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\sqrt{N} \times \text{TIME}}$$

$$\pm \text{time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Dead Time Stop to Start: 250 ns
Number of Samples Averaged (N):

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

Min. Amplitude for RISE/FALL Measurements: 500 mV pp
Ext. Controls: AVERAGE, ARMING.

Measuring Modes for PM 6654C

Frequency A

Range: 0.01 Hz...120 MHz (0.01 Hz...200 kHz when HOLD-OFF is selected).
Typically 120...160 MHz at 50 mV sensitivity
Mode: Reciprocal
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{FREQ}}{\text{measuring time}}$$

When HOLD-OFF or EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING

Frequency C optional

Range: 100 MHz...1.5 GHz
Mode: Reciprocal
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{FREQ}}{\text{measuring time}}$$

When EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units
Accuracy:

$$\pm\frac{\text{resolution}}{\text{FREQ}} \pm \text{time base error}$$

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST AVG.
Ext. Controls: EXT GATE, AVERAGE, ARMING

Period A

Range: 8 ns...100s
LSD Displayed:

$$\frac{5 \times 10^{-9}\text{s} \times \text{PERIOD}}{\text{measuring time}}$$

When HOLD-OFF or EXT GATE is selected, see specification for PM 6652C.

Resolution: 1 or 2 LSD units, LSD is 1 ns and resolution 2 ns, when SINGLE PERIOD is selected.
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{PERIOD}} \pm \frac{\text{trigger error}}{\text{measuring time}}$$

± time base error

Number of Cycles Averaged:

$$\frac{\text{measuring time}}{\text{PERIOD}}$$ or a single period

Ext. Controls: EXT GATE, AVERAGE, ARMING

Time Interval A-B, Pulse Width A, Rise/Fall A; Single

Range: 8 ns...10^{10}s
LSD Displayed: 1 ns (TIME <10s)

$$\frac{5 \times \text{TIME}}{10^{10}}$$ (TIME ≥10s)

Resolution: 2 ns (TIME <10s); 1 LSD unit (TIME ≥10s)
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\text{TIME}}$$

$$\pm \text{time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Amplitude for RISE/FALL TIME Measurements: 500 mV pp
Ext. Controls: ARMING
Note: When HOLD-OFF is selected, see specifications for PM 6652C.

Time Interval A-B, Pulse Width A, Rise/Fall A; Averaged

Range:
Time Interval: 0 ns...100s
Pulse Width: 4 ns...100s
Rise/Fall Time: 8 ns...100s
LSD Displayed:

$$\frac{2.5 \times 10^{-9}\text{s}}{\sqrt{N}}$$

Resolution:

$$\frac{10 \text{ ns}}{\sqrt{N}}$$

or 1 LSD unit, whichever is greatest.

Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{TIME}} \pm \frac{\text{trigger error}}{\sqrt{N} \times \text{TIME}}$$

$$\pm \text{ time base error} \pm \frac{\text{syst. error}}{\text{TIME}}$$

Min. Dead Time Stop to Start: 50 ns
Number of Samples Averaged (N):

$$\frac{\text{measuring time}}{\text{internal repetition time}}$$

Min. Amplitude for RISE/FALL Measurements: 500 mV pp
Ext. Controls: AVERAGE, ARMING.
Note: When HOLD-OFF is selected, see specification for PM 6652C.

Measuring Modes Common for PM 6652C and PM 6654C

Duty Factor A

Range: 0...1 - (250 ns x Pulse rep. rate)
Example: 0...0.9999 at 50 Hz; 0...0.9997 at 1 kHz; 0...0.5 at 2 MHz
Frequency Range: 0.03 Hz...2 MHz
LSD Displayed:

$$\frac{2.5 \times 10^{-7}\text{s}}{\text{measuring time}}$$

Resolution: 100 ns x pulse rep. rate/$\sqrt{N}$ or 1 LSD unit, whichever is greatest
Accuracy:

$$\pm\frac{4 \text{ ns} \times \text{FREQ}}{\text{DUTY FACTOR}} \pm \frac{\text{resolution}}{\text{DUTY FACTOR}}$$

$$\pm\frac{\text{trigger error}}{\sqrt{N} \times \text{PULSEWIDTH}}$$

Number of Cycles Averaged (N): Measuring time x pulse rep. rate
Ext.Controls: None

Totalize A

Range: 1...10^{18}
Frequency Range: 0...120 MHz and 0.01 Hz...200 kHz when HOLD-OFF is selected
Pulse Pair Resolution: 8 ns
Manual Mode: Controlled by pushbutton START/STOP
External Mode: Totalizing on A during pulse duration on B or between start/stop pulses on B.
Inaccuracy:

$$\pm\frac{\text{Pulse rate A} \times \text{trigger error B}}{\text{total counts}}$$

Ext. Controls: ARMING (not valid in manual mode).

Ratio A/B

Range: 10^{-9}...10^{10}
Frequency Range:
0.1 Hz...120 MHz/0.01 Hz...10 MHz
(0.01 Hz...200 kHz/0.01 Hz...10 MHz when HOLD-OFF is selected).

LSD Displayed:

$$\frac{2.5 \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A}}$$

Resolution: 1 or 2 LSD units
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{RATIO}} \pm \frac{\text{trigger error B}}{\text{measuring time}}$$

Ext. Controls: ARMING

Ratio C/B

Range: 10^{1}...10^{11}
Frequency Range:
100 MHz...1.5 GHz/0.01 Hz...10 MHz.
LSD Displayed:

$$\frac{40 \times \text{RATIO}}{\text{measuring time} \times \text{FREQ C}}$$

Resolution: 1 or 2 LSD units
Inaccuracy:

$$\pm\frac{\text{resolution}}{\text{RATIO}} \pm \frac{\text{trigger error B}}{\text{measuring time}}$$

Ext. Controls: ARMING

Phase A-B

Range: 0...360° x (1 - 250 ns x FREQ)
Example: 0...360° at 50 Hz; 0...359.9° at 1 kHz; 0...180° at 2 MHz
Frequency Range: 0.03 Hz...2 MHz
LSD Displayed:
1° Measuring time ≤180µs;
0.1° Measuring time 180 µs...1.8 ms;
0.01° Measuring time ≥1.8 ms
Resolution: 1 LSD unit
Inaccuracy:

$$\pm\frac{4 \text{ ns} \times 360° \times \text{FREQ}}{\text{PHASE}} \pm \frac{\text{resolution}}{\text{PHASE}}$$

$$\pm\frac{\text{FREQ} \times 360° \times \text{trigger error}}{\sqrt{N} \times \text{PHASE}}$$

$$\pm\frac{\text{systematic error}}{\text{PHASE}}$$

Input Voltage: 100 mV...3.5V or 1V...35V (RMS sine).
Number of Cycles Averaged (N): Measuring time x FREQ A
Ext. Controls: None

V max, V min, V pp A

Range: -50V...+50V; DC and 100 Hz...120 MHz
LSD Displayed:
10 mV for signals within ±5V
100 mV for signals outside ±5V
Resolution: 1 LSD-unit

Typical Inaccuracy (mV):
DC and 100 Hz...20 MHz
Input Signals Within ±5V:
±(20 mV + 2% of reading)
Input Signals Outside ±5V:
±(200 mV + 3% of reading)

Typical Inaccuracy (mV):
20 MHz...80 MHz (50 Ohm):
Input Signals Within ±5V:
±(20 mV + 6% of reading)
Input Signals Outside ±5V:
±(200 mV + 7% of reading)

High-Freq. Error: >80 MHz (50Ω) or >20 MHz (1 MΩ) deviation is typically ±3 dB
Ext. Controls: None

Input Specification

Inputs A and B

Frequency Range: *DC-coupled:* 0...120 MHz; *AC-coupled:* 20 Hz...120 MHz
Rise Time: Approx 1 ns
Sensitivity: 20 mV rms sinewave or 60 mV p-p (0...60 MHz); 30 mV rms sinewave or 90 mV p-p (60...120 MHz)
Min. Pulse Duration: 4 ns
Attenuation: x 1, x 10 (fixed)
Hysteresis Band: Approx. 40 mV p-p
Hysteresis compensation is automatically performed in TIME A-B, P Width A, RISE/FALL A, PHASE A-B and DUTY FACTOR measuring modes; resulting in a residual hysteresis band which is virtually 10 mV p-p.
Dynamic Input Voltage Range:
60 mV p-p within ±5V p-p ±5V dc (x 1);
600 mV p-p within ±50V p-p ±50V dc (x 10)
Trigger Level Selection: Manually via keyboard (10 mV steps); Manually via potentiometers; Auto trigger
Trigger Level Range: -5V...+5v (x 1);
-50V...+50V (x 10)
Trigger Slopes: Positive or negative
Trigger Level Output: Set trigger levels for channel A and B, -5V...+5V, available at rear panel (BNC-connectors).
Trigger Level Readout: Set trigger levels for channel A and B are displayed with a resolution of 10 mV (x 1) or 100 mV (x 10)
Trigger Indicators: Tri-state LED indication
On: Signal is above the set trigger level
Blinking: Triggering occurs
Off: Signal is below the set trigger level
AUTO Trigger: The AUTO trigger will automatically set A and B trigger levels to 50% of input signal amplitude (10% and 90% for rise/fall time measurements).
Frequency range: 100 Hz...120 MHz
Measuring cycle time: Approx. 300 ms + measuring time.
Note: Auto trigger requires a repetitive signal. Input signal may have any duty factor.
Coupling: DC/AC
Channel Input: Separate A and B or common via A
Impedance: Separate A and B: 1 MΩ//35 pF or 50Ω nominal (A and B);
Common A: 0.5 MΩ//70 pF nominal or 50Ω nominal (A). Open input (B).

PM 6654C & PM 6652C

Max. Voltage Without Damage:
1 MΩ (x 1): 260V rms ≤20 kHz, declining to 12V rms at ≥1 MHz
1 MΩ (x 10): 260V rms ≤20 kHz, declining to 100V rms at 1 MHz and to 25V rms at 120 MHz
50Ω: 12V rms DC...120 MHz

Input C (Option/PM 9610)

Frequency: 100 MHz...1.5 GHz
Operating Input Voltage Range:
10 mV rms...12 mV rms (100 MHz...1 GHz)
30 mV rms...12 mV rms (1...1.5 GHz)
Coupling: AC
Impedance: 50Ω nominal; VSWR ≤2
AM Tolerance: 98%; minimum signal must exceed minimum operating input voltage
Max. Voltage Without Damage: 12V rms; overload protection with PIN diodes

Input D (Ext. standard in)

Range: 100 kHz...10 MHz
Coupling: AC
Impedance: 1.5 kΩ nominal
Sensitivity: 400 mVRMS
Max. Voltage Without Damage: 25V rms

Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Input E (Ext. reset)

Electrical reset, equivalent to front panel RESET pushbutton. Counter is reset when input E is high. A new measurement can be made after input E has returned low. The measurement will start after a delay of approx. 50 ms to 100 ms (depending on selected function) plus time needed for synchronization with the input signal.
Active High Level: ≥2V
Passive Low Level: ≤0.5V
Impedance: 2 kΩ nominal
Max. Voltage Without Damage: ±25V
Min. Pulse Duration: 50 ns

Input F (Arming, Ext. gate, Average)

A 4-position rear panel switch gives choice of external control of the counter
OFF: No function selected
ARMING: The counter is prevented from starting a new measurement when input F is high. A high-to-low transition arms the counter to start a new measurement. Arming is not applicable in TOT A (manual), PHASE and DUTY FACTOR measurements.
AVERAGE: Frequency (channel A or C), period A and time interval A-B measurements are interrupted when input F is high. The measurement is continued again when input F is low.
EXT. GATE: The signal on input F defines start and stop of the measuring time and overrides the set MEASURING TIME. The measurement will start when input F goes high, after a synchronization delay. The measurement will stop when input F returns low, after a synchronization delay.
High Level: ≥2V
Low Level: ≤0.5V
Impedance: 2 kΩ nominal
Max. Voltage Without Damage: ±25V
Min. Pulse Duration (Arming): 200 ns
Min. Pulse Duration(Ext. gate): 500 ns
Min. Pulse Duration (Average):
PM 6652C: 500 ns; *PM 6654C:* 200 ns
Internal Delay: Approx. 50 ns

Output Specifications

Output G (10 MHz out)

Output Frequency: 10 MHz
Output Level: 1.3V p-p in 50Ω load
Output Protection: Short-circuit proof

Output H (Gate Open)

The gate status output allows monitoring on an oscilloscope of the actual measuring time and the trigger hold-off time.
Output Levels:
Main gate closed: Approx.4.5V;
Main gate open: Approx. 0V;
Hold-off time: Approx. 1.2V
Output Impedance: Approx. 1.5 kΩ
Internal Delay: Approx. 150 ns
Output Protection: Short-circuit proof

Outputs I and J (Trigg Level Out)

Buffered output for set trigger levels on channels A and B. The range is -5V...+5V unaffected by the input attenuator setting (x 1 or x 10). The outputs can be used as two independent bus programmable DACs.
Output Levels: -5V...+5V
Output Impedance: Approx. 2 kΩ
Output Protection: Short-circuit proof
Non-Linearity Error: Less than ±5 mV
DC-Offset: Less than ±7 mV
Setting Time: Less than 1 ms

Auxiliary Functions

Measuring Time/Display Time

The measuring time can be selected in three different ways:
Variable: The measuring time is continuously variable 0.1 ms...96s, with clear setpoints at 0.1 ms, 1 ms, 10 ms, 0.1s, 1s, 10s and 96s. Selected variable measuring time is displayed, without any delay, when depressing the measuring time "READ" push-button.
Minimum/Single: With minimum/single activated the counter will perform single event measurements for: PERIOD A, RATIO A/B, RATIO C/B, TIME A-B, P WIDTH A, and RISE/ FALL A.
A minimum measuring time of approx. 2µs is performed for FREQ A, FREQ C in PM 6654C.
A minimum measuring time of approx. 1µs is performed for FREQ A, FREQ C in PM 6652C and for PHASE A-B and DUTY FACTOR A in both PM 6652C and PM 6654C.
The variable MEASURING TIME/DISPLAY TIME control will now act only as display time control. The measured result is displayed during the set display time and a new measurement will start at the next input signal.
Ext. Gate: The use of EXT GATE (see INPUT specifications) will override the set measuring time. The external gate duration must be in the range 500µs...96s.

Display Hold:

Depressing the DISP HOLD push-button sets display time to infinity and freezes the last measurement result. A new measurement can be initiated using RESET.

Hold-Off:

With trigger HOLD-OFF activated the counter ignores re-triggering (channel A) or stop-triggering (channel B) during the set hold-off time. The hold-off function is applicable in all channel A measuring modes and also on channel B in the TIME A-B mode. The hold-off function can be used as low-pass filter with variable cut-off frequency between 5 Hz...150 kHz for FREQUENCY and PERIOD measurements.
Range: 5µs...200 ms or 0 (OFF)
Read-Out: The hold-off time is measured and displayed by pressing the READ push-button.
Monitor: The set hold-off duration is visible via the GATE OPEN output.

Note: When hold-off is active, the frequency measurements are limited to 0.01 Hz...200 kHz (PM 6652C and PM 6654C) and clock resolution in all measuring modes will always be 100 ns (PM 6654C).

Time Interval Delay (T.I. delay):

The T.I. delay is a bus-programmable Hold-off, active in PM 6654C in the modes:
- Time Interval A-B, single
- Pulse width A, single
- Rise/Fall Time A, single

Range: 100 µs...99s
Inaccuracy: 25 µs ±1% of set value

Mathematics:

The mathematical functions of PM 6652C and PM 6654C make it possible to offset a measuring value or to change scale factor (normalizing).
The offset facility allows adding or subtracting a reference value to the measured value before display, e.g. measurement of tuned receiver frequency, by measuring the local oscillator frequency (IF-offset).
The scaling facility allows multiplying of the measured value by a constant before display, e.g. conversation of frequency to RPM.
The scaling and offset features may be combined, so that the displayed value equals K*X+L. X is the measured value and K and L are constants.

Check:

10 MHz internal reference is connected to the counting logic of input channels A and B. Self-test of most measuring functions can be selected.

Reset:

Manual via push-button or electrical via input E. Reset will clear keyboard entry status, clear an active STORE state, and/or start a new measurement.

Power On/Stand By:

In "ST BY" position, power is available to maintain an ovenized crystal oscillator.

Test Function:

The counter performs a choice of 5 self test routines of the logic and computing functions. The functions tested are: ROM (No. 1), RAM (No. 2), EAROM (No. 3), measuring logic (No. 4) and display (No. 5), Test No. 6 when selected will perform all tests 1...5 in a sequence.
At power-up a limited test sequence is performed.

Programs P1...P8:

Eight front panel "menus" can be stored in and recalled from a non-volatile memory. All front and rear panel settings can be stored; except hold-off value (but status of push-button "HOLD-OFF on/off" is stored). Programs P7 and P8 can not store the mathematical functions.

Time Base:

For specifications see chart on following page.

Definitions

Synchronization Modes:

Conventional Mode means that the gate time is synchronized with an integer number of clock pulses. The error is ±1 input cycle. (Only used in the PM 6652C above 10 MHz).
Reciprocal Mode means that the gate time is synchronized with an integer number of input cycles. The error is ±1 clock pulse, i.e. ±100 ns (PM 6652C) or ±2 ns (PM 6654C). The use of this mode gives 7 digits (PM 6652C) or 9 digits (PM 6654C) resolution for a one second measuring time.

LSD Displayed:

Unit value of the Least Significant Digit displayed. All calculated LSDs (see section Measuring modes) should be rounded to the nearest decade before display (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 10th digit.

Accuracy:

The accuracy (relative error) of a measurement is dependent on 4 factors:
- rel. resolution
- rel. time base error (if any)
- rel. trigger error (if any)
- rel. systematic error (if any)

Accuracy + ± rel. resolution ± rel. time base error ± rel. trigger error ± rel. systematic error

Resolution

For Multiple Event Measurements: FREQUENCY, PERIOD and RATIO,the resolution is the smallest increment between two measuring results. The measuring resolution is due to the ±1 count error. After calculation, the result to be displayed is truncated to include only significant digits, giving a measuring resolution of 0.2...2 LSD units. Total resolution, including LSD resolution is therefore 1 LSD unit (70% probability) or 2 LSD units (30% probability) but can always be reduced to 1 LSD unit by increasing the measuring time somewhat.
For Single Event Measurements: PERIOD SINGLE and TIME INTERVAL SINGLE, resolution is one clock pulse period, regardless of the measuring time.
For Statistical Measurements: TIME INTERVAL AVERAGE, RISE/FALL TIME, PULSE WIDTH, PHASE and DUTY FACTOR,the resolution is the smallest increment between two measuring results with a confidence level of 95%.

Time Base Error:

The relative time base error is the relative deviation of the clock pulse frequency from 10 MHz. Rel. time base error = $\Delta f/10$ MHz. See spec. for oscillators.

Trigger Error:

Trigger error (T.E.) is the absolute measurement error due to input noise causing triggering which is too early or too late.
Frequency, Period, Ratio: T.E. = ± Noise Voltage (V pp)/Signal slew rate (V/s);
T.E. = ± 1/FREQ x π x S/N-ratio (sinewave)
Time Interval, Rise/Fall Time, Pulse Width, Duty Factor: T.E. = ± Noise Voltage (V p)/slew rate at START point ± Noise Voltage (V p)/slew rate at STOP point
Phase: T.E. = ± 1/(FREQ x π x S/N-ratio) (sinewave, same S/N-ratio for both channels).

Systematic Errors:

When a systematic error is known, the measured value can be compensated by using the MATH function.
Time Interval, Pulse Width: Syst. error < ±2 ns (PM 6654C) or < ±4 ns (PM 6652C)
Rise/Fall Time: Syst. error = TIME INTERVAL Syst. error ±

$$\pm \frac{2\% \text{ of V pp (A)} + 5 \text{ mV}}{\text{slew rate (A) at 10\% (V/s)}}$$

$$\pm \frac{2\% \text{ of V pp (A)} + 5 \text{ mV}}{\text{slew rate (A) at 90\% (V/s)}}$$

Phase (AC-Coupling, Trigger Level = 0V)
Sinewave:
Syst. error
<arcsin (5 mV/U max A) - arcsin (5 mV/U max B)
Triangular wave:

$$\text{Syst.error} < \frac{5 \text{ mV} \times 90^\circ}{\text{U max A}} - \frac{5 \text{ mV} \times 90^\circ}{\text{U max B}}$$

General Specifications

Display

Read Out: 10 digits, sign and exponent (engineering notation) 11 mm high-efficiency LED.
Unit Indicators: 3 LEDs indicating Hz, s or V. Any prefix (kHz, µs) is indicated by the exponent on the display.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
St By: Stand-by indication with LED when instrument is not switched ON.
Remote: Indicates that the counter is remotely controlled via the BUS interface option (IEC-625, IEEE-488).
Armed/Freq Avg/Ext Gate: Indicates position of rear panel EXT CONTROL switch (LOCAL mode) or programmed setting of EXT CONTROL function (REMOTE mode).
Cursor: Indicates selected measuring function and/or selected front panel menu (Programs P1...P8).

Power Requirements:

In addition to the normal line voltage supply, the PM 6652C and PM 6654C can also be powered by an external DC voltage; 17V...29V.
Line: 115/230V ±15%; 45...440Hz 60 VA
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556 B

Environmental Conditions

Ambient Temperature:
Storage and transport: -40°C...+70°C;
Rated range of use: -5°C....50°C
To allow air convection, at least 2 cm free space is required above and below the counter. Without any free air space around the counter (tightly packed 19 inch racks), the built-in fan option PM 9612 is necessary at ambient temperatures above 40°C.
Humidity:
Operating: 10...90% RH, no condensation;
Storage: 5...95% RH
Altitude/Barometric Pressure:
Operating: 5 000m (15 00 ft) -53.3 kN/m²
Storage: 15 000m (50 000 ft) -15.2 kN/m²

Dimensions and Weight:

440 mm W x 89 mm H x 440 mm L (excl. 19" brackets) (17.3 in W x 3.5 in H x 17.3 in L)
Net: Approx. 8 kg (17.5 lb)
Shipping: Approx. 10 kg (22 lb)

Optional Accessories

Analog Recorder Output PM 9695

The digital-to-analog converter PM 9695 provides a high resolution analog output e.g. for recording frequency stabilities of oscillators, filters and crystals on a strip chart recorder. In frequency control systems having analog feedback, the DAC serves as an extremely accurate

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PM 6654C & PM 6652C

frequency-voltage converter. The PM 9695 permits conversion of any three consecutive digits; as such it functions as a magnifying glass to focus on the most important part of the readout.
Decade Conversion: Any 3 consecutive digits can be selected. The value of the least significant of the 3 digits can be selected with a 12-position switch.
Normal Mode: Analog output is directly proportional to digital input. 000 produces 0.000V. 999 produces 0.999V.
Output:
Zero output: 0V;
Full scale deflection: 0.999V
Connector: BNC

Ext. Reference Frequency Multiplier PM 9697:

To accept external reference frequencies other than 10 MHz, the frequency multiplier PM 9697 can be ordered.
With this option installed, the PM 6652C or PM 6654C can accept external reference frequencies of 1 MHz, 5 MHz or 10 MHz. All other input specifications as for "Input D".
Included: Operating manual, power cord, rack-mounting brackets

GPIB/IEEE-488 Bus Data

(PM 9696 Installed)
The PM 6652C and PM 6654C timer/counters are IEEE-488 bus programmable through the optional hardware interface PM 9696B.

Programming Instructions:

Programming modes: The counter can be programmed in 3 different ways:
Remote recall of P1...P8: Manually stored front panel menus are recalled with one single bus-command (LP1...LP8).
Bus learn mode: The programming codes for all manually set controls are sent from the counter and stored in the controller's memory with one single bus-command. The string of codes can later be returned to the counter for reprogramming.
Normal mode: Only changes in the current programming status need to be programmed, and can be sent in an arbitrary order. Any number of spaces can be inserted anywhere in the programming string. The counter complies with IEC-625-2 and IEEE-728 and accepts all standardized formats for numeric values; NR1, NR2 and NR3.

Output Messages:

High Speed Dump Mode: The contents of the counting registers are sent to the controller without being processed by the internal microcomputer. The processing must be done in the controller instead.
Limit Monitoring: The MATH constants K and L will specify upper and lower limits for the measurement. When the input signal exceeds either of the limits, an SRQ-alarm is sent to the controller. Limit monitoring is not applicable in the V max V min measuring mode.

Timing Characteristics:

Max. Data Output Rate:
Normal mode: 30-50 readings/sec.;
High speed dump mode: Approx. 420 readings/sec.
V max, V min or V p-p: 3-4 readings/sec.

Ordering Information

Models

The PM 6652C and PM 6654C ordering number consists of the basic type number and a 3 digit XYZ suffix, specifying the required customer version.
PM 6652C/54C/X.. indicating maximum frequency;
PM 6652C/54C/.Y. indicating reference oscillator;
PM 6652C/54C/..Z indicating interface
PM 6652C/011 Programmable High Resolution Timer/Counter; 120 MHz basic frequency range, 100 ns single shot resolution, standard oscillator 5 x 10^{-7}/month, incl. 19" rackmount brackets, excl. IEEE-488 businterface board
PM 6654C/011 Idem, but with 2 ns single shot resolution
PM 665.C/5.. Incl. 1.5 GHz input channel PM 9610
PM 665.C/.2. Incl. crystal oscillator PM 9678
PM 665.C/.3. Incl. crystal oscillator PM 9679
PM 665.C/.4. Incl. crystal oscillator PM 9690
PM 665.C/.5. Incl. crystal oscillator PM 9691
PM 665.C/.8. Incl. standard crystal oscillator and external reference frequency multiplier PM 9697
PM 665.C/..2 Blind panel version incl. IEEE-488 bus interface PM 9696
PM 665.C/..5 Normal panel version incl. analog recorder output PM 9695
PM 665.C/..6 Normal panel version including IEEE-488 bus interface PM 9696
PM 665.C/..7 Normal panel version including IEEE-488 bus interface and MATE/CIL interfaces

Accessories

PM 9610 1.5 GHz Option (input C)
PM 9611 Built-in Rear Panel Input Wiring Option
PM 9612 Fan
PM 9613 Rack-Mount Slide Kit
PM 9678B TCXO Time Base Oscillator (version/.2.)
PM 9679E Ovenized Time Base Oscillator (version/.3.)
PM 9690 Ovenized Time Base Oscillator (version/.4.)
PM 9691 Ovenized Time Base Oscillator (version/.5.)
PM 9695 Analog Recorder Output
PM 9696B IEEE-488 Bus Interface
PM 9697 External Reference Frequency Multiplier
PM 9581 50Ω feed-through termination; 3W
PM 9585 50Ω Feed-Through Termination; 1W
PM 9665B 50 kHz Low Pass Filter
PM 9666 Trigger Level Output Cable

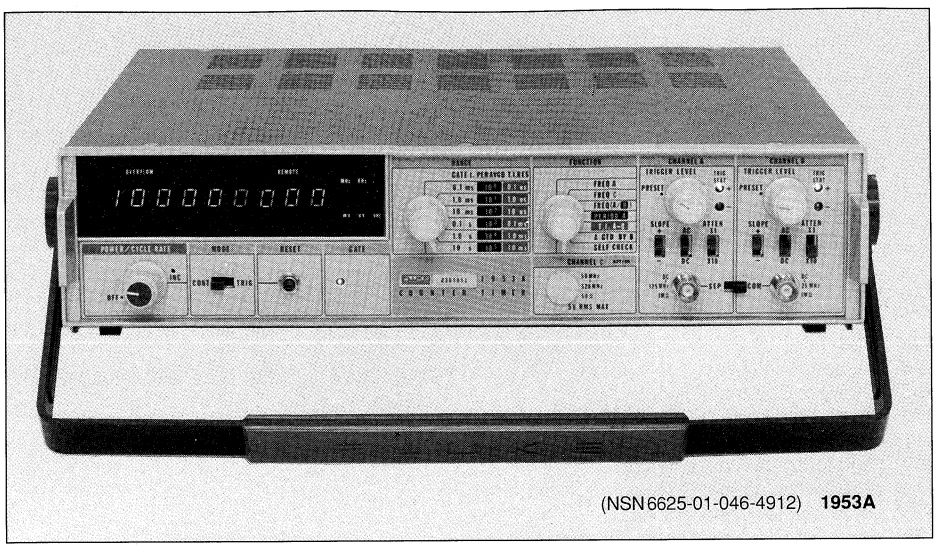
Crystal Oscillator Summary

PM 66../...Version Including Time Base Option	/.1. Standard Version	/.2. Version PM 9678	/.3. Version PM 9679	/.4. Version PM 9690	/.5.Version PM 9691
Stability Against	Standard	TCXO	Oven	Oven	Oven
Aging:/24h /Month /Year	N/A <5 x 10^{-7} <5 x 1^{-6}	N/A <1 x10^{-7} <5 x 10^{-7}	N/A <1 x 10^{-7} <5 x 10^{-7}	<1.5 x 10^{-9*} <3 x 10^{-8} <1.5 x 10-7	<5 x 10^{-10*} <1 x 10^{-8} <7.5 x 10^{-8}
Temperature: 0°C to 50°C Ref. to +23°C	<1 x 10^{-5}	<1 x 10^{-6}	<1 x 10^{-7}	<3 x 10^{-8}	<5 x 10^{-9}
Change in supply Mode: line/int. battery /ext. DC 12V to 28V	<3 x 10^{-7}	<5 x 10^{-8}	<1 x 10^{-8}	<3 x 10^{-9}	<3 x 10^{-9}
Line Voltage:±10%	<1 x 10^{-8}	<1 x 10^{-9}	<1 x 10^{-9}	<5 x 10^{-10}	<5 x 10^{-10}
Warm-up time to reach 10^{-7} of final value	N/A	N/A	<10 min	<15 min	<15 min

**After 48 Hours of continuous operation.*

1953A

GPIB IEEE-488



(NSN 6625-01-046-4912) **1953A**

1953A Universal Counter/Timer

- Frequency to 125 MHz (optional 520, 1000, 1250 MHz)
- Time interval measurements to 100 ns (single shot); 0.1 µs (averaged)
- Gated totalizing, frequency ratio and period measurements
- Fully GPIB/IEEE-488 programmable, including trigger levels
- 9 digit display

The 1953A is a systems counter with a wide array of options allowing you to select just the capability you need.

The 1953A can provide a variety of measurements: frequency, frequency ratio, period, period averaging, time interval, and gated totalizing. Trigger level controls allow selection of a preset level (0V dc), or adjustment to suit conditions. DMM output jacks and LED status indicators help the user to set the trigger levels properly.

Signal conditioning switches permit the operator to select positive or negative slope trigger, ac or dc coupling, and X1 or X10 attenuation. A marker output is provided for use with an oscilloscope for accurate determination of trigger points.

The GPIB/IEEE-488* interface option (1953A-15) allows full programming of function, range, and signal conditioning, including trigger levels. Data output includes 9 digits of display information, decimal point, and exponent. Front panel lockout is provided. TTL level parallel remote programming (1953A-12) is also available. (Both these options are built into the unit and must be ordered at the time of purchase.)

Specifications

Technical Specifications

Frequency Measurements

Range: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)
Gate Time: 0.1 ms to 10s in 6 decade steps
Resolution: 1/gate time (in Hz)

Period Measurements

Range: 0 to 25 MHz (dc coupled); 5 Hz to 25 MHz (ac coupled)
Periods Averaged: 1 period to 10^5 in decade steps
Resolution: 10^{-7}/periods

Time Interval Measurements

Range: 0.1 µs to 10^7s
Input: Channels A and B, common or separate
Resolution: 10 ms to 0.1 µs in 6 decade steps

Totalize Measurements

Range: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)

Ratio Measurements

Display: Ch A/Ch B
Range
Channel A: 0 to 125 MHz (dc coupled); 5 Hz to 125 MHz (ac coupled)
Channel B: 0 to 25 MHz (dc coupled); 5 Hz to 25 MHz (ac coupled)

Sensitivity

Channel A: 30 mV rms sinewave to 75 MHz, increasing to 50 mV at 125 MHz; 100 mV pulse amplitude with minimum pulse width of 10 ns
Channel B: 30 mV rms sinewave to 25 MHz; 100 mV with minimum pulse width of 50 ns
Channel C
520 MHz Channel C Input (-07)
Covers frequency range of 50 to 520 MHz, using a scaling ratio of 4. Sensitivity is 15 mV rms (AGC). Maximum allowable input is 5V rms (fuse protected). VSWR less than 2:1 into 50Ω for levels less than 1V rms
1000 MHz Channel C Input (-13)
Covers 50 to 1000 MHz using a scaling ratio of 8. Sensitivity is 15 mV rms, and maximum allowable input is 5V rms (fuse protected). VSWR is less than 2.5:1 for levels less than 1V rms
1250 MHz Channel C Input (-14)
Covers 50 to 1250 MHz using a scaling ratio of 8. Sensitivity is 15 mV to 1000 MHz, decreasing to 30 mV rms at 1250 MHz. Maximum input is 5V rms (fuse protected). VSWR is less than 2.5:1 (50Ω) for levels less than 1V rms

Input Impedance

Channel A or B: 1 MΩ ≤30 pF
Channel C: 50Ω nominal

Rear Panel Signals

External Timebase: 10 MHz, 250 mV to 8V
Gate Time: High True, TTL level output
Time Interval Marker: Low True, TTL level output
Trigger Level Output: Channels A & B only

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

1953A

Timebases

	Standard	-04 Option	-10 Option	-20 Option
Frequency	10.00 MHz	10.00 MHz	10.00 MHz	10.00 MHz
Aging Rate (Constant Temp)	$\pm 3 \times 10^{-7}$/mo 1 ppm/yr	$\pm 3 \times 10^{-7}$/mo 1 ppm/yr	$\pm 1 \times 10^{-7}$/mo	$\pm 1.5 \times 10^{-8}$/mo
Temp Accuracy 0°C-50°C	$\pm 2 \times 10^{-6}$	$\pm 5 \times 10^{-7}$	$\pm 1 \times 10^{-8}$	$<7 \times 10^{-9}$*
Line Voltage (±10%)	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$	$\pm 3 \times 10^{-9}$	$\pm 1 \times 10^{-9}$

**Peak-to-peak variation*

General Specifications

Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating
Power: 115 or 230V ac ±10% (100V available), 50 to 400 Hz, 30W nominal
Size: 8.8 cm H x 36.2 W x 34.3 cm D (3.45 in H x 14.25 in W x 13.5 in D)
Weight: 4.32 kg (9.5 lb)

Included with Instrument: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) separately.

Ordering Information

Models

1953A Universal Counter/Timer
1953A-12 w/Full Remote Programming (Option -12) Installed
1953A-15* w/GPIB/IEEE-488 Interface (Option -15) Installed

** Not compatible with Option -11*

Options

-04** Superior TCXO
-05 Timebase Multiplier
-07* 520 MHz Channel C Input
-10** Oven-Stabilized Timebase
-11** Basic Remote Programming
-13* 1000 MHz Channel C Input
-14* 1250 MHz Channel C Input
-16** Rear Inputs (Channels A,B,C)
-20** Superior Oven-Stabilized Timebase

**Factory or Service Center installation only. Options -04, -10, and -20 are mutually exclusive in one mainframe.*
***Factory installation only*

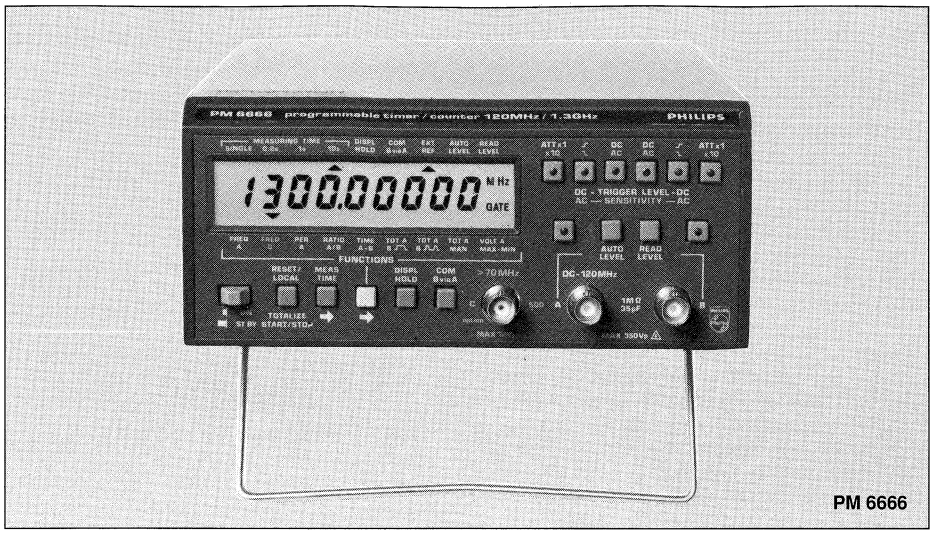
Accessories (Also see Section 20)

A53 Whip Antenna
Y7201 Attenuator/Filter
M00-200-622 3½" Rack Mount Kit
M00-200-626 3½" Rack Mount Kit w/18" slides, for DEC cabinets
Y7206 3½" Adapter w/24" slides, for non-DEC cabinets
Y8021 IEEE-488 Bus Cable, 1m
Y8022 IEEE-488 Bus Cable, 2m
Y8023 IEEE-488 Bus Cable, 4m
Y9103 50Ω BNC Feed-thru Terminator
Y9111 Coaxial Cable 50Ω, BNC to BNC 3 ft (0.93m)
Y9112 Coaxial Cable 50Ω, BNC to BNC 6 ft (1.85m)

PM 6665 & PM 6666

T&M EXPRESS LINE

GPIB IEEE-488



PM 6666

PM 6665 & 6666 Programmable Timer/Counters

- Unrivalled price/performance
- High resolution reciprocal counting
- High trigger accuracy
- PM 6666: Full GPIB/IEEE-488 programmability, Auto Trigger, Voltage Measurements
- PM 6665: Continuously variable sensitivity, HF filter
- High stability MTCXO: 2 x 10^{-7} over 0...50°C -push button calibration
- 9 measuring modes including high resolution time-interval average
- 1.3 GHz RF-Input

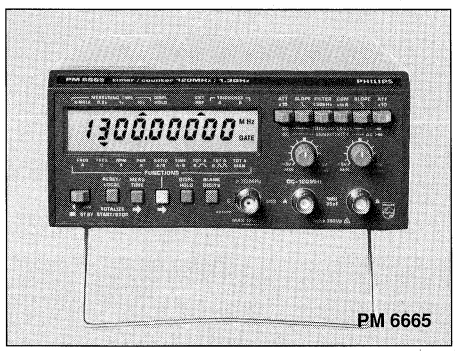
The PM 6665 and PM 6666 are very versatile timer/counters with many functions included as standard, spanning frequencies from 0.1 Hz to 120 MHz, and optionally up to 1.3 GHz. The measuring functions include FREQUENCY, PERIOD, FREQ RATIO, TOTALIZE pulses, TIME INTERVAL, RPM (PM 6665) and VOLT peak values (PM 6666).

The units have a built-in microprocessor that uses the reciprocal frequency counting technique, which yields high resolution measuring results under all conditions, even on low frequency measurements.

Measuring accuracy is increased by the high performance counter front-ends, providing variable sensitivity and noise immunity. Accuracy can be further improved with the optional high stability time-base.

Both units provide unmatched value for money and offer a high degree of programmability through the GPIB/IEEE-488* interface. All major functions can be programmed with the PM 6665; and the PM 6666 offers 100% programmability including trigger level and sensitivity settings.

Note: The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.



PM 6665

PM 6665

The PM 6665 timer/counter is specifically designed for applications with a small budget but a demand for a broad range of high performance counting and timing. It is low cost and offers the same high quality as other Philips test and measurement instruments. For example:

- Design is highly integrated, ensuring reliable, low power operation
- Stability is exceptional with Philips' MTCXO temperature compensated crystal oscillator, which delivers stability comparable to that of costly oven stabilized oscillators at the price level of a conventional TCXO
- An all-metal cabinet gives excellent RFI shielding and mechanical stability
- PM 6665 offers the best solution for both frequency and time measurements with its high quality inputs. Frequency measurements have continuously variable sensitivity and noise immunity and time measurements can be triggered within a wide ±5V/±50V range. A noise rejection filter is included as standard.

Optimal Time Measurements

The inputs for time measurements in the PM 6665 incorporate high speed synchronizers and equalized input channels to eliminate differences in delay and risetime. High sensitivity inputs reduce the possibility of trigger errors; trigger levels can be selected in the range from -50 to +50V and trigger indicators simplify level setting.

Frequency Measurements

Frequency measurements must have a variable noise immunity - which in practice means variable sensitivity - for correct triggering. On the PM 6665 this is accomplished with the continuously variable x1...x100 input signal attenuator.

Noise Rejection Filter Standard

The built-in noise rejection filter is useful for cleaning up noisy LF signals and for filtering off HF noise, even at levels higher than the input signal.

PM 6666

The PM 6666 is the first low cost timer/counter with high accuracy frequency, time and voltage measurements that also offers 100% programmable GPIB/ IEEE-488 operation. With the GPIB/ IEEE-488 bus, all measurement functions include trigger level settings and sensitivity can be programmed. A bus learn mode is provided to speed and simplify programming.

The PM 6666 is also an excellent all-purpose instrument for bench-top use, with 9 front panel selectable measuring functions including voltage max./min. measurements.

Time-out and separator settings are also programmable on both the PM 6665 and PM 6666 and a high speed mode delivers high-speed output of unformatted data at over 100 measurements/s. An optional rack mount adapter is available for both units for integration into measuring systems.

Error Free Triggering

Triggering is error-free on the PM 6666 for all waveforms. Trigger-level setting can be automatic on all input signals over 100 Hz. Resolution is 20/200 mV, over a very wide range (-50...+50V) that allows measurements to be accurate even on high voltage events. The trigger level can be displayed immediately with

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PM 6665 & PM 6666

one key-stroke; and inputs can be instantly checked for triggering with the tri-state LED trigger indicators.

To give the various noise immunity settings, input sensitivity has six steps, from 20 mV to 1V rms.

Peak Voltage Measurements to 50 MHz

The PM 6666 has a unique capability for an instrument in this price range, i.e Vpeak measurements (-50...+50V) at up to 12 MHz at an error level of no more than a few percent. Vpeak measurements are possible over the range 12...50 MHz with slightly higher errors. When displaying Vmax./min. measurements, positive and negative signal peaks of the input signal are shown simultaneously with a resolution of 20/200 mV.

PM 6665 & PM 6666: Leading Technology

The latest technology is used in these timer/counters to give them their unrivalled performance for instruments in their price class.

Special emphasis was placed on reliability and integration to decrease the component count, which reduces heat dissipation and gives a high MTBF figure. For example, the entire counting logic circuitry consists of just two chips - the LSI counter-on-a-chip and a single chip control microcomputer. Also, a unique crystal oscillator is used for timebase facilities - the MTCXO (see below). All this combines to give very powerful instruments in a small package and low price.

The PM 6665 and PM 6666 have high input protection, allowing them to withstand inputs of 12Vrms on the optional 50 ohm RF input, and 350V (DC + AC peak) on the 1 MΩ LF input.

Unique MTCXO Timebase

Until now, choice of the timebase crystal oscillator, which determines the final accuracy of the counter, was only between the low-cost uncompensated standard crystal oscillators, medium price TCXOs (temperature compensated crystal oscillators) and high price, high stability oven-controlled oscillators.

Now, Philips has developed a mathematically compensated crystal oscillator which costs the same as a normal TCXO yet has a stability of 2 x 10^{-7} (0...50°C), comparable with that of an oven stabilized oscillator.

The new oscillator is called the MTCXO or Mathematically Temperature-compensated Crystal Oscillator. It has an associated non-volatile memory in which are stored the frequency deviations from the factory measured temperature dependent frequency curve, at each temperature. During a measurement, the temperature of the crystal is measured, the deviation for that temperature is retrieved from the memory and the result is automatically compensated before display. In addition, because the temperature of the crystal is always compensated for each measurement, no warm up time is required for high accuracy measurement. Calibration is performed with the touch of a button, without warm-up.

High Resolution

Both PM 6665 and PM 6666 can measure low frequency signals to high resolution with synchronized multiple period measurements and computing the reciprocal values.

Resolution is at least 7 digits on a 1s measuring time, because the traditional ±1 input cycle error is eliminated by the built-in microprocessor. This high resolution applied to all input frequencies, whether high or low. Thus long gate times are no longer needed to obtain high resolution when measuring low frequency input signals. There is also no risk of instrument rounding error, because of the full 9-digit display.

Time interval measurements are high resolution as well as high accuracy, due to the time interval averaging technique. The 100 ns resolution is improved by a factor √N (N + number of time intervals averaged) when compared with single time interval measurements. The maximum obtainable N is 4 x 10^{-7}, resulting in a resolution of better than 20 pica seconds.

Versatility for All-Purpose Use

Several variations and options are available so the user can choose exactly the configuration required for his application. The options are factory installed and tested in each user configuration. However, all options can also be field installed by the user allowing upgrading of the counter at any time.

The full range comprises:

- GPIB/IEEE-488 interface
- Highly stabilized timebase (MTCXO)
- 1.3 GHz HF input
- Battery power pack
- Rack mount kit
- Carrying case.

Specifications

Measuring Functions

Frequency A or C

(Frequency B via GPIB/IEEE-488 only)

Range:
Freq. A: 0.1 Hz...120 MHz
120 MHz...160 MHz typically at 60 mVrms sensitivity
Freq. B: 0.1 Hz...12 MHz (via GPIB/IEEE488 only)
Freq. C: 70 MHz...1.0 GHz (PM 9615)
Mode: Reciprocal frequency counting
LSD displayed: $\frac{2.5 \times 10^{-7} \times \text{FREQ}}{\text{measuring time}}$

RPM A (PM 6665 only)

The FREQUENCY A measurement is made. The measured frequency is multiplied by 60, and shown on the display as revolutions per minute (RPM).
Range: 6 RPM ... 720 x 10^6 RPM

Period A

Range: 8 ns...2x10^8s
Mode: Single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10s measuring times)
LSD displayed:
SINGLE period measurement:
100 ns (TIME <100s)
$\frac{5 \times \text{PERIOD}}{10^9 \text{s}}$ (TIME > 100s)
Period average measurement:
$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$

Ratio A/B (Ratio B/A, C/A or C/B via GPIB/IEEE-488 only)

Range:
0 and 1 x 10^{-7}...2 x 10^9 (A/B)
0 and 1 x 10^{-8}...2 x 10^8 (B/A)
0...1 x 10^{15} (A/B SINGLE and B/A SINGLE)
8...6 x 10^{10} (C/A and C/B)
Frequency Range:
Input A: 0 Hz... 120 MHz (A/B)
0 Hz...12 MHz (B/A, C/A, A/B SINGLE)
Input B: 0 Hz... 12 MHz
Input C: 100 MHz... 1.1 GHz
LSD displayed (Ratio A/B):
$\frac{25}{\text{meas. time x FREQ B}}$ (0.2, 1 or 10s measuring times)
LSD Displayed (Ratio B/A):
$\frac{2.5}{\text{meas. time x FREQ A}}$ (0.2, 1 or 10s measuring times)
LSD Displayed (A/B single, B/A single):
1 RATIO <10^9
$\frac{5 \times \text{RATIO}}{10^9}$ RATIO≥10^9
LSD displayed (Ratio C/A or C/B):
$\frac{640}{\text{meas. time x FREQ A or B}}$

Time Interval A/B (time interval B-A via GPIB/IEEE-488 only)

Range:
100 ns...2 x 10^8s (SINGLE)
0 ns...20s (average)
Mode: Single time interval (SINGLE) for time interval measurements (at 0.2, 1 or 10s measuring times)
LSD Displayed:
SINGLE Time-interval measurement:
100ns (Time<100s)
$\frac{5 \times \text{TIME}}{10^9 \text{s}}$ (TIME > 100s)
Time-interval average measurement:
$\frac{2.5 \times 10^{-7} \text{s}}{N}$

Number of intervals averaged N:
$\frac{\text{measuring time}}{\text{pulse repetition period}}$
NOTE: Input signals must be repetitive and asynchronous with respect to the timebase

Min. dead time from start to stop: 250 ns
Timing difference A-B channels: 4 ns max

Totalize A

(Totalize B via GPIB/IEEE-488 only)
Range: 0...1 x 10^{15} with indication of K or M (Kilopulses or Megapulses). The result is truncated if out of display range.
Frequency range: 0 Hz...12 MHz
Pulse pair resolution: 80 ns
LSD displayed:
1 unit count (counts $<10^9$)
5x counts/10^9 (counts $\geq 10^9$)
Gated by B (A) mode: Event counting on input A (B) during the duration of a pulse on input B (A).
Start/stop by B (A) mode: Event counting on input A (B) between two consecutive pulses on input B (A).
Manual mode: Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the Timer/Counter to zero.

Volt max/min A (PM 6666 only)

Volt max/min B via GPIB/IEEE-488 only
Range: -51V... +51V
Frequency range:
DC and 100 Hz...50 MHz (input A)
DC and 100 Hz...5 MHz (input B)
Resolution:
Input signals within ±5V: 20 mV
Input signals outside ±5V: 200 mV
Inaccuracy DC and 100 Hz...12 MHz (A) or ...1 MHz (B):
Input signals within ±5V:
30 mV ± 1% of reading ± 3% of V p-p
Input signals outside ±5V:
300 mV ±3% of reading ±3% of V p-p
Inaccuracy 12 MHz... 50 MHz (A) or 1 MHz ...5 MHz(B):
Input signals within ±5V:
30 mV ±10% of reading ±10% of V p-p
Input signals outside ±5V:
300 mV ±10% of reading ±10% of V p-p

Input Specifications

Input A and Input B; PM 6665 only

Frequency Range:
DC-coupled: DC... 120 MHz
AC-coupled: 20 Hz...120 MHz
Minimum pulse duration: 4 ns
Coupling: AC- or DC-coupled, switch selectable.
Impedance: 1 MΩ//35 pF, independent of "COM via A" switch setting.
Channel input: Separate A and B, or Common via A.
Maximum voltage without damage:
350V (DC + AC peak) between 0 and 440 Hz, falling to 8V rms at 1 MHz
Sensitivity; DC coupled:
Sine: 20 mVrms, 0 Hz... 100 MHz
30 mVrms, 100 MHz...120 MHz
Pulse: 60 mV p-p, 0 Hz...100 MHz
90 mV p-p 100 MHz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Sensitivity, AC coupled:
Sine: 20 mVrms...200 mVrms, 20 Hz...100 MHz
30 mVrms...300 mVrms, 100 MHz
...120 MHz continuously variable
Sensitivity decreases to 60 mVrms at 160 MHz typically
Filter: Switchable 50 kHz low-pass noise filter with approx 40 dB suppression at 1 MHz.
Attenuation: x1 or x10, switch selectable.
Trigger slopes: Positive or negative, switch selectable
Trigger level range:
DC coupled: +5V...-5V (attenuator x1)
-50V...+50V (attenuator x 10), adjustable by potentiometer
AC coupled: 0V fixed
Trigger indicators: Indication on LCD display when triggering on inputs A or B occurs.

Input A and Input B; PM 6666 only

Frequency range:
DC-coupled: DC...120 MHz
AC-coupled: 20 Hz...120 MHz
Minimum pulse duration: 4ns
Coupling: AC- or DC-coupled, switch selectable
Impedance: 1 MΩ//35 pF, independent of 'COM via A' switch setting
Channel input: Separate A and B, or common via A
Maximum voltage without damage:
350V (DC + AC peak) between 0 and 440 Hz, falling to 8Vrms at 1 MHz
Sensitivity; DC coupled:
Sine: 20 mVrms, 0 Hz...30 MHz
40 mVrms, 30 MHz...120 MHz
Pulse: 60 mVp-p, 0 Hz...30 MHz
110 mVp-p, 30 MHz...120 MHz
Sensitivity decreases to 60 mVrms at 160 MHz typically
Sensitivity; AC coupled:
Sensitivity is selectable in 6 steps; 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1Vrms (sine) nominal
Max. sensitivity:
20 mVrms; 20 Hz...30 MHz
40 mVrms; 30 MHz...120 MHz
sensitivity decreases to 60 mVrms at 160 MHz typically
Attenuation: x1 or x10, switch selectable or AUTO.
Trigger slopes: positive or negative, switch selectable
Trigger level range:
DC-coupled: -51V...+51V, adjustable via up/down control
AC-coupled: 0V fixed or AUTO level
Trigger level resolution:
20 mV; signals within ±5V
200 mV; signals outside ±5V
Trigger level setting accuracy: ±10 mV ±1% of setting
AUTO trigger level: Trigger level on input A (and B when required) is automatically set to 50% of input signal amplitude.
Frequency range: 100 Hz...120 MHz
Trigger indicators: Tri-state LED indicators
on: Signal above set trigger level
Off: Signal below set trigger level
Blinking: Triggering occurs

Input C (Option PM 9608B)

Frequency range: 70 MHz...1.3 GHz
Coupling: AC
Operating input voltage range:
10 mVrms...12 Vrms; 70...900 MHz
15 mVrms...12 Vrms; 900...1100 MHz
40 mVrms...12 Vrms; 1100...1300 MHz
AM tolerance: 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement
Input impedance: 50Ω nominal, VSWR <2:1
Max. voltage without damage:
12 Vrms; overload protection with pin diodes.

Input C (Option PM 9615):

Not available in all countries.
Frequency Range: 70 MHz...1.0 GHz
Operating input voltage range:
15 mVrms...12 Vrms; 70...100 MHz
10 mVrms...12 Vrms; 100...1000 MHz
For all other specifications, see PM 9608B

Ext. reference input

The input automatically detects when a suitable external reference signal is connected. The use of an external reference signal is indicated in the display.
Input frequency: 10 MHz ±0.1 MHz
Coupling: AC
Sensitivity: 500 mVrms
Input impedance: Approx 300Ω at 10 MHz
Maximum input voltage: 15 Vrms

Auxiliary functions

Power on/off

Switches counter power on/off. At power up a self-test is performed and the counter is set to default settings.
Default settings
Function: FREQ A
Measuring time: 0.2s
AUTO trig level: On (PM 6666)
Coupling input A: AC (PM 6666)
Coupling input B: DC (PM 6666)
Trigger slope, A, B: Positive (PM 6666)

Reset

The RESET button has three functions:
RESET: Starts a new measurement. The set-

tings are not changed.
LOCAL: Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
START/STOP: Opens/closes the gate in TOTALIZE A, manual mode.

Measuring time

A measuring-time of 0.2s, 1s, 10s or SINGLE can be selected.
NOTE: When SINGLE is selected together with PERIOD, RATIO or TIME, the result is a single cycle measurement. SINGLE used in FREQUENCY or RPM results in a fixed 3 ms measuring time.
Max. measuring rate: Approx 5 measurements/s.
Approx. 2 measurements/s when AUTO trigger level (PM 6666) is switched on.
Display time: Normally the display time equals the set measuring time. When SINGLE is selected, a display time of 0.1 seconds is used.

Display hold

The current measuring result is frozen on the display. A new measurement starts when RESET button is pressed.

Definitions

LSD displayed

LSD = unit value of least significant digit displayed. All calculated LSDs (see section Measuring Functions) should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz), and cannpt exceed the 9th digit.

Resolution

Resolution = smallest increment between two measuring results on the display, due to the ±1 count error.
Freq A, Freq C, Period A:
Resolution can be 1 LSD unit or 2 LSD units.

$$\text{if: } \frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$$

The resolution is 2 LSD units, (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
Ratio A/B:
Resolution can be 1 LSD unit or 2 LSD units

$$\text{If: } \frac{\text{LSD x measuring time}}{\text{RATIO}} < \frac{10}{\text{FREQ A}}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70%probability)
SINGLE Period A and SINGLE Ratio A/B:
Resolution equals 1 LSD unit.
Time A-B:
Resolution (95% confidence level) equals 1 LSD unit or 100 ns/√N, whichever is the greatest.

Inaccuracy

Inaccuracy, i.e. the relative error, depends on the following factors:

$$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD, RATIO or TIME}}$$

± relative trigger error
± relative time base error
± relative systematic error
Relative Trigger Error:
Freq. A, Period A:

$$\pm \frac{\text{noise voltage A (V p-p)}}{\text{signal slope A (V/s) x meas. time}}$$

Ratio A/B:

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s) x meas. time}}$$

Totalize A, gated or start stop by B:

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s) x gate time B}}$$

Time A-B:

$$\pm \frac{\text{noise voltage A (V p-p)}}{\text{signal slope A (V/s) x TIME x } \sqrt{N}}$$

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s) x TIME x } \sqrt{N}}$$

Relative timebase error:

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Relative Time A-B systematic error:
Inaccuracy caused by timing difference between A and B channels <±4 ns/TIME.

General Specifications

Power requirements

Line voltage: 115 or 230 Vrms ±15%; 46...440 Hz, <22 VA (PM 6665) resp. <24VA (PM 6666) incl. all options
Safety: In accordance with IEC 348 CLASS 1 and CSA 556B
Line interference: Below VDE 0871 B and FCC Part 15J.
Battery unit: See PM 9605 option.

Timebase (Crystal Oscillator)

Versions:
1. Uncompensated crystal oscillator (order no. PM 666./.1.)
2. MTCXO, ie Mathematically Temperature Compensated Crystal Oscillator (order no. PM 666./.3.). The MTCXO can be ordered separately for later upgrading of the counter (option PM 9607).

MTCXO working principle: The temperature of the crystal is measured. The built-in microprocessor calculates the frequency deviation for that particular temperature from a stored table. The measuring result is mathematically corrected for the timebase frequency dependency, before being displayed.
The correction is switched off when SINGLE is selected, to increase measuring rate. This may cause an additional timebase error of <1 x 10^{-5}.

Oscillator version:	Uncompensated	MTCXO
Stability against:		
Ageing *per month*	<5 x 10^{-7}	<1 x 10^{-7}
per year	<5 x 10^{-6}	<5 x 10^{-7}
Temperature changes 0...50°	<1 x 10^{-5}	<2 x 10^{-7}
line voltage changes 10%	<1 x 10^{-8}	<1 x 10^{-9}

Display

Read out: 9-digit LCD display with unit indication.
Unit indication: MHz, kHz, Hz, mHz, ks, s, ms, s, ns, M, k, m, µ and n.
Gate indicator: Indicates measurement activity.
REMOTE indicator: Indicates when the counter is remotely controlled via an installed GPIB/IEEE-488 interface PM 9604.
Cursor: Indicates selected measuring function, selected measuring time, display hold, the use of an external reference frequency, trigger indicators (PM 6665), AUTO trigger level (PM 6666) and trigger level read-out (PM 6666).

Mechanical Specifications

Dimensions and weight

Width: 186 mm (7.32 in)
Height: 88 mm (7.46 in)
Depth: 270 mm (10.63 in)
Weight: *net,* 2.1 kg (4.63 lb)
Cabinet: The counter is housed in a metal cabinet to minimize electromagnetic interference and achieve good mechanical stability.

Environmental conditions

Temperature
Operating: 0°C...+50°C
Storage: -40°C...+70°C
Altitude
Operating: 5000m
Storage: 15000m
Humidity
Operating: 10%...90% RH, no condensation
Storage: 5%...95% RH

Optional Accessories

GPIB/IEEE-488 interface, PM 9604

Mounting: Inside counter cabinet
Interface functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Address setting: Switch selectable at rear panel between 0 and 30. Factory preset at 10.
Programmable device functions:
Measuring functions

Measuring time
Trigger slope
Trigger levels (PM 6666)
Sensitivity (PM 666)
Input coupling (PM 6666)
Input attenuator (PM 6666)
Manual totalize gate control
Output separator selection
Device clear
Device trigger
High-speed dump
Short output format
Set time-out
Free run/Triggered measurements
Set SRQ mask
Program data out
Device identity

Programming code format:

7-bit ISO code (ASCII) characters. Both upper and lower case characters are accepted.
Input separator: The counter accepts the following characters as separators: ETX, ETB, CR, LF, '(space)', '(comma)', '(colon)', '(semicolon)'.
Output format
FFFFFFOXXXXXXXXXXEXS(S)
FFFFFF = Function code 3...6 characters
O = Normally space. O on overflow
X...X = Measuring result
E = Exponent pointer
± = Exponent sign (+ or -)
X = Exponent value 0...9
S = Selected separator
(S) = Selected separator LF only if output separator CR+LF has been selected.
When 'Short output format' is selected, function code FFFFFF and leading zeros are omitted.

Output data separator: Default separator at power-on is LF. The separator can be programmed to be any non printable ASCII-code with decimal equivalent 01-31, except 27 (ESC). In addition the combination 13 + 10 (CR+LF) can be programmed. The EOI line can be programmed to be active together with the last output byte sent.
Max data output rate:
Normal mode: Approx 5 readings/s
High-speed dump: Approx. 100 readings/s
The highest output rate is obtained at SINGLE measuring time.
High speed dump:
The contents of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.
Max. data output rate: Approx. 100 readings/s.
Output format: CCXXXXXXXXXXXXS(S)
CC = code for calculation formula,
X...X = 12 hex digits representing the register contents,
(S) = selected output separator.
Output time for measuring data:
Normal mode: Approx. 15 ms (20 bytes)
High speed mode: Approx. 6 ms (15 bytes)
Response time for addressing:
Approx. 600 µs
Response time for trigger command (GET):
Approx. 10 ms
Typical read time for programming data:
Approx. 1 ms/byte

Battery unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
Battery capacity (20°C): Approx 15 Wh
Operating time when battery powered: Approx 2 hours (PM 6666) or 2.5 hours (PM 6665) of continuous operation.
Recharging time: 7 hours to approx 75% of full capacity.
Battery protection: Overcharge protection and deep discharge(auto shut-off) protection.
Temperature:
Operating: 0... +40°C
Storage: -40...+50°C
Weight: 0.8 kg (1.8 lbs)

High stability timebase PM 9607

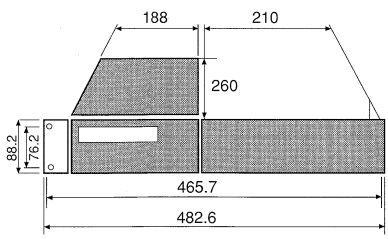
See specifications for optional MTCXO timebase.

1.1 GHz HF input PM 9608

See specifications for optional input C.

Rack-mount kit PM 9606

PM 6665 and PM 6666 can be installed in a standard 19" rack using the rack mount kit PM 9606. One counter PM 6665/66 can be installed together with a second instrument with a half 19-inch width.

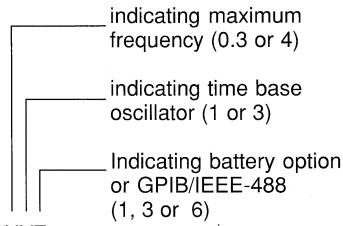


Carrying case PM 9609

PM 9609 is a leather-like carrying case, for protection of the counter during transportation.

Ordering information

Versions
The PM 6665/66 ordering numbers consists of the basic type number and a 3 digit XYZ suffix, specifying the required configuration.



PM 666./XYZ

Type No.	Description
PM 6665/011	Basic PM 6665 timer/counter, 120 MHz frequency range, standard oscillator 5 x 10^{-7}/month, incl. operators manual.
PM 6666/011	Basic PM 6666 timer/counter, 120 MHz frequency range, standard oscillator. 5 x 10^{-7}/month, incl. operator's manual.
PM 666./.3..	As above, but including 1.0 GHz HF-input PM 9615. Not available in all countries.
PM 666./4..	As above, but including 1.3 GHz HF-input PM 9608B.
PM 666./.3.	As above, but including crystal oscillator PM 9607 (MTCXO).
PM 666./..6	As above, but including GPIB interface PM 9604.

Example: PM 6666/416 means a PM 6666 timer/counter, including both a 120 MHz and a GPIB/IEEE-488 interface.

Options and accessories

PM 9604 GPIB/IEEE-488 interface
PM 9605 Battery unit
PM 9606 Rackmount adaptor
PM 9607 MTCXO time-base
PM 9608B 1.3 GHz HF-input (Not available in all countries)
PM 9518 50Ω termination, 3W
PM 9585 50Ω termination, 1W
PM 2240 TestTeam package
PM 2241 TestTeam advanced analysis library
PM 2201/99 GPIB interface card for PC
PM 2231 Instrument drivers package for 'C' (including GPIB procedures)
PM 2233 Instrument drivers package for 'QuickBasic' (including GPIB procedures)

All options can be field installed by the user.

Note: Options PM 9604 and PM 9605 can not be installed together in a PM 6665/66 counter.

7200 Series

GPIB
IEEE-488

7200 Series Counters

- Frequency measurement to 1300 MHz
- Single-shot time intervals to 10 ns
- Autoranging resolution for simple operation
- 100 kHz low-pass filter
- Fully EMI shielded
- Ovenized accuracy with battery portability

The 7200 Series consists of four counters, capable of measuring frequencies up to 1300 MHz, packaged in the versatile Portable Test Instrument case.

The 7220A Communications Counter provides frequency measurements to 1300 MHz. The 7250A Universal Counter/Timer is the lowest priced member of the family, and offers frequency, period, time interval, and totalizing measurements up to 80 MHz. The 7260A offers these same features, plus trigger hold-off and an optional Channel C for frequency measurements to 1300 MHz. The top-of-the-line 7261A adds increased resolution through a 100 MHz timebase, and offers a phase modulated time base to ensure valid time interval averaging of clock-synchronous signals.

The PTI Concept

The Fluke-developed Portable Test Instrument (PTI) packaging concept allows you to easily configure low-cost, convenient mini-test systems using the Fluke 1120A IEEE-488 Translator. A number of compatible Fluke instruments can be interfaced using the 1120A, including counters and voltmeters. With the 1120A, any PTI instrument cluster may be operated in a GPIB/IEEE-488* system. The unique stack-and-latch design makes them easy to carry; requires less rack space, too.

Low Susceptibility, Minimal rf Radiation

A lightweight, interval stainless steel shield completely surrounds the instruments and mates with the metal front and rear panels to provide an rf enclosure meeting most requirements of MIL-STD-461. This means low susceptability in high rf environments, as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

Portable Counters With Ovenized Accuracy

For applications demanding the best possible accuracy, ovenized timebase oscillators are available. These oscillators consume such low power they can be used when the counters are operating from batteries. When you go out on a field assignment you can switch to battery power and keep the oscillator warm and standing by for instantaneous use with laboratory stability and accuracy. There are two oven options to choose from, one with an accuracy of $\pm 1 \times 10^{7}$, and one with an accuracy of $\pm 3 \times 10^{8}$ over the 0°C to 40°C temperature range.

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

Simple, Hands-Off Operation

All counter/timer models (7250A, 7260A, 7261A) feature AUTO ranging resolution. Simply select the desired measurement function, set the resolution switch to AUTO range, and the instrument will automatically choose the correct range for best resolution, position the decimal point properly, and light an annunciator LED indicating the units of measurement.

7220 Communications Counter

The 7220A gives you 10 Hz to 1300 MHz coverage via two separate channels. Channel A is for low-frequency applications (10 Hz to 125 MHz), where the loading of the signal source and the effects of high frequency noise must be minimized. Channel B has a 50 ohm input and is for signals from 100 MHz to 1300 MHz.

An ac-coupled, 1 megohm input and versatile front-end controls for Channel A let you measure signals having extremely high noise levels and still produce stable, accurate readings. A continuously variable X1 to X10 wideband attenuator plus switchable 1X or 10X attenuation lets you minimize noise without losing the signal. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequencies. Used together, the attenuator and filter can solve most noise problems.

The resolution multiplier (Option -351) increases measurement resolution by a factor of 1000 for frequencies from 10 Hz to 10 kHz with out requiring any more measurement time. Resolution goes from 0.001 Hz for 10 Hz signals to 0.1 Hz for 10 kHz signals.

7250A Universal Counter/Timer

The 7250A measures frequencies to 80 MHz, time intervals down to 100 ns, and periods down to 100 ns with 1 ps resolution (in the average mode). In addition, it will measure the ratio of two signal frequencies, counts per minute, or totalize events to 9,999,999 counts.

A broadband, continuously variable, x100, analog attenuator lets you add just enough attenuation to minimize the input signal noise level and optimize the signal amplitude for counting. A switchable 100 kHz, lowpass filter solves the problem of high frequency contamination of audio signals. You can use the filter and attenuator separately or in combination to solve tough noise problems, like calibrating audio oscillators near high power rf transmitters. For timing measurements, there are ±slope controls, fixed-offset trigger level switches, and a separate/common switch at your fingertips.

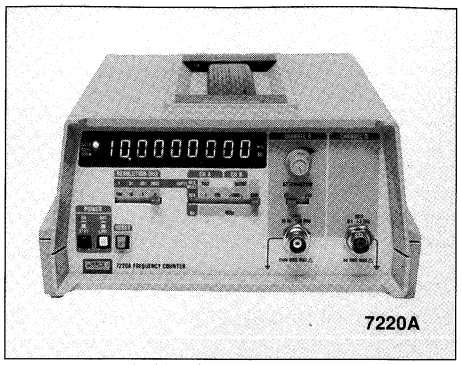
7260A & 7261A Universal Counter/Timers

The 7260A and 7261A will measure frequencies to 125 MHz, or (optionally) to 520 MHz or 1300 MHz, with a 50Ω channel (Channel C).

The instruments are essentially alike except the 7261A has a 100 MHz clock, with a corresponding basic resolution of 10 ns, and the 7260A has a 10 MHz clock, with 100 ns resolution. Both counters will make time-interval or signal-period measurement and will average from 10^{0} to 10^{5} such measurements per reading when greater resolution or accuracy is desired. That extends the resolution of the 7261A to 31.6 ps for time-interval measurements or to 0.1 ps for period measurements. In addition, the 7261A is available with a unique phase-modulated timebase option to assure averaging out small consistent errors.

A broadband attenuator lets you select 1X, 10X or 100X attenuation to minimuze interference from signal noise and to trigger near the peak of high amplitude signals. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequency signals. The signal may be dc coupled or ac coupled and either + or - slope of the sign may be selected for triggering. The Channel A and Channel B trigger level controls have a zero-volt preset position for easy triggering on sinewaves and other signals that cross the zero-volt level.

Trigger status lights tell when triggering is unstable, and the precise trigger level setting of both channels may be monitored at a rear panel connector. Also at the rear panel is a marker output — a gate signal that brackets each period or time-interval measurement. The marker is for use with an oscilloscope. The trigger level and marker outputs are for making accurate timing measurements such as the rise time and fall time of complex signals. A time interval hold-off control with a 1000:1 ratio (20 µs to 20 ms) delays the end of the marker gate to measure the precise portion of a signal.



7220A

7220A Specifications

Frequency Measurements

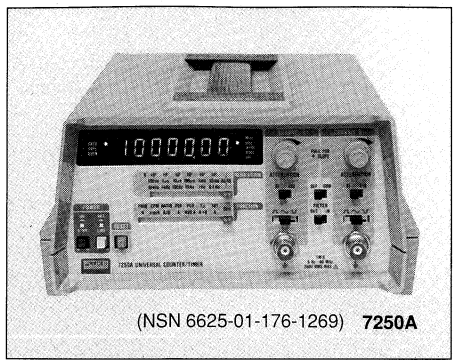
Channel A Range: 10 Hz to 125 MHz
Channel B Range: 100 MHz to 1300 MHz
Resolution: 0.1 Hz to 100 kHz in decade steps
Accuracy: ±1 count ± timebase error*
Display: MHz
Burst Mode: Minimum burst equals gate time +40 ms
**See Timebase Characteristics chart*

Channel A Input Characteristics

Bandwidth: 10 Hz to 125 MHz, ac-coupled
Sensitivity: 10 mV rms, 10 Hz to 50 MHz; 15 mV rms, 50 MHz to 100 MHz; 25 mV rms, 100 MHz to 125 MHz
Impedance: 1 MΩ, <60 pF
Filter: 100 kHz, low pass
Attenuator: X1 to X100; X1 or X10 fixed, plus X1 to X10 continuously variable
Maximum Input: 250V rms from 10 Hz to 5 kHz decreasing linearly from 250V rms at 5 kHz to 5V rms at 2 MHz; 5V rms from 2 MHz to 125 MHz

Channel B Input Characteristics

Bandwidth: 100 MHz to 1300 MHz
Sensitivity: 5 mV rms, 100 MHz to 600 MHz; 10 mV rms, 600 MHz to 1000 MHz; 40 mV rms, 1000 MHz to 1300 MHz
Impedance: 50Ω
VSWR: 2.5:1, maximum
Maximum Input: 5V rms



(NSN 6625-01-176-1269) 7250A

7250A Specifications

Frequency Measurements (CH A)

Range: 5 Hz to 80 MHz, ac coupled
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
**See Timebase Characteristics chart*

Period Measurements (CH A)

Range: 100 ns to 99,999.99 seconds
Frequency Range: 5 Hz to 1 MHz
Resolution: 10 ms to 100 ns in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal

Period-Average Measurements (CH A)

Range: 1 ps to 999,999.9 µs
Frequency Range: 5 Hz to 1 MHz, sinewave
Resolution: 100 ns to 1 ps in decade steps
Accuracy: ±100 ns ÷ N* ± timebase error ± trigger error ÷ N*
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Time-Interval Measurements (CH A/B)

Range: 100 ns to 99,999.99 sec
Frequency Range: 5 Hz to 1 MHz
Resolution: 100 ns to 10 ms in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec with decimal

Totalize

Range: 5 Hz to 80 MHz for channel A
Count Capacity: 9,999,999
Display: Digits only, no decimal or annunciator

Ratio Measurements

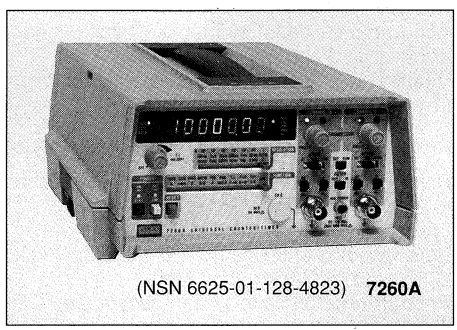
Range: 5 Hz to 80 MHz for channel A, 5 Hz to 1 MHz for channel B
Resolution: ± frequency of B ÷ (N* x frequency of A)
Accuracy: ±Resolution ±(frequency of B x trigger error of B ÷ N*)
Display: Digits with decimal, no annunciator

Counts Per Minute (cpm x 200,* CH A)

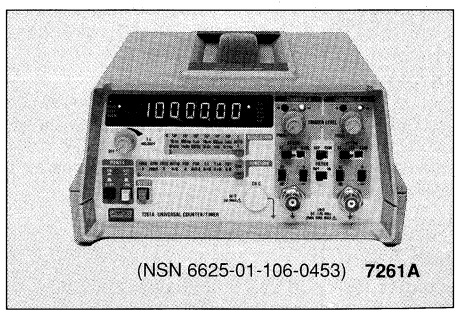
Range: 5 Hz to 80 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ± 1 count ± timebase error
Display: Digits only, no decimal or annunciator
**Reads RPM direct of 100-tooth wheel/sensor*

Channel A & B Input Characteristics

Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms 5 Hz to 50 MHz; 15 mV rms, 50 MHz to 80 MHz
Impedance: 1 MΩ, 50 pF, nominal
Coupling: AC only
Attenuator: X1, X100, continuously variable
Filter: Low pass, 100 kHz 3 dB point, nominal
Trigger Level: +150 mV, 0V, or -150 mV, 0V or -150 mV, switch-selectable
Maximum Input: 100V rms 5 Hz to 45 Hz; 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz to 80 MHz



(NSN 6625-01-128-4823) 7260A



(NSN 6625-01-106-0453) 7261A

7260A & 7261A Specifications

Technical Specifications

Frequency Measurements (Channel A)

Range: 0 Hz to 125 MHz
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

7200 Series

Frequency Measurements, Channel C Option (-310 or -331)

Range: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

Ratio Measurements (A/B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for channel B
Resolution: ± frequency of B ÷ N* x frequency of A
Accuracy: Resolution ± frequency of B x trigger error of B ÷ N*
Display: Decimal, no annunciator

Period Measurements (Channel A)

Range: 100 ns to 999,999.99 seconds for 7260A, or 10 ns to 99,999.999 seconds for 7261A
Frequency Range: 0 Hz to 2 MHz, sinewave
Pulse Width: ≥500 ns from 0 Hz to 100 kHz; ≥250 ns from 100 kHz to 2 MHz
Resolution: 10 ms to 100 ns in decade steps for 7260A, or 1 ms to 10 ns in decade steps for 7261A
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal for 7260A, µs, ms, or sec with decimal for 7261A

Period-Averaged Measurements (CH A)

Range: 1 ps to 9,999,999.9 µs for 7260A; 0.1 ps to 999,999.99 µs for 7261A
Frequency Range: 0 Hz to 2 MHz, sinewave
Pulse Width: ≥500 ns from 0 Hz to 100 kHz; ≥250 ns from 100 kHz to 2 MHz
Resolution: 100 ns to 1 ps in decade steps for 7260A; 10 ns to 0.1 ps in decade steps for 7261A
Accuracy: 100 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7260A, or 10 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7261A
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles averaged in ratio mode.*

Time-Interval Measurements (CH A/CH B)

Range: 100 ns to 999,999.99 sec, for 7260A, or 10 ns to 99,999.999 sec 7261A
Frequency Range: 0 Hz to 5 MHz, sinewave
Pulse Width: 250 ns, for 7260A, 210 ns for 7261A
Resolution: 100 ns to 10 ms in decade steps for 7260A, 10 ns to 1 ms in decade steps for 7261A
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec 7260A; µs, ms, sec 7261A
Time Interval Holdoff: 20 µs to 20 ms, continuously variable

Time-Interval-Averaged Measurements (CH A/CH B)

Range: 1 ns to 9,999,999.9 +s for 7260A, or 0.1 ns to 999,999.99 µs for 7261A
Frequency Range: 0 Hz to 5 MHz, sinewave
Pulse Width: 250 ns for 7260A, 210 ns for 7261A
Resolution: 100 ns ÷ √N* for 7260A, 10 ns ÷ √N* for 7261
Accuracy: 100 ns ÷ √N* ±10 ns ± timebase error ± trigger error ÷ √N* for 7260A; 10 ns ÷ √N* ± timebase error ± trigger error ÷ √N* for 7261A
Dead Time: 4 µs
Display: µs or ms with decimal
**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Totalize (CH A Gated by CH B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for channel B
Count Capacity: 99,999,999
Display: Total count, no decimal or annunciator
Time Interval Holdoff: Range, 20 µs-20 ms, continuously variable

Counts Per Minute (cpm x100, CH A)

Range: 0 Hz to 125 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ±1 count ± timebase error
Display: No decimal or annunciator

Channel A & B Input Characteristics

Bandwidth: 0-125 MHz, dc coupled; 5 Hz-125 MHz, ac coupled
Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms, 0 to 50 MHz; 15 mV rms, 50 to 100 MHz; 35 mV rms, 100-125 MHz
Minimum Pulse: 50 ns at 50 mV pk (7260A); 10 ns at 50 mV pk (7261A)
Impedance: 1 MΩ, 50 pF, nominal
Coupling: AC or dc
Attenuator: X1, X10, X100, switchable
Slope: < or —, switchable
Filter: Low pass, 100 kHz 3 dB point, nominal
Trigger Level Range: +1.5V to -1.5V
Linear Operating Range: +2.5V to -2.5V
Maximum Input: 100V rms 0 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz, 5V rms 1 MHz to 125 MHz

Channel C Input Characteristics Option (-310 or -331)

Bandwidth: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)
Sensitivity: 10 mV rms (Option -310); 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms from 1000 MHz to 1300 MHz (Option -331)
Impedance: 50Ω, 2.5: 1 VSWR, maximum
Maximum Input: 5V rms, fused

Triggering

Trigger Level Output: ±1.5V level indicates dc trigger level set on either Channel A or B, switch-selectable
Trigger Status Indicators: Two per channel provide positive indication that the input signal is triggering the input amplifier and relative indication as to where on the signal the input amplifier is being triggered
Cont/Trig Mode: Rear panel switch activates external trigger mode for initiating a measurement

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F
Operating Time (Typical): 7220A, 5.5 hours; 7250A, 3.5 hours; 7260A, 2.8 hours; 7261A, 2 hours
Charge Time: 16 hours at room temperature
Charge Protection: Thermistor-actuated shut down of charging circuit if battery temperature exceeds 65°C
Discharge Protection: Automatic low-voltage shutdown to prevent over discharge

Timebase Phase Modulation Option (-190) 7261A only

Description: Option insures valid time interval averaging of clock-synchronous signals by phase modulating internal timebase

520 MHz Channel C Option (-310) (7260A, 7261A)

Range: 50 MHz to 520 MHz
Sensitivity: 10 mV rms
Input Impedance: 50Ω
VSWR: 2.5:1, maximum

1300 MHz Channel C Option (-331) (7260A, 7261A)

Range: 100 MHz to 1300 MHz
Triggered Mode: Handles bursts as short as 3.6 ms
Sensitivity: 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms above 1000 MHz
Input Impedance: 50Ω
VSWR: 2.5:1, maximum
Maximum Input: 5V rms, fuse protected

Timebase Characteristics

Characteristics	Option			
	Standard	-112 TCXO	-131 Oven	-132 Oven
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const Temp)	$\pm5x10^{-7}$ /mo	$\pm3x10^{-7}$ /mo $\pm1x10^{-6}$ /yr	$\pm1x10^{-7}$ /mo*	$\pm5x10^{-8}$ /mo* $\pm3x10^{-9}$ /day*
Temperature Accuracy (0°C to 40°C)	$<5x10^{-6}$ **	$\pm2x10^{-6}$	$\pm1x10^{-7}$	$\pm3x10^{-8}$
Line Variation (±10% change)	$\pm1x10^{-7}$	$\pm2x10^{-8}$	$\pm2x10^{-8}$	$\pm4x10^{-9}$
Battery Operation	$\pm1x10^{-7}$	$\pm2x10^{-8}$	$\pm5x10^{-8}$	$\pm1x10^{-8}$
Warm-up*** 10 Minutes	—	—	$\pm5x10^{-7}$	$\pm5x10^{-7}$
20 Minutes	—	—	$\pm3x10^{-8}$	$\pm3x10^{-8}$

**After five days of continuous operation*
***Peak-to-peak variation over temperature range*
****Compared to frequency 24 hours after turn on*
(1) Timebase error is the sum of all errors specified for the particular timebase (see timebase specifications)
(2) Trigger error is the measurement error caused by noise on the input signal triggering the input amplifer too early or too late, calculated as follows:

$$\text{Microseconds of trigger error} = \frac{2 \times \text{pk noise voltage (V)}}{\text{signal slope at trigger point (V/µs)}}$$

or Trigger error +±0.3% of one period divided by number of periods averaged for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude, whichever is greater.

Resolution Multiplier Option (-351) (7220A only)

Description: Frequency-locked loop circuit designed to increase low frequency resolution 1000 times
Range: 10 Hz to 10 kHz
Lock Time: 1.5 seconds
Resolution: 0.0001 Hz to 0.1 Hz in decade steps
Accuracy: ±2 counts ± timebase accuracy*
**See timebase characteristics for timebase accuracy*

Data Output Option (-521)

Type: Serial BCD output of all digits and measurement units
Levels: TTL, "1" state low

Personality Card Option (-522K)

For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)

Description: Interfaces to IEEE-488 via the Fluke 1120A IEEE-488 Translator. (Note: 1120A must be purchased separately.) Provides full measurement output capability as well as remote selection of all functions and ranges.
Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

General Specifications

External Timebase Input

Frequency: 10 MHz, ac coupled
Sensitivity: 300 mV rms
Impedance: 1 kΩ, 30 pF, nominal
Maximum Input: 3V rms

Display: LED with leading zero suppression, decimal, and annunciators. 9-digits (7220A), 8-digits (7260A, 7261A), 7-digits (7250A)
Cycle Rate: Fixed 250 ms between readings
Reset: Reset button clears display, lights all display segments and, on release, activates a new measurement
Self Check: Counts and displays 10 MHz clock
Temperature: 0°C to 40°C, operating; -40°C to +70°C, non-operating
EMI: Internal metal RFI shield meets most requirements of MIL-STD-461, Notice 3
Safety: Designed to meet requirements of UL 1244 and IEC 348
Power: 100V, 120V, 220V or 240V ac ±10%, 47 to 63 Hz, 32 VA max
Size: 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 3 kg (6.5 lb), 7250A, 7260A, 7261A; 3.2 kg (7 lb), 7220A

Included with Instrument: Instruction manual, power cord, serialized and dated calibration certificate

Ordering Information

Models

7220A Communications Counter
7250A Universal Counter/Timer
7260A Universal Counter/Timer
7261A Universal Counter/Timer

Options

All options may be ordered with all models, except as indicated.
-010* Rechargeable Battery Pack
-111* 1 ppm TCXO (7220A)
-112* 2 ppm TCXO (7250A, 7260A, 7261A)
-131* Low Power Oven
-132* Superior Low Power Oven
-190** Timebase Phase Modulation (7261A)
-310* 520 MHz Channel C (7260A, 7261A)
-331*** 1300 MHz Channel (7260A, 7261A)
-351* Resolution Multiplier (7220A)
-521* Interface w/PTI Cable
-522K Personality Card for 1120A
-529[1] IEEE-488 Interface

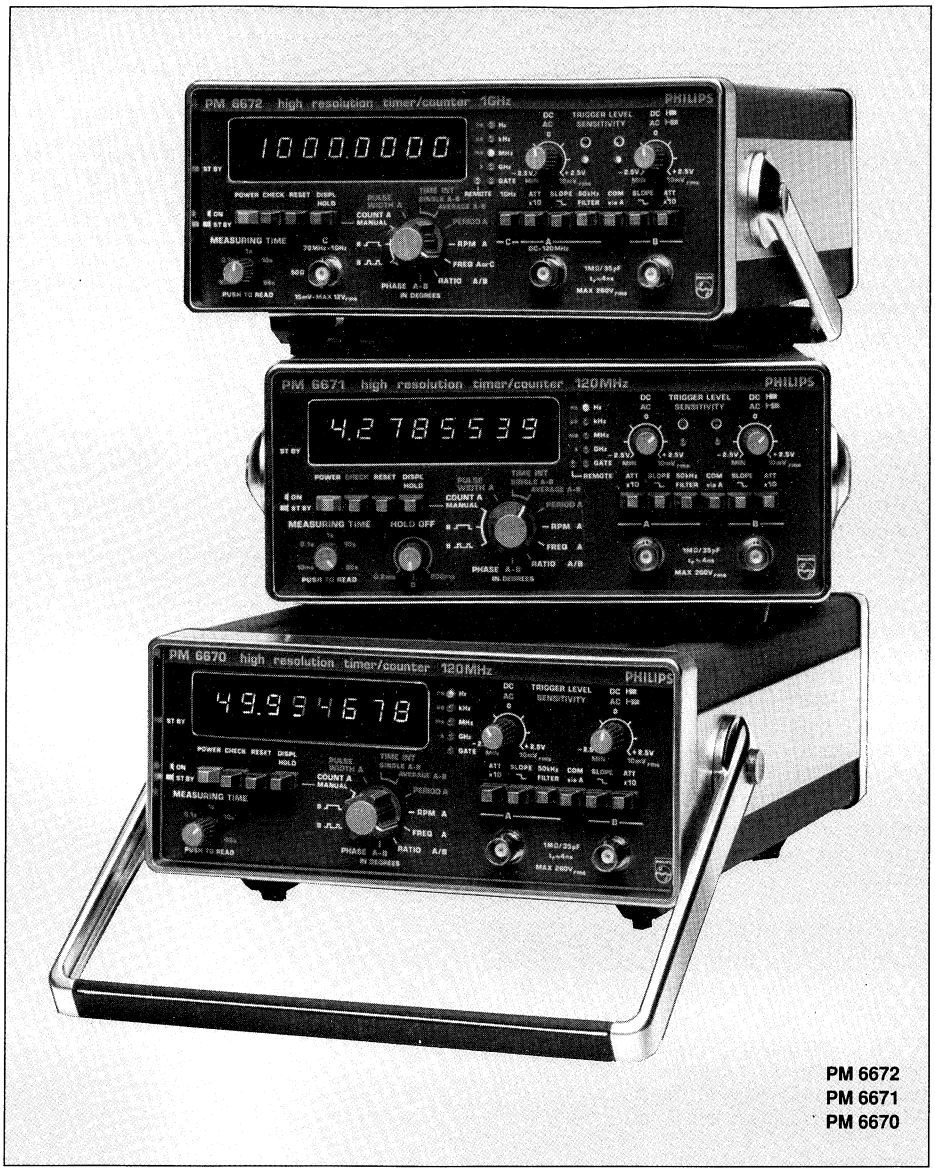
**Factory or Service Center installation only.*
***Factory installation only.*
****Not compatible with Option -010. Also factory option only.*
[1] The -529 Option can be ordered and installed at time of manufacture only. Includes parts needed to interface the 7260A or 7261A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. Includes -521, -522K, and Y7203 2 ft ribbon cable. For existing instruments which do not have the -529 Option installed, an IEEE interface can be added by ordering -521 and -522K Options (1120A also required).

Accessories (Also see Section 20)

1120A IEEE-488 Translator
A53 Whip Antenna
Y7201 Attenuator/Filter
Y9111 Coaxial Cable, 50Ω, BNC to BNC, 3 ft (0.93m)
Y9112 Coaxial Cable, 50Ω, BNC to BNC, 6 ft (1.85m)
Y9103 50Ω BNC Feed-thru Termination
Y2014 5¼" Rack Panel PTI, Single
Y2015 5¼" Rack Panel PTI, Double
Y2020 DIN Panel Mount PTI
Y7203 PTI Ribbon Cable, 2 ft
Y7204 PTI Ribbon Cable, 5 ft
Y2023 PTI Accessory Case

PM 6670, PM 6671 & PM 6672

GPIB
IEEE-488



PM 6672
PM 6671
PM 6670

PM 6670, PM 6671 & PM 6672 Reciprocal Timer/Counters

- High resolution reciprocal frequency measurements (120 MHz - 1 GHz)
- Superior time resolutions to 10 ps (using time interval averaging
- Advanced, accurate trigger facilities
- Multiple measuring modes including Burst, Frequency Average, Pulse width, Phase, RPM and Ratio
- High stability Crystal oscillators, up to 5 x 10^{-10}/24h
- Excellent 10 mV sensitivity
- GPIB/IEEE-488 option

These microcomputer-based timer/counters satisfy a wide range of frequency and time measuremnt requirements. Their general purpose versatility, wide frequency range, high accuracy crystal oscillators and powerful measuring features makes them ideal for research and development applications.

Lightweight, compact construction results from the dramatically reduced number of components – down to only a few state-of-the-art LSI circuits, including a custom designed counter-on-a-chip and a one-chip microcomputer. Philips advanced R & D capability allows size and cost reduction while still providing the ultimate in reliability and performance.

A choice of bus interfaces, including the GPIB/IEEE-488* bus puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of the instruments to field service applications.

Choice of Time Base Oscillator

The time base crystal oscilator determines the accuracy limit of the counters.

Note that even the most stable version (5 x 10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications – without long warm-up periods after changing location.

By means of external reference input, the user's own frequency standard can also be used, when available.

High Resolution Computing Frequency Counting

By making a synchronized multiple-period measurement and computing the reciprocal value these timer/counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, period measurements or phase-locked frequency multipliers, normally required to obtain a high resolution.

High Time Resolution

For time interval measurements, these instruments also feature very high measuring resolution. By using the time interval averaging technique, these timer/counters greatly improve both the measuring accuracy and the resolution.

Compared to single time interval measurements, the basic 100 ns resolution is improved by a factor of $\sqrt{N}$, where N is the number of time intervals being averaged.

**The terms GPIB and IEEE-488 may be used interchangably throughout this catalog.*

With the PM 6670/71/72, N can be more than 10^8. The resolution becomes:

$$\frac{100\ ns}{\sqrt{108}} = 10\ ps$$

High Trigger Accuracy

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available.

These timer/counters feature special input signal conditioning configurations, which are optimized for both frequency and time interval measurements, e.g. either adjustable trigger levels for time interval measurements or adjustable sensitivity and noise immunity for frequency measurements.

Time Measurements

Meaningful use of the averaging technique is made thruoghout the high-speed synchronizers and equalized input channels. Amplifiers and schmitt-trigger circuits for both start and stop channels are all on the one IC-chip, thereby avoiding differences in delay and rise times. This reduces systematic trigger errors which cannot be elimnated by averaging.

Systematic trigger errors are further reduced by the low hysteresis via the use of high sensitivity input amplifiers, as shown in the counter's introduction section.

The PM 6671 and PM 6672 feature trigger level outputs on the front panel, allowing accurate measurements to be made of the set trigger level with a DVM. The trigger level can also be positioned accurately with respect to the waveform using an oscilloscope.

Frequency Measurements

For frequency measurements, the trigger control can be selected to act as a wide-band, continuously variable input attenuator (x1...x100) to allow optimum matching of trigger sensitivity and noise immunity.

Noise Rejection Filter

To obtain full benefit from the high resolution reciprocal design, noise and interference can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects high frequency noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The 1 GHz model PM 6672 has a special RF input with front-end circuits that feature advanced RF techniques, including PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection; 12V rms
- High AM tolerance: up to 98%
- Wide dynamic range: .15 mV rms...12V rms

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example, all the counters are encased in sturdy metal cabinets, which provide excellent RFI shielding. Reduction of RFI radiation far below the most severe requirements, including MIL STD 461 and VDE 0871 (B), contributes to the superior accuracy of these models.

Variable measuring Time

A valuable microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

Phase and RPM

Another micrcomputer benefit in these timer/counters is the possibility of new measuring functions – such as phase and RPM (revolutions/minute) – which are not normally found in counters.

A simultaneous measurement of period duration and the phase delay between two signals allow the microcomputer to calculate and display phase delays directly in degrees.

Trigger Hold-Off and Arming

The PM 6671 and PM 6672 give full control over the start conditions of a measurement. With an external gate signal, one can prevent the timer/counter from triggering on the first input signal.

Another useful feature, found on the PM 6671 is trigger hold-off, which avoids false stop triggering on spurious or unwanted signals. A typical example is the pulses from relay contact bounce (see fig 1).

Trigger Indicators

Tri-state trigger indicator LEDs on the PM 6671 and PM 6672 facilitate quick setting of the trigger level. LEDs for channel A and B blink to indicate that these inputs are triggered. Lights on/off indicate that the trigger level is too low/high. This feature is of great help, particularly when making time interval measurements, where both channels have to be triggered correctly.

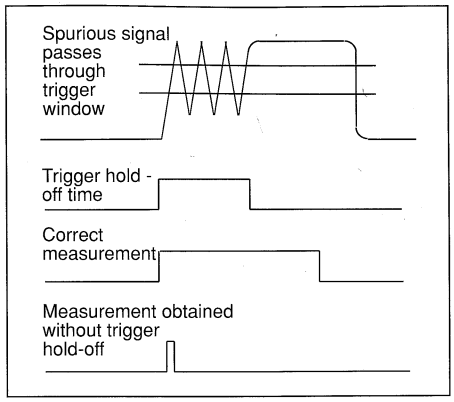


Fig. 1. The use of the PM 6671 variable trigger hold-off enables the influence of spurious signals such as ringing or relay bounce to be ignored and correct measurements obtained.

Specifications

Measuring modes

Frequency

Range: 0.1 Hz... 120 MHz (PM 66700/6671); 0.1 Hz... 1 GHz (PM 6672)
Mode: Input signal synchronized, high resolution computing measuring method (reciprocal).
Signal Mode: CW, SINGLE BURST, MULTIPLE BURST, FREQUENCY AVERAGE
LSD (Least Significant Digit) Displayed: 10^{-7} Hz... 10^{3} Hz (PM 6670, PM 6671). 10^{-7} Hz... 10^{4} Hz (PM 6672), depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.
Resolution: LSD
Inaccuracy (rel.error):

$$\pm\frac{\text{Resolution}}{\text{FREQ}} \pm \frac{\text{trigger error}}{\text{measuring time}} \pm \text{rel. trigger error}$$

Period Average

Range: 100 ns... 100s
LSD Displayed: 10^{-15}... 10^{-6}s, depending on measuring time and period duration. At least 7 digits displayed per second of measuring time.

10

PM 6670, PM 6671 & PM 6672

Resolution: LSD
Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{PERIOD}} \pm \frac{\text{trigger° level}}{\text{measuring time}} \pm \text{rel. timebase error}$$

Time interval A to B; Single

Range: 100 ns...10^8s
LSD° Displayed: 10^{-7}s...10^0s
Resolution: LSD°
Inaccuracy (rel.error):

$$\pm \frac{\text{resolution} \pm \text{trigger° error}}{\text{TIME INT}} \pm \text{rel. timebase error}$$

Pulse Width A

Pulse width measurements are similar to single time interval measurements. Both start and stop triggering take place in channel A, with common trigger level setting and automatic trailing edge trigger slope inversion with respect to selected leading edge trigger slope.
All other specifications are identical to single time interval. High resolution, pulse width measurements on narrow pulses can be made in the time interval average mode with manual selection of common source and stop slope polarity.

Time Interval A to B Average

Range: 0 ns...100s
LSD° Displayed: 10^{-15}s...10^{-6}s, depending on measuring time and time interval.
Resolution:

$$\frac{10^{-7}\text{s}}{\sqrt{N}}$$ or 1 LSD, whichever is greater

Inaccuracy (rel. error):

$$\pm \frac{4\text{ ns} \pm \text{resolution}}{\text{TIME INT}} \pm \frac{\text{trigger° error}}{\sqrt{N} \times \text{TIME INT}} \pm \text{rel. time base error}$$

Number of Intervals Averaged (N):
Measuring time x interval repetition rate.
Minimum Dead Time from Stop to Start:
300 ns

NOTE: *Input signal must be repetititive and asynchronous with respect to the time base.*

Count A

Totalize Range: 1...10^{17}, with indication of M-pulses and G-pulses beyond the 10^8 display range.
Pulse Pair Resolution: 80 ns
Mode:
Manual: Start-stop by DISPL. HOLD push button. Sequential start-stop periods are accumulated or individually totalized after reset.
External: Totalizing interval controlled via input B, selectable: count A gated during pulse duration on B or count A gated between start and stop pulse on B.
Inaccuracy: Pulse repetition rate A x trigger error B.

Models	Functions				
	Basic functions	**Extra facilities:**	**Options:**	**Trigger Hold-off**	**1 GHz input C**
	Frequency 120 MHz, Period, Pulse width, Time interval; single + average, Count, Phase, RPM, Ratio, Choice of 5 crystal oscillators, Sturdy metal cabinet with RFI shielding	LED trigger indicators, Trigger level outputs, Burst frequency average, Arming, Ext. reset/start, Gate open monitor, Reference frequency input/output, Ext. DC supply 12...28V.	IEC-IEEE 488 Bus talker/listener interface, BCD output, Analog recorder output, Internal battery supply, Ext.reference frequency multiplier		
PM 6670	Included				
PM 6671	Included	Included	Optional	Included	
PM6672	Included	Included	Optional		Included

Phase A-B

Phase is the result of a simultaneous time interval average and period average measurement. The maximum phase range is therefore limited, due to the 300 ns dead time between stop and start of the next time interval, and consequently frequency dependent. For phase measurements between 180° and 360° on high frequency signals, measure the complementary phase 0°...180° by changing the input leads (phase B to A).
Phase Range: 0.1° ...360° x [1-(300 ns x FREQ)]
Example: 0.1°...359.995° at 50 Hz
0.1...357.3° at 25 kHz
0.1°...180° at 1.666 MHz
Frequency Range: 0.03 Hz...1.6 MHz
LS Displayed: 10^{-6} P...10^{-2} degrees, depending on measuring time and phase difference.
Resolution:

$$\frac{10^{-7}\text{s} \times \text{FREQ} \times 360°}{\sqrt{N}}$$

Inaccuracy (rel. error):

$$\pm \frac{4\text{ ns} \times 360° \times \text{FREQ}}{\text{PHASE}} \pm \frac{\text{resolution}}{\text{PHASE}}$$

$$\pm \frac{\text{trigger° error} \times \text{FREQ} \times 360°}{\sqrt{N} \times \text{PHASE}}$$

Number of Input Cycles Averaged (N):
Measuring time x FREQ A
Minimum input signal: 100 mVrms
Phase Jitter Tolerance: The tolerated phase jitter peak-value ≤ phase difference, i.e. phase jitter around 0° should not cause consecutive measurement results of slightly above 0° and slightly below 360° since the total measurement result is the statistical average of all individual results.

Ratio

Range: $\frac{\text{FREQ A}}{\text{FREQ B}} = \frac{0...10\text{ MHz}}{0...10\text{ MHz}}$ (all models)

LSD Displayed: 10^{-7}...10^0

Resolution: LSD
Inaccuracy (rel error):

$$\pm \frac{\text{resolution}}{\text{RATIO}} \pm \text{rel. trigger error B}$$

NOTE: Frequency ratiio measurements

$$\frac{\text{FREQ A (or C)}^*}{\text{FREQ D}} = \frac{0.1\text{ Hz... 120 MHz (or 1 GHz)}^*}{50\text{ kHz...10 MHz}}$$

can also be made in the frequency mode, by making use of the internal reference input D. However, this arrangement does not give correct decimal points.

RPM

The RPM (revolutions per minute) mode is similar to the frequency mode. The measured frequency is multiplied x60 before being displayed.
Range: 0.6 RPM...10^8 RPM (with one pulse per revolution).
LSD Displayed: 10^{-7} RPM...10^0 RPM, depending on measuring time and RPM.
Resolution: LSD
Accuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RPM}} \pm \frac{\text{trigger error}}{\text{MEASURING TIME}}$$

± rel. time base error

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms...96s, with clear setpoints at 10 ms, 100 ms, 1s, 10s and 96s. Selected measuring time is displayed, without any delay, when depressing the measuring time control.

Hold-Off

(PM 6671 only)
With trigger hold-off activated, the counter ignores retriggering (channel A) or stop triggering

**PM 6672 only*

(channel B) during the set hold-off time. The hold-off time can be digitally measured by pressing CHECK. Applicable in all time modes.

Range: 200 µs...200 ms, in period, time interval and pulse width mode, the set hold-off time is visible with CHECK depressed.

On/Off indication: LED indicates when hold-off is activated.

Monitor: The selected hold-off duration can be made visible via the gate monitor output.

On/Stand By

In "ST BY" position, power is available to maintain an ovenized crystal oscillator heated and to recharge the optional battery pack.

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected. By using this mode, the COUNT function provides a stopwatch facility.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.
In the COUNT mode, the "DISP HOLD" control is used to start and stop manual totaalizing.

Reset

Manual via pushbutton or electrical via input E.

Input and Output Specifications

Inputs A and B

Frequency Range:
DC coupled: 0...120 MHz;
AC coupled: 50 Hz... 120 MHz
Rise Time: Approx. 4 ns
Sensitivity:
DC coupled: 10 mV rms sinewave
or 30 mV p-p (0...75 MHz),
or 20 mV rms sinewav,
or 60 mV p-p (75...120 MHz)
AC coupled:
0...75 MHz 10 mV rms...100 mV rms
75...120 MHz 20 mV rms...100 mV rms
Attenuation: x1/x 10 fixed.
For frequency related measurements, the fixed attenuator can be used in combination with the continuously variable attenuator x1...x10 (AC coupled position).
Noise Immunity/Hysteresis Band:
DC coupled: approx. 20 mV p-p/200 mV p-p
AC coupled: approx. 20 mV p-p...2 V p-p
Dynamic Input Voltage Range:
DC coupled: 30 mV p-p...5V p-p/
300 mV p-p...50V p-p
AC coupled: 10 mV rms...2V rms/
100 mV rms...20V rms
Trigger Level:
DC coupled: -2.5V...+2.5V/-25V...+25V
AC coupled: fixed 0V; level control acts as continuously variable attenuator, which is more suitable for frequency related measurements.
Trigger Level Outputs: (Not available on PM 6670). Set trigger voltage -2.5V...+2.5V, available on 1 mm jacks at the front for monitoring of set trigger level.
Trigger Indicators: (Not available on PM 6670). Tri-state LED trigger lights to indicate trigger status:
On: trigger level is too low.
Blinking: triggering occurs, input signal crosses hysteresis band.
Off: trigger level is too high.
Coupling: DC/AC
Impedance: Approx. 1 MΩ//35 pF, independent of sep/com switch position.
Channel Input: Separate A and B or common A
Noise Filter: Switchable 50 kHz Low pass filter in channel A. Noise supression approx. 40 dB at 1 MHz
Maximum Voltage Without Damage:
DC: 300V
AC: 260V rms at ≤440 Hz declining to 12V rms at ≥1 MHz (in ATT x 1 position), 260V rms (in ATT x 10 position).

Input C

(PM 6672 only)
Frequency Range: 70 MHz...1 GHz
Operating Input Voltage Range:
15 mV rms...12V rms (70 MHz...800 MHz);
25 mV rms...12V rms (800 MHz...1 GHz).
Impedance: 50Ω nominal; VSWR <2
Coupling: AC
AM tolerance: 98%; minimum signal must exceed minimum operating input voltage.
Maximum Voltage Without Damage:
12V rms; overload protection with PIN diodes.

Ext. Reference and Ratio Input (Ch. D)

(Not available on PM 6670)
Frequency Range: 50 kHz...10 MHz
Sensitivity: 500 mV rms
Impedance: Approx. 2 kΩ
Coupling: AC
Max. Voltage Without Damage: 25V rms

NOTE: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Internal Standard Output (Ch. D)

(Not available on PM 6670)
Crystal Frequency: 10 MHz
Output Level: LS-TTL compatible
Output Impedance: Approx 400Ω
Coupling: DC
Overload protection: Short circuit proof

Ext. Arming/FREQ-Avg/Reset (Ch. E)

(Not available on PM 6670)
A 3-position rear panel switch gives choice of external control over:
Arming: In this position, the counter is prevented from starting a new measurement when input E is high. A high-to-low going pulse arms the counter to start a new measurement.

NOTE: Arming not applicable in COUNT A, manual mode.

Frequency Average: Frequency measurements (max. 100 MHz) and period measurements are interrupted when input E is high. The measurement is continued again when input E is low. Each individual frequency sample must contain at least 20 pulses (FREQ mode) or 2 pulses (PERIOD mode).
The effective measurement time (defining resolution and accuracy) is the sum of external gate times that occurs during the selected measurement time.
Ext. Reset-Start: Electrical reset, equivalent to the front panel RESET push button. (See HOLD and RESET). Counter is reset when input E goes high. A new measurement can be made after input E has returned low.
Input Levels: High: ≥2V; Low: ≤0.5V
Input Impedance: Approx. 2 kΩ
Max. Input Voltage Without Damage: ±25V
Minimum Pulse Duration: Arming and frequency avg.: 500 ns; External reset: 200 µs

Gate Monitor Output (Rear)

(PM 6671 only)
The gate status monitor permits observation on an oscilloscope of the measured time interval and the trigger hold-off time.
Output Level:
Main gate open: approx. 0.4V;
Hold-off active: approx. 1.2V;
Main Gate Closed: approx. 2.5V
Output Impedance: Approx. 1.5 kΩ
Delay: Internal delay between actual triggering and gate monitor output is approx. 150 ns.
Overload Protection: Short circuit proof

Interface Data

(Not available on PM 6670)
GPIB/IEEE-488 interface option PM 9696: Can be supplied fitted (to order), or retrofitted in the field.
Connector: 24-pole: address set by switches
Output Data: Measuring data including function code, overflow and range. Status data, generated at serial poll or after instruction, including full programming status data and function status.
Output Rate: 10...20 readings per second
Input Data: Programming data for all manually controllable functions except input trigger functions.

General Specifications

Time Base
For specifications, see table.

Display

Readout: 8 digits, 7.6 mm high-efficiency LEDs.

PM 6670, PM 6671 & PM 6672

Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns, µs and s.
Display Time: Continuously variable 80 ms...96s plus DISP HOLD.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
ST BY: Stand-by indication with LED when instrument is not switched ON.
REMOTE:** Indicates when control over counter is taken by the installed BUS interface option (IEC 625/GPIB/IEEE-488).
Low-Battery:** Indication by blinking display some 15 min. before recharging is needed.

Power Requirements

In addition to the normal line-voltage supply, the PM 6671 and PM 6672 can also be powered from an optional battery pack or extenal DC voltage.
Line: 115/230V ±15%; 45...440 Hz; <25 VA
Internal Battery Unit:** PM 9693
External DC Source: 11.8V...28V
Line Interference: Below VDE 0871 (B) and MIL STD 461
Safety: According to IEC 348 and CSA 556B

Mechanical Specifications

Dimensions: 210 mm W x 89 mm H x 280 mm L (8.25 in W x 3.8 in H x 11 in L)
Weight: 2.5 kg (5.5 lb)

Environmental Conditions

Temperature:
Rated range of use: -5°C...+50°C
Storage and Transport: -40°C...+70°C
Humidity:
Operating: 10...90% RH, no condensation.
Storage: 5...95% RH.
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) -53.3 kN/m²
Storage: 15000m (50000 ft) -15.2 kN/m²

Definitions

LSD (Least Significant Digit) Displayed

Unit value of least significant digit, displayed.

For FREQUENCY, PERIOD AVERAGE, RPM and PHASE:

$$LSD = \frac{2.5}{\text{measuring time}} \times \frac{\text{FREQ or PERIOD or RPM or } 360°}{10^{-7}\text{Hz}}$$

For RATIO:

$$LSD = \frac{2.5 \times \text{prescaling factor (P)} \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A or C}}$$

(P) + 1 Channel A, all models
(P) + 256 Channel C, PM 6672

***Detail contained in ordering information*

For SINGLE TIME INTERVAL and PULSE WIDTH:

LSD = 100 ns (for times <10s).

$$LSD = \frac{5 \times \text{TIME}}{10^8} \quad \text{(for times >10s)}$$

For TIME INTERVAL AVG:

$$LSD = \frac{2.5 \times 10^{-7}\,\text{s}}{\text{meas. time} \times \text{time int. rep. rate in Hz}}$$

All calculated LSDs shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 8th digit.

Resolution

For Multiple Event Measurements:

FREQUENCY, PERIOD AVERAGE, RPM and RATIO, the resolution is the smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation, the resolution can be 2 LSD units if:

$$\frac{\text{LSD} \times \text{measuring time}}{\text{FREQ or PERIOD or RPM or RATIO}} < 10^{-7}\text{s}$$

but can then be reduced to 1 LSD unit, by doubling the resolution time.

Trigger Error

Trigger error is the absolute measurement error due to noise on the input signal causing a too early or too late triggering.
For any waveform (FREQ, PERIOD, RATIO, RPM and PULSE WIDTH):

$$\frac{\text{peak-to-peak noise voltage}}{\text{signal slope (V/s)} \times \text{measuring time}}$$

For Sinewave (FREQ, PERIOD, RATIO, RPM):

$$\frac{1}{\text{FREQ} \times \pi \times \text{S/N ratio}}$$

Example: For S/N ratio of 100 (40 dB) and 1 second measuring time, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{FREQ}}$$

For Separate Source TIME INTERVAL:

$$\pm \frac{\text{peak noise voltage (input A)}}{\text{signal slope A (V/s)}}$$

For PHASE:

$$\frac{1}{\text{FREQ} \times 2\pi} \times \left(\frac{1}{\text{S/N ratio (input B)}} \pm \frac{1}{\text{S/N ratio (input B)}} \right)$$

NOTE: S/N ratios calculated with peak to peak signal and noise values.

Ordering Information

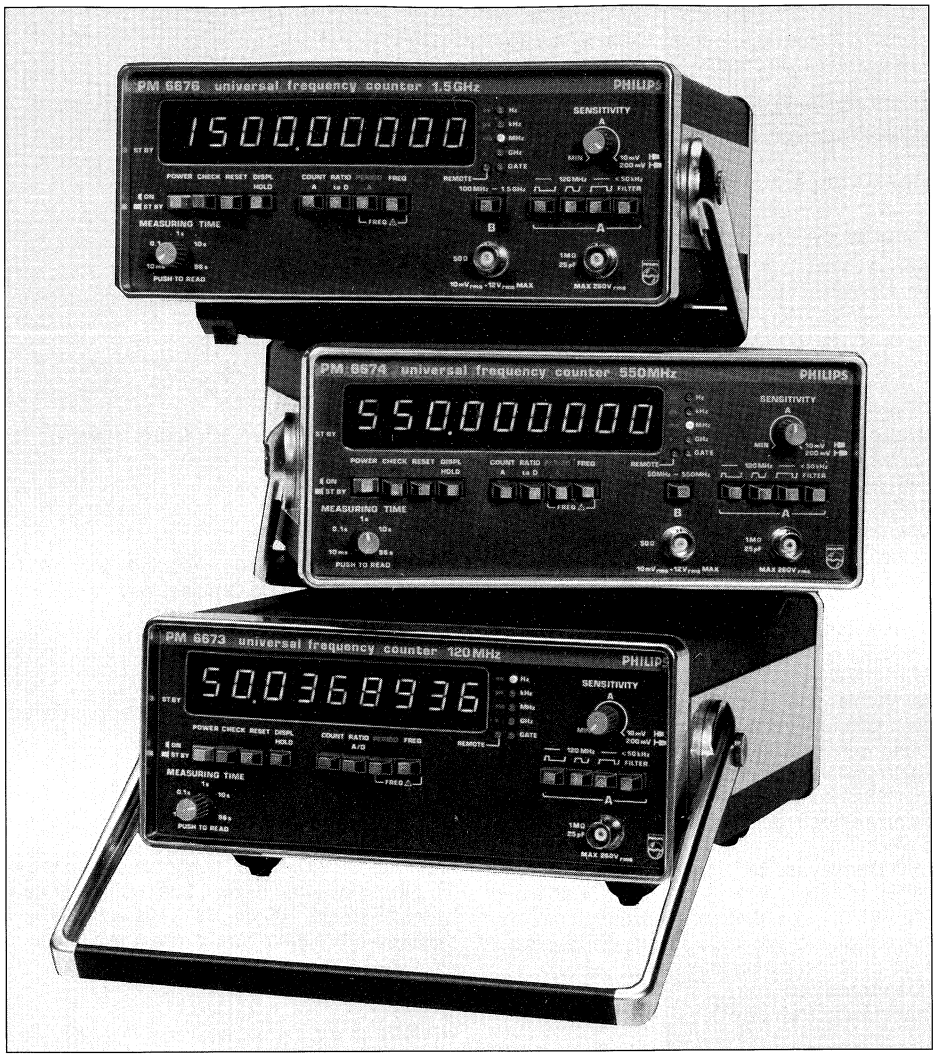
Models

For ordering information, see counter models PM 6673 - PM 6677.

Crystal Oscillator Summary

PM 667./... Version Including Time Base Option	/.1. Standard Version	/.2. Version PM 9678	/.3. Version PM 9679	/.4. Version PM 9690	/.5. Version PM 9691
Stability against	Standard	TCXO	Oven	Oven	Oven
Aging: 24h /month /year	N/A $<5 \times 10^{-7}$ $<5 \times 10^{-6}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	N/A $<1 \times 10^{-7}$ $<5 \times 10^{-7}$	$<1.5 \times 10^{-9}$ $<3 \times 10^{-8}$ $<5 \times 10^{-7}$	$<1.5 \times 10^{-0}$ $<1 \times 10^{-8}$ $<7.5 \times 10^{-8}$
Temperature: 0°C to 50°C Ref. to +23°C	$<1 \times 10^{-5}$	$<1 \times 10^{-6}$	$<1 \times 10^{-6}$	$<3 \times 10^{-9}$	$<5 \times 10^{-9}$
Charge in supply mode: line/int. battery /ext. DC 12V to 28V	$<3 \times 10^{-7}$	$<5 \times 10^{-8}$	$<5 \times 10^{-9}$	$<3 \times 10^{-9}$	$<3 \times 10^{-9}$
Line voltage ±10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$	$<5 \times 10^{-10}$
Warm-up time to reach 10-7 of final value	N/A	N/A	<10 min.	<15 min.	<15 min.

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677



PM 6673-PM 6677 High Resolution Universal Frequency Counters

- High resolution frequency measurements (120 MHz to 2.3 GHz)
- Measuring modes include multiple burst frequency average & ratio
- High stability crystal oscillators up to 5 x 10^{-10}/24 hour
- High 10 mV sensitivity
- Error-free triggering
- Programmable via GPIB/IEEE-488 option
- BCD or analog output

These microprocessor-based universal frequency counters satisfy a wide range of frequency measurement requirements. Their high accuracy concept, wide frequency ranges and new powerful measuring features make these counters ideal for research and development of telecommunication, broadcast, TV, radio control and navigation equipment.

Lightweight, compact construction results from the dramatically reduced number of components – down to only a few state-of-the-art LSI circuits, including a counter-on-a-chip and a one-chip microcomputer. Philips' advanced R & D capability yields reduction in size and cost while still providing the ultimate in reliability and performance.

A choice of interfaces, including the GPIB/IEEE-488* bus, puts this capability at the user's disposal for production and quality assurance testing. In addition, the optional battery unit extends the use of instruments to field service applications.

High Resolution Computing Counting

By making a synchronised multiple-period measurement and computing the reciprocal value, the counters perform high resolution frequency measurements on all low frequency signals. The built-in microcomputer eliminates traditional ±1 input cycle errors and as a result gives at least seven digits resolution per second of measuring time. This avoids the need for long gate times, period measurements or phase-locked frequency multipliers normally required to obtain a high resolution. Above 10 MHz, the conventional counting method is automatically selected, to give improved resolution at the higher frequencies (see fig.1).

Error-Free Triggering

Ultimately, no counter is better than its front-end circuitry. Therefore the PM 6670 series employs the best front-end circuit concept available. The wideband, continuously variable input attenuator allows optimum matching of trigger sensitivity and noise immunity over a wide dynamic range from 20 mV p-p to 10V p-p. See introduction of the counter section.

To obtain full benefit from the high resolution reciprocal design, meaningless digits can be excluded by a switchable built-in noise-rejection filter for low frequency measurements. This filter even rejects high frequency noise or interference that is stronger than the input signal itself.

Automatic Triggering on RF Signals

The UHF counter models PM 6674, 6675, 6676 and 6677 have special inputs up to 550 MHz, 600 MHz, 1.5 GHz and 2.3 GHz respectively. Their front-end circuits feature advanced RF techniques, including automatic PIN-diode attenuators that bring a number of user benefits:

- Automatic triggering
- Excellent overload protection ; 12 V rms
- High AM tolerance: up to 94%
- Wide dynamic range: 10 mV rms...12 V rms

For high speed/high accuracy measurements, the 600 MHz model PM 6675 offers direct gating (non-prescaled) and a high 5 mV rms sensitivity.

RFI Suppression

Effective precautions have been taken to reduce radiation and susceptibility to radio frequency interference (RFI) to minimum levels. For example,all the counters are encased in sturdy metal cabinets, which provide excellent

** The terms GPIB and IEEE-488 may be used interchangably throughout this catalog.*

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

RFI shielding. This reduces RFI radiation to far below the most severe requirements, including VDE 0871 (B). This contributes to the superior accuracy of these models.

Variable Measuring Time

Another microcomputer benefit is the continuously variable measuring time, which is no longer limited to decade steps. It is possible, for example, to select a measuring time of 2.4 seconds if one second does not give sufficient resolution. This avoids the need to switch directly to a time-wasting 10 second measurement period.

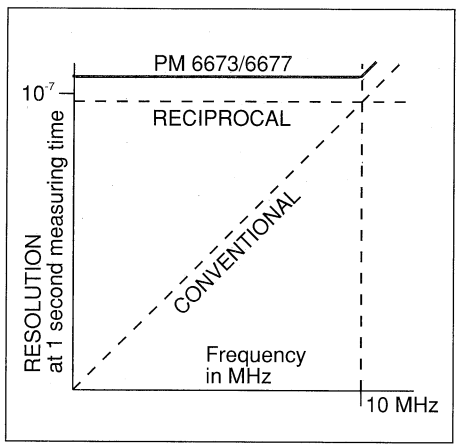


Fig. 1. The PM 6670 series benefits from both RECIPROCAL and CONVENTIONAL measuring principles. Automatic selection of the measuring mode always gives the best possible resolution.

Choice of Time Base Oscillator

The time base crystal oscillator determines the accuracy limit of the counters.

Note that even the most stable version (5×10^{-10}/24h) can be operated from internal batteries. This unique feature is achieved by specially developed oven-stabilized crystal oscillators with extremely low power consumption. Thus laboratory accuracy is now available for field applications – without irritatingly long warm-up times after changing location.

By means of the external reference input, the user's own frequency standard can be used, when available.

Frequency Average

The use of microcomputers provides new opportunities in frequency measurements. The computing measuring principle, with synchronized sample-taking, enables frequency and period measurements to be made during one or a great number of measuring intervals. Start and duration of these intervals are controllable via an external gate input.

Individual samples may be as short as 500 ns or as long as 96 seconds.

Multiple-burst-frequency measurements or sampling frequency-sweep-profiles can be activated by a single control.

Specifications

Measuring Modes

Frequency

Range

Sine: 10 Hz... 120 MHz (PM 6673)
10 Hz... 550 MHz (PM6674)
10 Hz...600 MHz (PM 6675)
10 Hz...1.5 GHz (PM 6676)
10 Hz...2.3 GHz (PM 6677)

Pulse: Minimum frequency down to 0.1 Hz

Mode: RECIPROCAL and CONVENTIONAL. For the highest possible resolution from both LF and HF measurements, the counter employs the RECIPROCAL mode for LF signals. Above 10 MHz it automatically uses the CONVENTIONAL mode.

For special applications, one can select either RECIPROCAL or CONVENTIONAL.

Signal Mode: CW, SINGLE BURST, MULTIPLE BURST FREQUENCY AVERAGE. In the FREQUENCY AVERAGE mode (rear panel selectable), the counter measures the average of a multiple of frequency samples. Samples are taken with external gate control (≥500 ns) and totalized during the selected measuring time (10 ms...96s) to allow multiple burst frequency measurements or to sample frequency sweep profiles.

LSD Displayed: 10^{-8} ... 10^{2} (PM 6673 and PM 6675), 10^{-8} Hz... 10^{3} Hz (PM 6674, PM 6676 and PM 6677), depending on measuring time and input frequency. At least 7 digits displayed per second of measuring time.

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{FREQ}} \pm \text{rel. trigger* error}$$

± time base error

Period Average

Range: 100 ns...100s

LSD Displayed: 10^{-16}...10^{-6s}, depending on measuring time and peak duration. At least 7 digits displayed per second of measuring time.

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{PERIOD}} \pm \text{rel. trigger* error}$$

± time base error

Ratio

Range:

$$\frac{\text{FREQ A}}{\text{FREQ D}} = \frac{\text{10 Hz... 120 MHz}}{\text{1 kHz... 10 MHz}} \quad \text{(PM 6673)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz... 550 MHz}}{\text{1 kHz... 10 MHz}} \quad \text{(PM 6674)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz... 600 MHz}}{\text{1 kHz... 10 MHz}} \quad \text{(PM 6675)}$$

$$\frac{\text{FREQ A or B}}{\text{FREQ D}} = \frac{\text{10 Hz... 1.5 GHz}}{\text{1 kHz... 10 MHz}} \quad \text{(PM 6676)}$$

LSD Displayed:

10^{-8}...10^{-1} (A.D all models and B/D; PM 6675)
10^{-8}...10^{0} (B/D; PM 6674)
10^{-8}...10^{0} (B/D; PM 6676); depending on measuring time and ratio

Resolution: LSD*

Inaccuracy (rel. error):

$$\pm \frac{\text{resolution}}{\text{RATIO}} \pm \text{rel. trigger* error D}$$

± time base error

Count

Totalize Range: 1...10^{17}, with indication of K-pulses, M-pulses, and G-pulses beyond the 10^{9} display range

Frequency Range:

Sine: 10 Hz... 10 MHz
Pulses: 0 Hz... 10 MHz

Sequential start-stop periods are accumulated or individually totalized after reset.

Auxiliary Functions

Measuring Time

The measuring time is "continuously" variable (33 steps/decade): 10 ms...96s, with clear set-points at 10 ms, 100 ms, 1s, 110s and 96s. Selected measuring time is displayed, without any delay, when depressing the measuring time control.

On/Stand By

In "ST BY" position, power is available to maintain an ovensized crystal oscillator heated and to recharge the optional battery pack.

Check

10 MHz internal reference connected to logic circuitry. Self-test of most measuring functions can be selected.

Display Hold

Depressing "DISP HOLD" button sets display time to infinite and freezes the last measurement result. A new measurement can be initiated using reset.

Reset

Manual via push-button or electrical via input E.

** See definitions*

Input and Output Specifications

LF-Input (Channel A)

Frequency Range: 10 Hz ...120 Mhz
Sensitivity:
Sine: 10V rms (20 Hz... 120 MHz), 6 dB down at 10 Hz
Pulse: 30 mV p-p (0 Hz... 120 MHz), minimum pulse duration 4 ns
Attenuation: Continuously variable in two ranges between x 1 ...x 500. Noise immunity band (hysteresis band) can be continuously adjusted over the range: 20mV p-p... 10V p-p nominal.
Noise Filter: Switchable 50 kHz low pass filter. Noise suppression ≥20 dB at 500 kHz
Impedance: 1 MΩ//≤25 pF
Trigger Level: Switchable with waveform selection for optimum triggering on signals of various duty factors.
: for duty factor of <0.25
: for duty factor of 0.25...0.75
: for duty factor of >0.75
Coupling: AC
Maximum Voltage Without Damage:
DC: 300V
AC: 260V rms at ≤440 Hz declining to 12V rms at ≥1 MHz (in 10 mV rms range), 260V rms (in 200 mV rms range)

RF-Input (Channel B)

Frequency Range:
PM 6674: 50 MHz...550 MHz; 6 x prescaled
PM 6675: 50 MHz...600 MHz; direct gating
PM 6676: 100 MHz...1.5 GHz; 16 x prescaled
PM 6677: 100 MHz...2.3 GHz; 16 x prescaled
Operating input voltage range:
PM 6674: 10 mV rms... 12V rms
PM 6675: 5 mV rms...12V rms
PM 6676: 10 mV rms...12V rms; 0.1...1 GHz
30 mV rms...12V rms; 1...1.5 GHz
PM 6677: 20 mV rms... 12V rms; 100...300 MHz
10 mV rms...12V rms; 0.3...2 GHz
25 mV rms... 12V rms; 2...2.3 Ghz
AM Tolerance: 94% at max 100 kHz modulation frequency. Mininmum signal must exceed minimum operating input voltage requirement.
Input Impedance: 50Ω nominal
VSWR: <2.0: 1; 50...1500 MHz
<2.5: 1; 1.5...2 GHz
<3.5: 1; 2...2.3 GHz
Max. voltage without damage: 12V rms; overload protection with pin diodes

Ext. Reference and Ratio Input (Ch. D)

Frequency Range: 1 kHz... 10 MHz
Sensitivity: 500 mVrms
Impedance: Approx. 2 kΩ
Coupling: AC
Max. voltage without damage: 25V rms

Note: As external reference frequency, only 10 MHz will give correct decimal point and unit indication. With the optional frequency multiplier PM 9697 references of 1 and 5 MHz can also be accepted.

Ext. arming/Freq-avg Reset(channel E)

Arming: A high-to-low going pulse arms the counter to start a new measurement. Arming is not applicable in the COUNT mode.
Frequency Average: For frequency or period measurements, the measurement is interrupted when input E is high. The measurement is restarted when input E is low.
Frequency Range: <100 MHz
Mode: Reciprocal
Ext. RESET-START: Counter is reset when input E goes high.
Input levels:
High: ≥2V
Low: ≤0.5V
Input Impedance: Approx. 2 kΩ
Max. input voltage without damage: ±25V
Minimum Pulse Duration:
Arming and frequency avg: 500 ns
External reset: 200 µs

Timebase Oscillator Output

Crystal frequency: 10 MHz
Output Level: Low: <0.4V (Z_l≥10 kΩ)
High: >3.5V (Z_l ≥10 kΩ)
Output Impedance: Approx. 400Ω
Coupling: DC
Overload Protection: Short-circuit proof

GPIB/IEEE-488 Interface Data

GPIB/IEEE Interface Option PM 9696: Can be supplied fitted (to order), or retrofitted in the field.
Connector: 24-pole: address set by switches
Output Data: Measuring data including function code, overflow and range. Status data, generated at serial poll or after instruction, including full programming status data and function status
Output Rate: 10...20 readings per second
Input data: Programming data for all manually controllable functions except input trigger functions.

General Specifications

Display

Readout: 9 digits, 11 mm high-efficiency LEDs. Microprocessor control of display format, decimal point and unit indication: Hz, kHz, MHz, GHz, ns, µs, ms and s.
Display Time: Continuously variable 80 ms...96s plus DISP HOLD.
Gate Lamp: Indicates that main-gate is opened and measurement takes place.
ST BY: Stand-by indication with LED when instrument is not switched ON.
REMOTE: Indicates when control over counter is taken by the installed bus interface option (GPIB/IEEE-488).
Low Battery: Indication by blinking display some 15 min. before recharging is needed.

Power Requirements

These counters can be powered form: line voltage, and optional battery or external battery voltage.
Line: 115/230V ±15%; 45...440 Hz; <25 VA
Internal Battery Unit: PM 9693 - 4.5...8W (depending on version and options installed)
External DC Source: 11.8V...28V <8W
Line Interface: Below VDE 0871 (B)
Safety: According to IEC 348 and CSA 556B

Environmental Conditions

Temperature:
Rated range of Use: -5°C...+50°C
Functional Operation: -10°C...+55°C
Storage and Transport: -40°C...=70°C
Humidity:
Operating: 10...90% RH, no condensation.
Storage: 5...95% RH.
Altitude/Barometric Pressure:
Operating: 5000m (15000 ft) -53.3 kN/m²
Storage: 15000m (5000 ft) -53.3 kN/m²

Definitions

LSD Displayed:

Unit value of Least Significant Digit displayed
For Frequency <10 MHz or period average:

$$LSD = \frac{2.5}{\text{measuring time}} \times \frac{\text{FREQ or PERIOD}}{10^7\ HZ}$$

For Frequency >10 MHz

$$LSD = \frac{2.5 \times \text{prescaling factor}^{(p)}}{\text{measuring time}}$$

For Ratio:

$$LSD = \frac{2.5 \times \text{prescaling factor}^{(p)} \times \text{RATIO}}{\text{measuring time} \times \text{FREQ A or B}}$$

All calculated LSDs shall be rounded to nearest decade (e.g. 5 ns will be 10 ns and 0.4 Hz will be 0.1 Hz) and cannot exceed the 9th digit.
(p) = 1 Channel A, all models
(p) = 6 Channel B, PM 6674
(p) = 1 Channel B, PM 6675
(p) = 16 Channel B, PM 6677

Resolution

Smallest increment between two measuring results, being most often 1 LSD unit. Due to arithmetic truncation the resolution can be 2 LSD units, but can then be reduced to 1 LSD unit by doubling the measuring time.

The Resolution is 2 LSD Units:

$$\text{if: LSD} < \frac{1}{\text{measuring time}} \quad \text{(Freq. >10 MHz)}$$

$$\text{or if } \frac{\text{LSD} \times \text{measuring time}}{\text{FREQ or PERIOD or RATIO}} < 10^{-7}\text{s}$$

(Freq. ≤10 MHz, Period or Ratio).
In all other cases the resolution is 1 LSD unit.

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

Rel. Trigger Error

For any Waveform:

$$\frac{\text{peak-to-peak noise voltage}}{\text{signal slope (V/s) x measuring time}}$$

For sinewave:

$$\frac{1}{\text{FREQ x measuring time x } \pi \text{ x S/N ratio}}$$

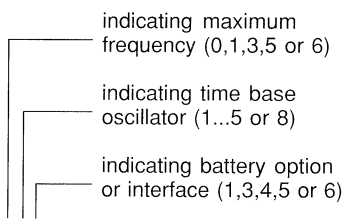
Example: For S/N ration of 100 (40 dB) and second measuring time, the trigger error is:

$$\frac{3 \times 10^{-4}}{\text{FREQ}}$$

Ordering Information

Versions

The PM 6673...77 ordering numbers consists of the basic type number and a 3 digit XYZ suffix, specifying the required configuration.



PM 667./ XYZ

Model

PM 6673 Basic 120 MHz frequency counter, standard oscillator 5 x 10^{-7} /month, incl. operator's manual
PM 6674/311 As PM 6673/011, but with frequency range to 550 MHz
PM 6675/111 As PM 6673/011, but with frequency range to 600 MHz (direct gated)
PM 6676/511 As PM 6673/011, but with frequency range to 1.5 GHz
PM 6677/611 As PM 6673/011, but with frequency range to 2.3 GHz
PM 667./.2. As above, but including time base PM 9678 (TCXO)
PM 667./.3. As above, but including time base PM 9679 (oven)
PM 667./.4. As above, but including time base PM 9690 (oven)
PM 667./.5. As above, but including time base PM 9691 (oven)
PM 667./.8. As above, but including external reference frequency multiplier PM 9697
PM 667./..3 As above, but including battery unit PM 9693
PM 667./..4 As above, but including BCD output and display-offset unit PM 9694
PM 667./..5 As above, but including analog recorder output PM 9695
PM 667./..//6 As above, but including GPIB/ IEEE-488 interface PM 9696B
Example: PM 6677/613 means a PM 6677 frequency counter, including both a 120 MHz and a 2.3 GHz input channel, a standard oscillator and a battery pack.

Options and Accessories

PM 9672 Carrying case
PM 9678B TCXO time base (version /.2.)
PM 9679E Ovenized time base (version/.3.)
PM 9690 Ovenized time base (version/.4.)
PM 9691 Ovenized time base (version/.5.)
PM 9693* Battery unit
PM 9694* BCD output and display-offset unit
PM 9695* Analog recorder output
PM 9696B* GPIB (IEEE-488) interface
PM 9697** External reference frequency multiplier; 1,5 or 10 MHz
PM 8911/091 1.5 GHz; 500Ω probe set; 1:10
PM 8922/501 120 MHz; 1 MΩ probe set; 1:1 and 1:10
PM 8943 650 MHz; 50Ω/ 1 MΩ FET probe set
PM 9581 50Ω feed-through termination, 3W, BNC-BNC
PM 9585 50Ω feed-through termination, 1W, BNC-BNC
All options can be field-installed by the user.

*Only one of the options PM 9693, PM 9694, PM 9695 or PM 9696B can be installed at a time in the counters.
**Only installable together with standard time base.

Battery unit PM 9693

Battery capacity (typical at 20°C): 30 Wh sufficient for >3 hours operation or 20 hours stand-by.
Battery voltage: 12V nominal
Recharging time: 8h to approx 75% or 12h to >90% of full capacity.
Recharging power: From counter <12W
Battery low indication: By blinking display 10 - 15 min before charging is needed.
Temperature:
Operating: 0...+40°C
Storage: -40...+50°C
Weight: 1.4 kg (3.1 lb)

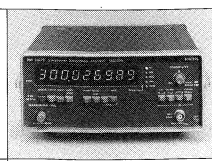
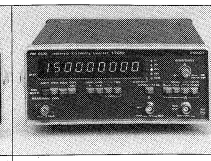
Analog Recorder Output PM 9695

Installation: Inside the counter
Decade conversion: Any 3 consecutive digits can be selected with a 12 position switch.
Normal Mode: Analog output is directly proportional to digital input. 000 produces 0.000V. 999 produces 0.999V
Output:
Zero output: 0V
Full scale deflection: 0.999V
Accuracy: ±2 mV
Nonlinearity: ±0.5 mV
Delay: Output voltage settling time <100 ms after end of measurement
Temperature Coefficient: ± (0.1 mV + 0.03% of reading)/°C
Output impedance: 100Ω ±1%

GPIB/IEEE-488 BUS interface PM 9696B

Installation: Inside the counter.
Programmable Functions: Frequency A, Frequency B, Period A, Ratio A/D or B,D, Count A, display hold, trigger, device clear, measuring time.
Interface function repertoire: SH1, AH1, T5, L4, R1, RL1, DC1, DT1 and E1.
Data output rate: 10...20 readings/s.

PM 6673, PM 6674, PM 6675, PM 6676 & PM 6677

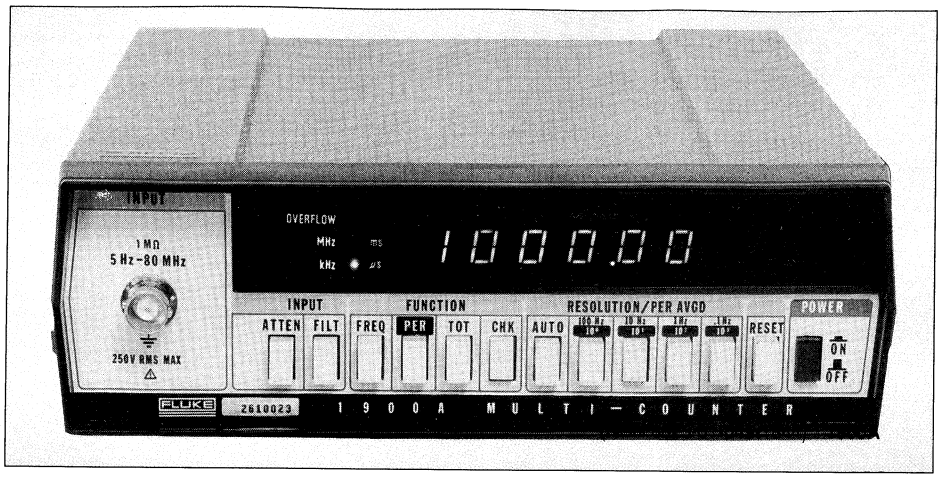
Quick reference performance survey					
	PM 6673	**PM 6674**	**PM 6675**	**PM 6676**	**PM 6677**
Freq. A Freq. B Prescaling factor	120 MHz - -	120 MHz 550 MHz 6	120 MHz 600 MHz 1	120 MHz 1.5 GHz 16	120 MHz 2.3 GHz 16
Sensitivity A Sensitivity B	10 mV -	10 mV 10 mV	10 mV 5 mV	10 mV 10 mV	10 mV 10 mV
Period, Count Ratio A/D Ratio B/D	10 MHz 120/10 MHz -	10 MHz 120/10 MHz 550/10 MHz	10 MHz 120/10 MHz 600/10 MHz	10 MHz 120/10 MHz 1500/10 MHz	10 MHz 120/10 MHz 2300/10 MHz

Choice of crystal oscillators

PM 667./... version including timebase option / Stability performance:	/.1. standard version Standard	/.2. version PM 9678 TCXO	/.3. version PM 9679 Oven	/.4. version PM 9690 Oven	/.5. version PM 9691 Oven
Aging: /24 h /month /year	n.a. <5 x 10^{-7} <5 x 10^{-6}	n.a. <1 x 10^{-7} <5 x 10^{-7}	n.a. <1 x 10^{-7} <5 x 10^{-7}	<1.5 x 10^{-9}* <3 x 10^{-8} <1.5 x 10^{-7}	<5 x 10^{-10}* <1 x 10^{-8} <7.5 x 10^{-8}
Temperature: 0...50°C ref. to +23°C	<1 x 10^{-5}	<1 x 10^{-6}	<1 x 10^{-7}	<3 x 10^{-8}	<5 x 10^{-9}
Line voltage ± 10%	<1 x 10^{-8}	<1 x 10^{-9}	<1 x 10^{-9}	<5 x 10^{-10}	<5 x 10^{-10}
Warm-up time to reach 10^{-7} of final value	n.a.	n.a.	<10 min.	<15 min.	<15 min.

** After 48 hours of continuous operation*

1900A



1900A Multifunction Counter

Frequency, period, period averaging and totalize measurements

6-digit display

1 MHz low-pass filter

Available with full parallel BCD output and rechargeable battery

Fluke's versatile 1900A Multi-Counter provides frequency, period, period averaging, and totalize measurements over a wide range of applications. In frequency mode, the 1900A verifies the accuracy of signal sources such as generators, oscillators and transmitters. Period mode measures the time duration of a single input cycle, which allows high resolution of low frequency measurements. In period average mode, the counter averages cycle time over 10, 100 or 1000 cycles for still finer resolution. Totalize mode is similar to frequency mode except that the signal gate is open and closed deliberately, a feature useful for totalizing the cycles in a single RF burst or counting electromechanical relay contact bounce. A selectable 1 MHz low-pass filter provides input signal conditioning to give accurate low frequency measurements in electrically noisy environments. A selectable 10:1 attenuator is provided.

A rechargeable battery is included in Model 1900A-01, providing up to 4 hours of operation with a 14 hour recharge time.

Specifications

Technical Specifications

Frequency: 5 Hz to 80 MHz. Four manually-selected gate times of 10 ms (100 Hz resolution), 100 ms (10 Hz resolution), 1s (1 Hz resolution), and 10s (0.1 Hz resolution). Autorange position automatically seeks to fill all 6 digits but will not select a gate time greater than 1s (1 Hz resolution)

Period: 5 Hz to 1 MHz. Manual selection of single period or 3 period-averaging ratios:

10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange position automatically seeks to fill all 6 digits but will not select a period average of greater than 10^2 averages

Totalizing: Accumulates up to 999999 counts, then activates overflow indicator

Sensitivity: 25 mV, typically 15 mV rms sine wave, 5 Hz to 80 MHz. Frequency and totalize: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 20 ns. Duty cycle >10%. Period: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 200 ns. Duty cycle >10%

Input Impedance: 1 MΩ, ≤30 pF

Noise Filter: 1 MHz (3 dB point) lowpass

Attenuator: Decreases sensitivity by 10

Overload: 250V rms 5 Hz to 1 kHz decreasing to 20V at 80 MHz

Timebase

Frequency:	10.00 MHz
Aging Rate:	$<\pm 5 \times 10^{-7}$/mo
Temperature Accuracy:	
0°C to 50°C	$<\pm 5 \times 10^{-6}$
Line Variation: (±10%)	$<\pm 1 \times 10^{-7}$

Display: 6-digit LED, leading zero suppression. Time between successive measurements is 200 ms plus measurement time.

Annunciation: MHz, kHz, ms, µs, overflow

Autorange: In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds to eliminate redundant up-range/down-range commands. This allows measurements to be made on signals containing large amounts of FM and øM. Hysteresis memory can be reset by depressing the "Reset" button

General Specifications

Autoreset: A new measurement sequence is started every time a front panel button is activated

Temperature: 0°C to +50°C operating (40°C max in battery version if being charged while operating); -40°C to +60°C, non-operating

Power: 115 or 230V ac ±10% (100V ac available) 50, 60 or 400 Hz. 6.5W line model, 8.5W battery model

Fuses: 1/8A line version, 1/2A slow-blow battery version

Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W (including handle) x 10 in D)

Weight: 1.2 kg (2.75 lb), 1.9 kg (4 lb) with batteries

Included with Instrument: Instruction manual, power cord. Order Y9111, Y9112 coaxial cable(s) and Y9103 50Ω Terminator separately

Ordering Information

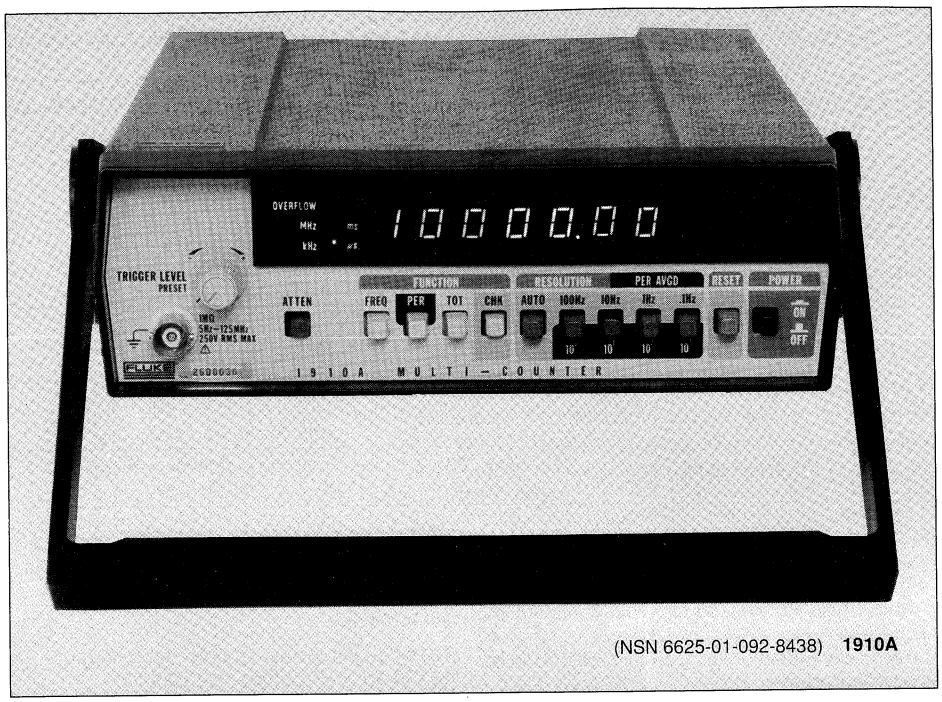
Models

1900A Multifunction Counter
1900A-01 w/Rechargeable Battery

Accessories (Also see Section 20)

A53 Whip Antenna
C86 Carrying Case, Molded Plastic
Y7201 Attenuator/Filter
Y8205 Soft Carrying Case w/shoulder strap
Y9111 Coaxial Cable, 50Ω, 3 ft (0.93m)
Y9112 Coaxial Cable, 50Ω, 6 ft (1.85m)
Y9103 50Ω Feed-thru Terminator
M00-100-714 Dust Cover
M00-200-611 3 1/2" Rack Mount, Offset
M00-200-612 3 1/2" Rack Mount, Center
M00-200-613 3 1/2" Rack Mount, Dual

1910A, 1911A & 1912A



(NSN 6625-01-092-8438) **1910A**

1910A, 1911A & 1912A Multifunction Counters

- Frequency, period, period averaging and totalize measurements
- 7-digit display
- Autoranging
- Autoreset
- Instant warning when input signal falls below sensitivity threshold (1911A & 1912A)
- Rechargeable battery pack version

These rugged counters are at home on the production line, in the lab, or in the field and do the work of counters costing much more. They measure frequencies to 125 MHz, 250 MHz or 520 MHz (depending on model), period of signals to 2 MHz, period average to 10 ps resolution and totalize to 9,999,999 counts.

Autorange

Full autoranging is supplemented by selectable four-range manual operation. In autorange, the display is automatically filled to a maximum 7-digit readout. A unique hysteresis capability eliminates undesirable up-and-down ranging for between-range signals.

Autoreset

This automatic feature is activated every time you select a new range or function, which means you never have to wait for a second reading, the first one in the new measurement sequence is always correct. Autoreset saves time and reduces errors.

Automatic Clean Dropout

The 1911A and 1912A Channel B input has a circuit which automatically monitors the input and gives you instant warning in the form of zero readout whenever your input signal falls below the sensitivity threshold of the trigger circuit. When the signal level returns to an acceptable level, the counter locks on for a correct reading.

Sensitivity

A basic sensitivity of 15 mV, backed by Fluke's conservative design margin, guarantees you will get reliable, solid readings every time. In practice, a typical sensitivity of 10 mV will be experienced.

Versatile Timebases

The standard 0.5 ppm per month timebase assures excellent long term stability for bench, production or field use. A convenient rear panel external timebase input jack and switch let you operate from your own 10 MHz frequency standard at any time. Choice of optional time bases with improved aging rates and temperature stabilities allows you to purchase only as much stability as you'll need in your applications.

Input Signal Conditioning

Each counter offers trigger level and attenuator controls which operate over the dynamic range of the input to permit accurate readings in the presence of noise. Even ringing TTL signals can be accurately measured. In addition, the 1911A offers a separate 50 ohm input for 50 MHz to 250 MHz and the 1912A does the same but goes to 520 MHz.

Battery Portability

All three counters are available with rechargeable batteries for field portability. Order 1910A -01, 1911A-01, or 1912-01. Four hours minimum operation gives you plenty of opportunity to solve those tough field service problems.



(NSN 6625-01-064-3855) **1911A**



1912A

Multifunction Counters

1910A, 1911A & 1912A

Specifications

Model	Channel	Operating Range		Sensitivity	Input Impedance	Overload (Max Input Voltage)	Prescale Factor
		Frequency	Period				
1910A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF ac coupled	dc + ac; <360V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	–
1911A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF ac coupled	dc + ac;<360V pk; 250V rms, 5 Hz - 1kHz 10V rms above 1 kHz	–
	B	50 MHz - 250 MHz	–	15 mV rms, 50 MHz - 175 MHz 30 mV rms, 175 MHz - 250 MHz	50Ω, VSWR <2.5:1	dc + ac: <100V pk; 5V rms, fuse protected	2
1912A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF ac coupled	dc + ac; <360 V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	–
	B	50 MHz - 520 MHz	–	25 mV rms, 50 MHz - 520 MHz	50Ω, VSWR <2.5:1	dc + ac: <100V pk; 5V rms, fuse protected	4

Technical Specifications

Ch. A Attenuator: X1, X10 (approx.)
Ch. A Trigger Level: ±0.5V range
Ch. A Totalize: 1 to 9,999,999 counts
Frequency Accuracy: Timebase accuracy ±1 count
Period Accuracy: Frequency accuracy plus trigger error*

* *Trigger error is less than 0.3% of one period ÷ periods averaged for sinewaves of 40 dB signal-to-noise ratio or better and amplitude equal to sensitivity of counter*

Frequency Resolution: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz, manually selected. Autorange automatically seeks to fill 7 digits but will not select gate time <1 second
Period Resolution: 100 ns, 10^0 single period; 10 ns, 10^1 period averaged; 1 ns, 10^2 periods averaged; 100 ps, 10^3 periods averaged. Auto range automatically seeks to fill 7 digits; if input frequency is high enough, may select 10^4 periods averaged (10 ps resolution) but will not select measurement time <1 second

Option Specifications

TCXO Options (-03, -04)

Timebase Selection Guide

Type (10 MHz)	Aging Rate	Line Variation (±10%)	Temperature Accuracy 0-50°C
Standard	±5 x 10^{-7}/mo	±1 x 10^{-7}	±5 x 10^{-6}*
Option -03	±3 x 10^{-7}/mo	±2 x 10^{-8}	±2 x 10^{-6}*
Option -04	±3 x 10^{-7}/mo	±2 x 10^{-8}	±5 x 10^{-7}*

**p-p variation*

Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all counters. Typical specifications are:
Input Impedance: 47 kΩ
Attenuation Range: X5 to X100, continuously adjustable
Low Pass Filter: 1 kHz, 20 kHz or 100 kHz, switch-selectable
Maximum Input: 30V ac

General Specifications

Display: 7-digit LED, leading zeros suppressed
Annunciation: MHz, kHz, msec, +sec, overflow
Operating Temperature: 0°C to 50°C (line models). 0°C to 40°C (battery models) when operating and charging
Storage Temperature: -40°C to +70°C (line models), -40°C to +60°C (battery models)
External Timebase Input
Frequency: 10 MHz to 300 kHz (typical)
Amplitude: 300 mV rms, 5V p-p max
Input Impedance: <1 kΩ
Power, Line Models: 100, 115, or 230V ac ±10%, 48 Hz to 440 Hz, 8W maximum
Power, Battery Models
100V ±10%, 48 Hz to 52 Hz, 8.5W max
100V ±10%, 58 Hz to 62 Hz, 8.5W max
115V ±10%, 58 Hz to 62 Hz, 8.5W max
230V ±10%, 48 Hz to 52 Hz, 8.5W max

Note: Voltage and frequency must be specified at time of order

Time (between successive measurements): 200 ms plus measurement time
Size: 6.4 cm H x 21.7 cm W x 27.1 cm D (2.52 in H x 8.55 in W x 10.65 in D)
Weight: 1.5 kg (3.2 lb) max, for line models, 2.2 kg (4.8 lb) max for battery models
Safety: Factory Mutual 3820 approved, CSA 556B certified

Included with Instrument: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) and Y9103 50Ω Terminator separately

Ordering Information

Models

1910A Multifunction Counter (125 MHz)
1910A-01 w/Rechargeable Battery
1911A Multifunction Counter (250 MHz)
1911A-01 w/Rechargeable Battery
1912A Multifunction Counter (520 MHz)
1912A-01 w/Rechargeable Battery

Specify line voltage and frequency if other than 60 Hz and 115V ac

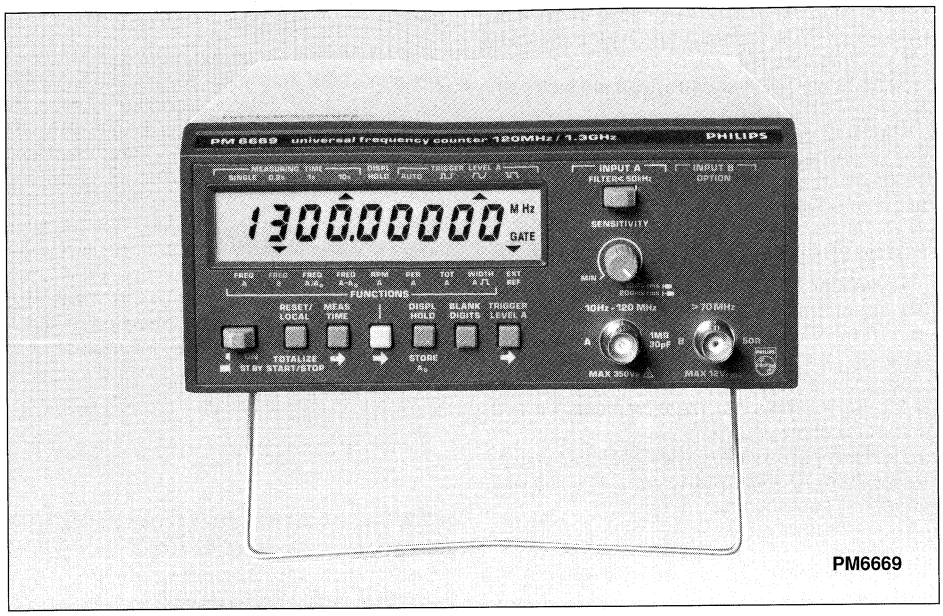
Options

19XXA-03* 2 ppm TCXO
19XXA-04* 0.5 ppm TCXO

**Factory installation only.*

Accessories (Also see Section 20)

A53 Whip Antenna
Y7201 Attenuator/Low Pass Filter
Y9111 Coaxial Cable, 50Ω BNC to BNC, 3 ft (0.93m)
Y9103 50Ω BNC Feed-thru Terminator
C86 Carrying Case, Molded Plastic
Y8205 Soft Carrying Case w/shoulder strap
M00-200-611 3½" Rack Mount, Offset
M00-200-612 3½" Rack Mount, Center
M00-200-613 3½" Rack Mount, Dual



PM 6662 & 6669 High Resolution Frequency Counters

- Unrivalled price/performance
- High resolution reciprocal counting
- Error-free triggering
- High stability MTCXO: 2 x 10^{-7} over 0° ...50°C with pushbutton calibration
- Eight measuring modes including PULSE WIDTH
- Versatile use with the GPIB/IEEE-488 interface or battery operation
- 1.3 GHz RF-input

Introduction

The PM 6662 and PM 6669 are economic, easy-to-use counters that meet the most stringent demands for high-precision measurements, reliability and durability.

The PM 6662 handles frequency measurements, while the multi-function PM 6669 offers period, count totalization, ratios, pulsewidth and frequency difference measurements.

Options for further enhancement include a 1.3 GHz input, battery pack and high-stability MTCXO timebase oscillator for both models, and a GPIB/IEEE-488 interface for the multi-function PM 6669.

The built in microprocessor uses the reciprocal frequency counting technique to yield high resolution measuring results under all conditions even on low frequency measurements. Measuring accuracy is improved by the high performance front-end, providing continuous adjustment of sensitivity and noise immunity. Accuracy can be further increased with the optional high-stability time-base PM 960.

The instruments are designed to fulfil a broad range of needs with a full range of options, including GPIB/IEEE-488 bus interface for systems use and a battery pack for independent field use.

These counters are housed in a sturdy, durable all-metal casing providing excellent shielding against RF interference. Both counters, therefore, have the durability and ruggedness to meet the demands of field service applications and severe environmental conditions.

The Versatile Counter - PM 6669

The PM 6669 offers as many as 8 measuring functions, including pulsewidth and relative frequency measurements; functions normally found only in more expensive timer/counters.

A wide range of configurations optimize the counter to meet your specific requirements. The PM 6669 can be used on the testbench, in GPIB/IEEE-488 systems (with the optional GPIB/IEEE-488 interface and rackmount kit), or for field service (using the optional battery pack and carrying case).

For enhanced performance, the 1.3 GHz input option or the high-stability MTCXO timebase oscillator can be ordered. All these options can be retrofitted at any time.

Both counters have a full 9-digit display, to allow complete presentation of measuring results. When less accurate masurements are required, blanking of irrelevant display digits can be made.

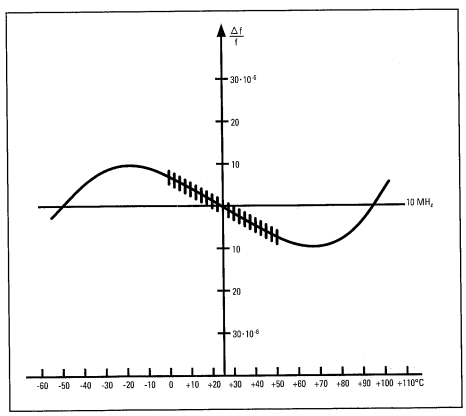
MTCXO timebase

Counter stability and precision have always been limited by the timebase crystal oscillator. Achieving really high stability demanded the use of costly oven-stabilized oscillators, while lower cost instruments use standard crystal oscillators or TCXOs (Temperature Compensated Crystal Oscillator).

The new PM 6662 and PM 6669 counters are available with the unique Philips MTCXO (Mathematically Temperature Compensated Crystal Oscillator). The temperature dependency curve for each individual crystal oscillator is factory measured, and the frequency deviations across the temperature range (Δf) are stored in a non-volatile memory.

During operation, the Δf value for the operating temperature is looked-up in the memory and used to compensate the measuring result before it is displayed. This automatic temperature compensation also results in highly accurate measurements instantly, without the need for long warm-up times.

The unique MTCXO principle gives a residual temperature stability of 2 x 10^{-7} over the temperature range 0° ...50°C, a value comparable to that of oven-stabilized oscillators, but at much lower cost.



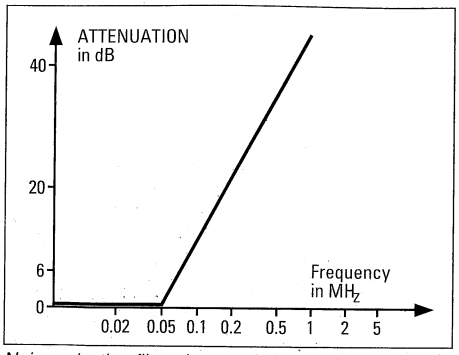
The ΔF characteristics for each MTCXO crystal are factory-measured and stored in a look-up table in a non-volatile memory. The ΔF value for any operating temperature is looked up during operation and used to correct the measured frequency value before display

Unprecedented Counter Value

The precision and stability of the MTCXO oscillator isn't the only way that PM 6669 and PM 6662 set new standards. The high-sensitivity input circuitry, with automatic triggering on all input waveforms, continuously variable attenuation and a switchable low-pass filter for noise reduction all features normally found only in higher priced counters.

The PM 6669 and PM 6662 also offers an

PM 6662 & PM 6669



Noise-rejection filter characteristic. When switched on, all HF noise and interference signals are suppressed as indicated

additional GPIB/IEEE-488 bus inerface that provides full remote control programmability of all major functions, making it probably today's lowest cost programmable precision counter.

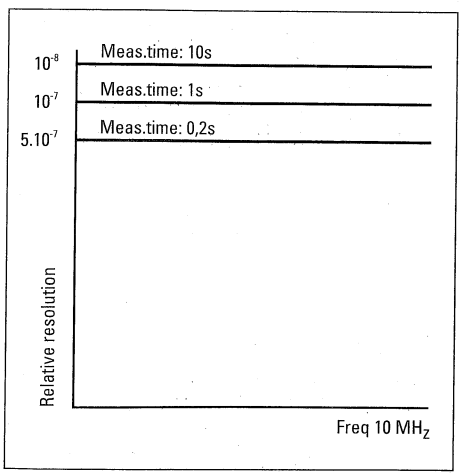
The PM 6669 and PM 6662 use Philips' state-of-the-art electronics technology throughout, including a new LSI single-chip counter which, together with a single-chip microprocessor, forms the complete counter logic. SMD (surface-mounted device) technology is also used for precise, highly automatic assembly.

Our advanced technology results in compact construction, low dissipation and very high reliability. All these benefits, in combination with PM 6662 and PM 6669's very attractive price level, add up to an unprecedented combination of counter performance and value.

High-resolution measurements

Synchronized multiple-period measurements, with computation of the reciprocal value, allow high-resolution measurements on signals of all frequencies. The microprocessor eliminates traditional ±1 input cycle errors, resulting in a measurement result of at least 7 digits per second of measuring time, regardless of the input frequency. This capability eliminates the need for the long gate times or period measurements which are normally required to obtain high resolution.

A full 9-digit display allows complete presentation of the measurement result, while unstable or insignificant display digits can be blanked to avoid erroneous readings of the display.

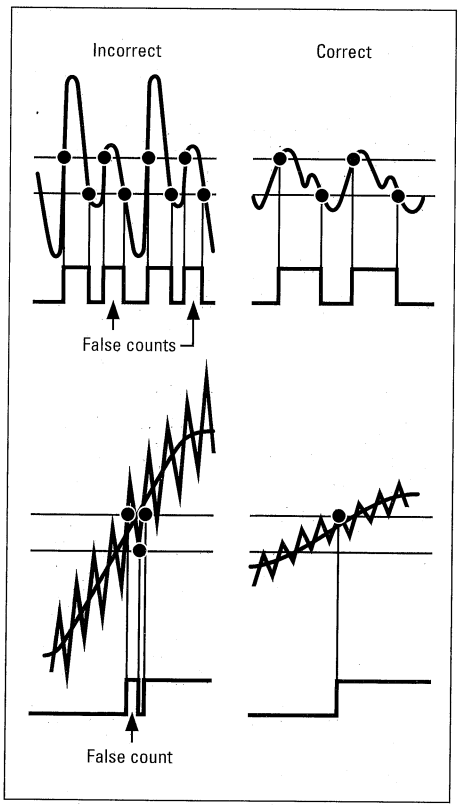


A variable input attenuator enables correct matching of the input signal to the trigger sensitivity of the counter. False counts caused by interference, distortion and noise are thereby prevented.

Frequency range up to 1.3 GHz

As standard, the PM 6662 and PM 6669 counters are guaranteed to measure frequencies up to 120 MHz under all conditions (typically 160 MHz at room temperature). The optional HF input extends the range right up to 1.3 GHz, ideal, for example, for measurements on telecommunications equipment.

The HF input has a very wide operating voltage range, from 10 mVrms to 12Vrms, to suit a wide variety of applications.



Smart and simple - PM 6662

For frequency measurements, the PM 6662 combines the same high accuracy as the PM 6669 with simple, foolproof operation every time.

The AUTO DISPLAY function always gives the correct range (Hz, kHz or MHz) and resolution for any input frequency and selected measuring time.

AUTOTRIGGER automatically sets the right trigger level to ensure correct triggering, whatever the waveform. A choice of measuring times allows for the optimum selection of measuring speed versus accuracy, and selection of sensitivity over a wide range allows for suppression of the influence of noise.

Specifications

Measuring Functions

Frequency A (standard) or B (optional)

Frequency range:
Freq A: 10 Hz ...120 MHz
(typically...160 MHz)
Freq B: 70 MHz... 1.3 GHz (PM 9608 B)
70 MHz...1.0 GHz (PM 9615)
Mode: Reciprocal frequency measurement
LSD unit displayed:

$$\frac{2.5 \times 10^{-7} \times \text{FREQUENCY}}{\text{measuring time}}$$

Frequency A/A_0 (PM 6669)

The FREQ A measurement is divided by the constant A_0 before display. At power-on, A_0 is set to 1 (default).

Frequency A-A_0 (PM 6669)

The FREQ A measurement is subtracted by the constant A_0 before display. At power-on, A_0 is set to 0 (default).

RPM A (PM 6669)

The freq A measurement is multiplied by 60 and displayed as revolutions per minute (RPM).
Range: 6 RPM ... 720 x 10^6 RPM

Period A (PM 6669 only)

Range: 8 ns x 10^8 s
Mode: single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10s measuring times).
LSD displayed:
SINGLE period measurement:
100 ns (TIME<100s)

$$\frac{5 \times \text{PERIOD}}{10^9 \text{ s}}$$ (TIME > 100s)

Period average measurement:

$$\frac{2.5 \times 10^{-7} \times \text{period}}{\text{Measuring time}}$$

Totalize A (PM 6669 only)

Event count is controlled by the START/STOP button. Sequential start-stop counts are accumulated.
Range: 0...1 x 10^{15} with indication of K or M (kilo-pulses or mega-pulses). The result is truncated to 9 digits
Frequency range:
Sine wave: 10 Hz... 12 MHz
Pulse: 0 Hz... 12 MHz
Pulse pair resolution: 80 ns

Width A (PM 6669)

A positive pulse width measurement is performed. Measuring time selection is not valid (always SINGLE)
Range: 100 ns...2 x 10^{8} s
LSD displayed: 100 ns (TIME<100s)

$$\frac{5 \times \text{width}}{10^{9}\text{s}}$$ (TIME ≥ 100s)

Input Specifications

Input A (PM 6662)

Frequency range:
10 Hz...120 MHz (typically...160 MHz)
Coupling: AC
Impedance: 1 MΩ//30 pF
Max. sensitivity:
Sinewave: 30 mV rms; 10 Hz...100 Hz
15 mV rms; 100 Hz...75 MHz
30 mV rms; 75 MHz...120 MHz
60 mV rms; 120 MHz...160 MHz
Pulse: 90 mV p-p; 10 Hz...100 Hz
45 mV p-p; 100 Hz...75 MHz
90 mV p-p; 75 MHz...120 MHz
Minimum pulse duration: 4 ns
Attenuation: X1,X3, X10, X30, X100 and X300. The attenuation selector is labelled sensitivity; 15 mV, 50 mV, 150 mV, 500 mV, 1.5V, 5V.
Trigger level: A fixed (+, 0 or -)
Trigger level offset is automatically applied to ensure correct triggering on any waveform and duty cycle (AUTO trigger)
Maximum voltage without damage:
350V (DC+AC peak) DC...440 Hz falling to 12 Vrms at 1 MHz

Input A (PM 6669)

Frequency range:
10 Hz...120 MHz (Tyically up to 160 MHz with 30 mVrms input signal).
Sensitivity:
sine: 10 mVrms 10 Hz...120 MHz
(30 mVrms, 120...160 MHz typically)
pulse: 30 mVp-p 0 Hz...120 MHz
Coupling: AC
Impedance: 1 MΩ//30 pF
Attenuation: continuously variable in two ranges between x1 and x400.
Filter: Switchable 50 kHz low pass noise filter with a supression of 20 dB at 200 kHz.
Trigger levels: 3 different levels for triggering on signals with various duty factors, and AUTO.


used for symmetrical input signals with a duty factor of 0.25...0.75.


used for input signals with duty factor <0.25.


used for input signals with duty factor <0.75.

AUTO trigger level: The counter selects a suitable trigger level setting automatically (not active in TOT-A measurements)
Input signal repetition rate: >100 Hz
Trigge slopes (via GPIB/IEEE488 only): + or -
Maximum voltage without damage: 350V (DC + AC peak) between DC and 440 Hz, falling to 11 Vrms at 1 MHz.

Input B (Option PM 9608B):

Frequency range: 70 MHz...1.3 GHz
Coupling: AC
Operating input voltage range:
10 mVrms...12Vrms; 70...900 MHz
15 mV-rms...12Vrms; 900...1100 MHz
40 mV-rms...12Vrms; 1100...1300 MHz
AM tolerance: 94% at max 100 kHz modulation frequency. Minimu signal must exceed minimum operating input voltage requirement.
Input impedance: 50Ω nominal, VSWR <2:1
Max. voltage without damage: 12 V-rms overload protection with pin diodes

Input B (Option PM 9615)

Not available in all countries
Frequency range: 70 MHz.. 1 GHz
Operating input voltage range:
15 mVrms...12Vrms; 70...100 MHz
10 mVrms...12Vrms; 100...1000 MHz
For all other specificatios, see PM 9608B

External reference input

The external reference input is automatically selected when an external signal of 9.9...10.1 MHz is connected.
Input Frequency: 10 MHz±0.1 MHz
Coupling: AC
Operating input voltage range: 500 mV-rms...15 Vrms (sine)
Maximum voltage without damage: 15V-rms
Impedance: approx 300Ω at 10 MHz

Auxiliary Functions

Reset

The RESET-button has three functions
1: **RESET.** Starts a new measurement. The settings are not changed.
2: **LOCAL.** Sets the counter to LOCAL, used when in remote operation (unless Local Lock-out is programmed).
3: **START/STOP.** Opens/closes the gate in TOTALIZE A MAN mode.

Measuring Time

A measuring time of 0.2s, 1s, 10s or SINGLE can be selected.

Displ Hold/Store A_0

The Displ Hold/Store A_0 button has two functions:
1: **DISPL HOLD:** The current measuring result is frozen on the display. A new measurement starts when the Reset button is pressed.
2: **STORE A_0:** This function is active in Frequency A measurements only. When the button is pressed for >1s, the result on the display is stored as the constant A_0, which is used for the calculation of frequency difference ($A-A_0$) and ratio (A/A_0).

Blank Digits

This function blanks any number of least significant digits on the display, in order to mask unstable display digits

Definitions

LSD displayed

LSD = Unit value of least significant digit displayed. All calculated LSDs should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

Resolution

Resolution = smallest increment between two measuring results on the display, due to the 1 count error.
Freq A, B, Period A:
Resolution can be 1 LSD unit or 2 LSD units.
if: $\frac{\text{LSD x measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$
the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
SINGLE Period A and Width A:
Resolution equals 1 LSD unit.

Inaccuracy

Inaccuracy, i.e. the relative error, depends on the following factors:
$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD or WIDTH}}$
± relative trigger error
± relative timebase error

Relative trigger error:

Freq A, Period A:
$\pm \frac{\text{noise voltage A (Vp-p)}}{\text{signal slope A (V/s) x meas. time}}$
Relative timebase error:
$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$

Note: For WIDTH measurements, triggering on 50% of amplitude will occur only if the duty factor is 0.5. In other cases the timing error caused by wrong trigger level setting should be added to inaccuracy.

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PM 6662 & PM 6669

General Specifications

Power requirements

Line voltage: 115 or 230V ± 15%, 45...440 Hz, less than 20 VA
Fuse: Internal thermal fuse in mains transformer
Line interference: Below VDE 0871 B

Time Base

Alternatives:
Standard built-in crystal oscillator. Order no. PM 6662/1. or PM 6669/.1.
MTCXO. Mathematically Temperature Controlled Crystal Oscillator. Order no. PM 6662/.3. or PM 6669/.3. The MTCXO can be separately ordered (option PM 9607) for later upgrading of the counter.

Osc version:	Standard	MTCXO
Stability against:		
Ageing /month	$<5 \times 7^{-7}$	$<1 \times 10^{-7}$
/year	$<5 \times 10^{-6}$	$<5 \times 10^{-7}$
Temperature 0...50°C	$<1 \times 10^{-5}$	$<2 \times 10^{-7}$
Line voltage change 10%	$<1 \times 10^{-8}$	$<1 \times 10^{-9}$
Change in supply line/battery	$<5 \times 10^{-7}$	$<1 \times 10^{-8}$

Environmental

Warming up time to reach specification: 5 minutes
Temperatures:
storage: -40°C...+70°C
Operating: 0°C...+50°C
Altitude: Operating and non-operating; 4600m (15000 ft)
Humidity: 95% R.H.; 0°C...40°C
Vibration: Operating; 15 min along each of the 3 major axis, 10 Hz...150 Hz, 0.3 mmp-p displacement and 2g max. acceleration.
Shock: Operating; 3 shocks along each of the 3 major axis, half sinewave, 6 ms duration and 40g acceleration pulses
Bench handling: MIL-STD-810D method 516.3, procedure VI
EMC: Meets VDE 0871 (B) and FCC part 15J
Safety: CSA bulletin 556B certified and Philips certification to comply with IEC 348 Class 1

Display

Read out: 9-digit LCD with unit indication
Gate indicator: Indicates gate open,i.e. measurement activity.
Cursors:
PM 6662: indicate used input (A or B), measuring time and use of ext. reference frequency
PM6669: Indicate selected measuring function, measuring time, input triggering, display hold and use of ext. reference frequency

Measuring Time/Rate

Measuring time:
PM 6662: 0.2, 1 and 10s
PM 6669: 0.2, 1, 10s and SINGLE
Note: SINGLE selected in PERIOD or WIDTH, results in a single cycle measurement. SINGLE in FREQUENCY or RPM, results in a fixed measuring time of 3 ms.
Display time: The display time equals measuring time plus approx 100 ms.
Max. measuring rate: Approx 5 measurements/s (standard osc). or 2 measurements/s (MTCXO)

Mechanical Specifications

Width x Height x Depth:
PM 6662: 186 x 88 x 220 mm (7.3 x 3.5 x 8.7 inches)
PM 6669: 186 x 88 x 270 mm (7.3 x 3.5 x 10.7 inches)
Net weight: PM 6662: 1.6 kg (3.6 pounds)
PM 6669: 2.1 kg (4.6 pounds)
Shipping weight:
PM 6662: 2.6 kg (5.7 pounds)
PM 6669: 3.1 kg (6.8 pounds)
Cabinet: All-metal cabinet with fold-down tilting support that also acts as a handle.

Optional Accessories

GPIB/IEEE-488 interface, PM 9604

(PM 6669 only)

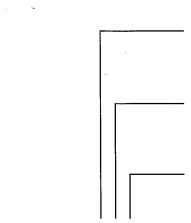
Mounting: Inside counter cabinet.
Interface functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
Address setting: Switch selectable between 0 and 30.

Programmable device functions: All front panel settings except Power on/St by, sensitivity and filter on/off; plus Trigger Slope (pos/neg).
Special bus functions:
Output separator selection
High-speed dump
MTCXO on/off
Short output format
Free run/Triggered measurements
Set SRQ mask
Program data out queries
Device identity query
Programming code format: 7-bit ISO code (ASCII) characters. Upper or lower case characters.
Input separator: The counter accepts the following separators:
EXT, ETB, CR, LF, '(space)', '(comma)', '(colon)', '(semicolon)'.
Output data separator: Default separator at power on is LF. The separator can be programmed to any non-printable ASCII code with decimal equivalent 0-31, except 27 (ESC). The combination 13 + 10 (CR + LF) can be programmed. The EOI line can be programmed to be active together with the last sound output byte sent.
Output format:
Normal: 20 characters plus separator(s)
7 characters alphabetic header plus 13 characters numeric value
Short output: Alphabetic header and leading zeros are omitted.
High-speed dump:
The contents of internal registers are transferred to the controller without being processed by the counter. The processing must be done in the controller instead.
Max. output rate: approx 100 readings/s
Output format: A 2 character header, followed by 12 Hex-digits plus separator(s)
Max. data output rate:
Normal mode: Approx 5 readings/s
High-speed dump: Aprox 100 readings/s
Output time for measuring data:
Normal mode: Approx. 15 ms (20 bytes)
High speed mode: Approx. 6 ms (15 bytes)
Response time for addressing:
Approx. 600 µs
Response time for trigger command (GET):
Approx. 10 ms
Typical readtime for programming data:
Approx 1 ms/byte

Ordering information

Versions

The PM 6662/69 ordering nubers consists of the basic type number and a 3 digit XYZ suffix, specifying the required configuration.



Type No.	*Description*
PM 6662/011	Basic frequency counter, 120 MHz frequency range, standard oscillator 5 x 10^{-7}/ month, incl operator's manual.
PM 6669/011	Basic frequency counter, 120 MHz frequency range, standard oscillator 5 x 10^{-7}/ month, incl operator's manual.
PM 666./3..	As above, but including 1 GHz HF input PM 9615. Not available in all countries.
PM 666./4..	As above, but including 1.3 GHz HF input PM 9608B.
PM 666./.3.	As above, but including crystal oscillator PM 9607 (MTCXO).
PM666./..3	As above, but including battery unit PM 9605
PM 6669/..6	As above, but including GPIB interface PM 9604. Note: PM 6669 only

Example: *PM 6669/413 means a PM 6669 frequency counter including both a 120 MHz and a 1.3 GHz input channel, a standard oscillator and a battery pack.*

Options and accessories

PM 9604	GPIB IEEE-488 interface
PM 9605	Battery unit
PM 9606	Rack-mount adapter
PM 9607	MTCXO timebase
PM 9608B	1.3 GHz HF input
PM 9609	Carrying case
PM 9615	1 GHz HF input (Not available in all countries)
PM 9665B	50 kHz low-pass filter, BNC-BNC (for PM 6662)
PM 8911/091	1.5 GHz, 500Ω probe set, 1:10
PM 8922/501	120 MHz, 1 MΩ probe set, 1:1 and 1:110
PM 8943	650 MHz, 1 MΩ FET probe set
PM 9581	50Ω termination, 3W
PM 9585	50Ω termination, 1W

All options can be field-installed by the user.

Note: The GPIB/IEEE-488 interface PM 9604 and the battery unit PM 9605 cannot be installed together in a PM 6669 counter.

Battery unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
Battery capacity (20°C): Approx 15 Wh
Operating time when battery powered:
Approx. 3 hours of continuous operation.
Recharging time: 7 hours to approx 75% of full capacity.
Battery protection: Overcharge protection and deep discharge (auto-shut-off)protection.
Low battery indication: All display indicators will blink whe approx 15 minutes operation time is left.
Temperature:
Operating: 1...+40°C
Storage: -40...+50°C
Weight: 0.8 kg (2 lb)

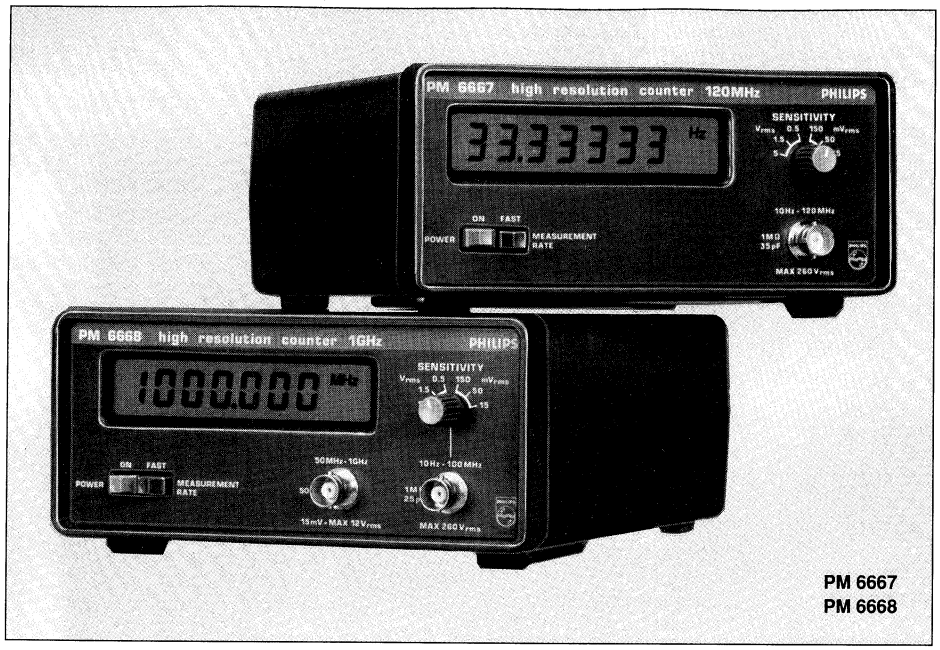
Rack-mount kit PM 9606

PM 6662 or PM 6669 can be installed in a standard 19" rack using the rack-mount kit PM 9606. One counter PM 6662/69 can be installed together with a second instrument with half 19 inch width, e.g. Philips PM 2534/35 DMMs, or Fluke 45 or Fluke 8040/42

Carrying case PM 9609

The PM9609 is a leather-look case to protect the PM 6662/69 counters during transportation.

PM 6667 & PM 6668



PM 6667
PM 6668

PM 6667/PM 6668 Reciprocal Frequency Counters

- High resolution computing counters (10 Hz to 1 GHz)
- Built-in intelligence for easy operation
- Auto triggering on all waveforms and duty cycles
- 15 mV rms sensitivity
- Crystal oscillator stability to 10^{-7}/month
- Clear high-contrast liquid crystal display
- Line and battery operation

The microprocessor controlled, high resolution PM 6667 and PM 6668 counters span a wide frequency range of 10 Hz to 120 MHz and 10 Hz to 1 GHz, respectively, with excellent economy. Operation is fast and the available computing power provides very high resolution capabilities normally associated with more expensive instruments.

The design incorporates an advanced technology microprocessor and dependable, large-scale CMOS digital circuitry with fully integrated front ends which will handle a wide range of input signal voltages. Thus, the benefits of electronic performance are accompanied by a vastly reduced component count. As a result, reliability and performance are increased, size and cost reduced.

Automatic Triggering on all Waveforms

No counter is better than it's front end circuitry, therefore special attention has been given to facilitate easy and accurate triggering. The multi-step attenuator allows attenuation of noisy input signals, giving a noise-immunity up to 10 dB better than with normal x 10 attenuators.

Another state-of-the -art feature is automatic trigger level setting. Depending on the input signal waveform, the counter sets automatically the required (+, 0, -) trigger level. Correct triggering is ensured without tiresome manual adjustments, for sinewaves and also for both high and low duty cycle pulses. In addition to these advanced features, the PM 6668 1 GHz front end has automatic PIN-diode attenuation, featuring automatic triggering and excellent excessive input signal tolerance.

High Resolution Computer Counter

By making a multiple period measurement and computing the reciprocal value, these counters perform high resolution frequency measurement on low frequency signals.

The microcomputer thus eliminates the traditional ±1 input cycle error and avoids the need for long gate times or period measurements or the limitations of phase-locked frequency multipliers.

Choice of two measurement times optimises the measurement rate to the application. In the NORMAL mode, a seven digit resolution measurement is made every one second.

The FAST mode allows the user to follow changing frequency values (as for circuit trimming) and gives a full six digit resolution every 200 ms.

Greater User Convenience

In addition to automatic triggering, these counters bring excellent readout convenience by eliminating manual range selection. Independent of the input frequency, maximum resolution is assured, without any risk of overflow.

This capability plus indication of Hz, kHz, MHz and proper decimal point positioning is accomplished by the microprocessor. Easy readout is ensured by the clear, high-contrast liquid crystal display with large 11.5 mm digits.

Ideal for Field Use

Both counters are packed in a rugged, high temperature and impact resistant polyphenylenoxide case containing a completely shielded metal inner construction.

The lightweight yet compact construction together with an optional battery pack and carrying case make these counters ideal for portable field use. A full battery charge gives approximately 5 hours of uninterrupted operation. A low battery indication 'LO BAT' is given on the LCD display at about 15 minutes before recharging is needed.

Self-Diagnosis

After switch-on a self test routine is executed. Should an error be detected, it is shown on the display by a diagnostic code, explained in the manual.

Quality without Compromise

These compact counters have been designed to the highest possible reliability standards. They employ a PHILIPS CMOS LSI and a single chip microcomputer that contribute to the excellent MTBF of 40000 hours.

Specifications

Frequency Measurements

Frequency Range
PM 6667: 10 Hz ... 120 MHz
PM 6668: 10 Hz ... 1 GHz

LSD Displayed

The unit value of the Least Significant Digit displayed is:
In normal display mode:

$$\frac{\leq 5}{10^7} \text{ X FREQUENCY}$$

In fast display mode

$$\frac{\leq 2.5}{10^6} \text{ X FREQUENCY}$$

(rounded to the nearest decade, e.g. 0.4 Hz will be 0.1 Hz and 0.5 Hz will be 1 Hz)

Resolution: 1 LSD unit
Inaccuracy (relative frequency error):

$$\pm\frac{\text{LSD}}{\text{input frequency}} \pm \text{rel. trigger error}$$

± time base error

Rel. Trigger Error
For any wave shape

$$\frac{\text{Measurement rate}}{\text{Signal slope (V/s)}} \text{ x peak-to-peak noise voltage}$$

For sinewaves

$$\frac{\text{Measurement rate}}{\text{Input frequency x } \pi \text{ x S/N ratio}}$$

Example: for S/N ration of 100 (40 dB) and sample rate of 1 measurement/s, the trigger error is:

$$\frac{3 \times 10^{-3}}{\text{input frequency}}$$

Input Specifications

Measuring Inputs

Input Sensitivity: (In 15 mV rms position)
LF-Input: 15 mV rms sinewave; 100 Hz ... 75 MHz
25 mV rms sinewave; 10 Hz... 120 MHz
45 mV p-p for pulses with a pulse duration of ≥7 ns
RF-Input: (PM 6668 only)
15 mV rms sinewave; 70 MHz ... 800 MHz
25 mV rms sinewave; 800 MHz ... 1 GHz
Input Attenuation:
LF-Input: x 1 to x 300 in 6 positions
RF-Input: Automatic attenuation
Trigger Level: A fixed (+, 0 or -) voltage is automatically applied to ensure proper triggering of any waveform and duty cycle.
Coupling: AC
Input Impedance:
LF-Input: 1 MΩ//≈25 pf
RF-Input: 50Ω nominal with VSWR <2 (PM 6668 only)
Max. Input Voltage Without Damage:
DC: 300V
AC: 260V rms at ≤440 Hz, falling to 12V rms at 1 MHz
Measurement Rate: At frequencies below 100 Hz, the measurement rate gradually slows down to one measurement per second to reduce the trigger error influence.

Ext. Reference Input

Frequency: 10 MHz
Input Voltage Range: 0.5V rms ... 12V rms
Input Impedance: 2 kΩ

Time Base

(/.1. Standard Version)
Frequency: 10 MHz
Ageing: ≤5 x 10^{-7}/month
Temperature Stability: (0...50°C, ref. to +23°C) ≤1 x 10^{-5}
(/.2. TCXO Version)
Frequency: 10 MHz
Ageing: ≤1 x 10^{-7}/month
Temperature Stability: (0...50°C, ref. to +23°C): ≤1 x 10^{-6}

General Specifications

Display: 7 digits, 11.5 mm, liquid crystal display with unit indication of Hz, kHz, MHz and LO BAT
Power Requirements: 115/230V. ±15%, 50...60 Hz; 15 VA or built-in optional battery pack PM 9601 or by external 12V battery.

Mechanical Specifications

Safety: According to IEC 348 and CSA 556 B
Dimensions: 160 mm W x 77 mm H x 180 mm L (6.3in W x 3 in H x 7.1 in L)
Weight: 1.2 kg (2.6 lb)

Environmental Conditions

Temperature:
Storage: -40°C... +70°C
Operating: 0°C... +45°C
Altitude/Barometer Pressure:
Storage: 15000m (50000 ft)/ 15.2 kN/m²
Operating: 5000m (15000 ft)/ 53.3 kN/m²
Humidity: 10%... 90% RH, (26°C dew point)

Optional Accessories

PM 9601 Battery Unit

The PM 9601 is a rechargeable battery unit for mounting inside the counters. This unit contains a standard 6V, 3 Ah sealed battery of solid gel lead-acid type and is provided with charging and overcharge-protection circuitry.
Capacity (typical at 20°C):
PM 6667: 6 hours continuous operation
PM 6668: 4 hours continuous operation
Recharging Time (typical at 20°C):
10 hours to 90% of full capacity;
5 hours to 70% of full capacity;
Trickle charge during operation (Power on).
Weight: 0.75 kg (1.65 lb)

PM 9602 Carrying Case

Hard shell, high-impact ABS carrying case provides protection during transportation
Included with the Instrument: Operating manual, line cord

Ordering information

Models

PM 6667 120 MHz Counter
PM 6668 1 GHz Counter

Optional Configurations

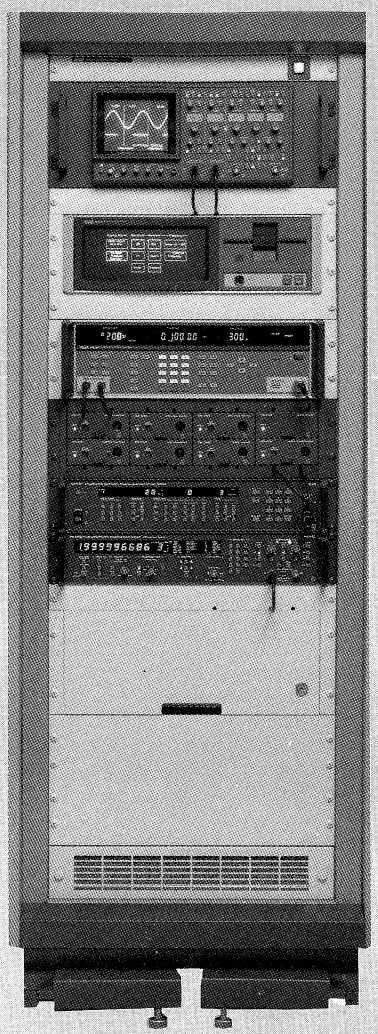
When ordering, select basic "PM" model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface
Input Frequency Option:
/0— Standard 120 MHz for PM 6667 only
/4— Standard 1 GHz for PM 6668 only
Reference Oscillator Option:
/-1- Standard Oscillator
/-2- TCXO
Interface Option:
/—1 Standard front panel only, line voltage
/—3 Battery (PM 9601/01)

Options and Accessories

PM 9601/01 Battery Pack
PM 9601/01 Carrying Case
PM 9603/01 19-in Rack/Panel Mount Adaptor
PM 9665B/01 50 kHz Low Pass Filter BNC-BNC

10

Instrumentation Systems



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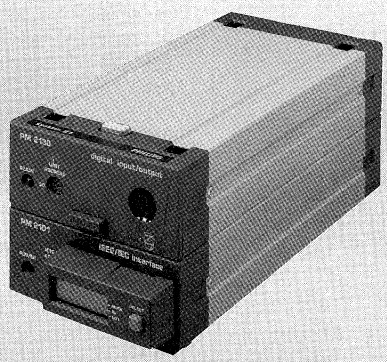

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Fluke and Philips meet today's increasing need for automation in test and measurement by offering one of the widest ranges of GPIB-controller instruments, industrial controllers, PC-based controllers, software tools and experienced customer support services.

The massive range of instrumentation makes it easy for the user in R&D, manufacturing and service to select the required building blocks for his application from one supplier.

Fluke and Philips anticipate the requirements of the users in R&D, manufacturing and service by offering an industrial GPIB controller for applications in manufacturing and process control demanding high speed and ease of programming. We also offer GPIB interface cards and software for PCs for applications that require flexibility and access to a wide range of software tools.

Our commitment to meet the user's requirement does not stop with products. It includes responsive customer support services which make us a uniquely qualified partner in the field of automation for test and measurement.

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GPIB
IEEE-488

Fluke & Philips GPIB/IEEE-488 Instrumentation Selection Guide

The following is a selection chart listing all the Fluke and Philips test and measurement instruments that support the GPIB/IEEE-488* bus. For more information on a particular instrument, refer to its page in the catalog.

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PM 3286A	200 MHz VHF Oscilloscope	10
PM 3065	100 MHz Oscilloscope	14
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6061A	Low-Noise Performance Signal Generator	260
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** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Fluke & Philips GPIB/IEEE-488 Instrumentation Selection Guide

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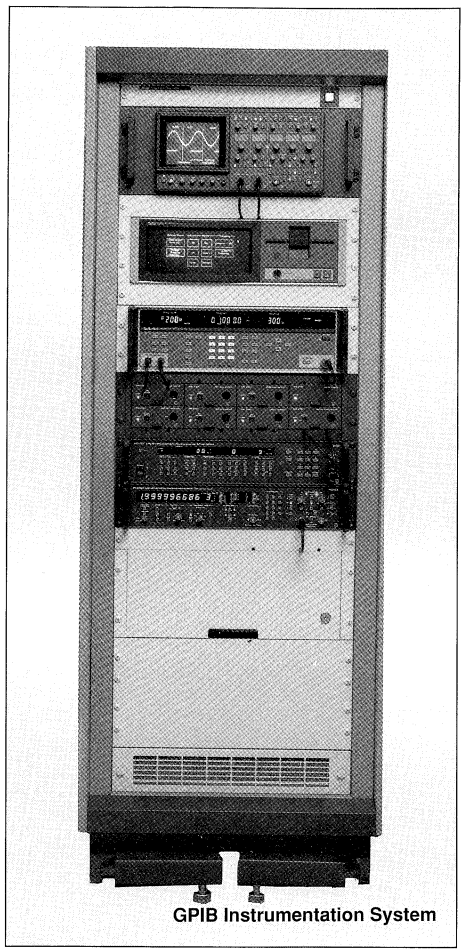
Introduction

Instrumentation Systems Introduction

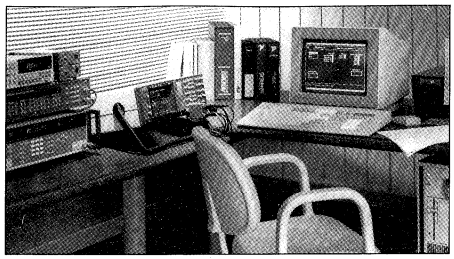


GPIB Instrumentation System

Philips & Fluke & GPIB/IEEE-488

Philips and Fluke offer not only a wide range of sophisticated test and measurement instruments, but also controllers, software and switches for GPIB/IEEE-488* systems.

Philips' and Fluke's extensive experience in automated test and measurement has resulted in instruments ideally tailored for use in GPIB instrumentation systems. When combined with worldwide sales, support and training facilities, the user is assured of simple and timely set-up of his own GPIB system.



The GPIB (General Purpose Interface Bus) is equivalent to the IEEE-488 and IEC-625 busses as worldwide standards supported by all major instrument suppliers. Philips and Fluke participate in international standardization committees, improving existing standards to ensure GPIB instrumentation systems are easier to build.

Instrument Controller

The instrument controller is the central element in a GPIB instrumentation system. The test program covering instrument control, data processing/analysis and display will, in most cases, be developed and executed on the controller.

Philips and Fluke offer a number of software packages to ease programming of instruments, data processing/analysis and data presentation on screen for their dedicated and PC-based instrument controllers.

Dedicated Instrument Controller

The dedicated instrument controller is an industrial instrument controller specially designed to control the GPIB bus. Dedicated controllers can extract maximum performance on the bus and are typically used for large scale GPIB applications. Program execution speed and reliability are the key elements for a dedicated controller. Philips and Fluke offer the 1722A Instrument Controller for medium to large scale GPIB applications. The touch-screen, display, processing power and wide range of software and hardware make the 1722A suitable for industrial applications.

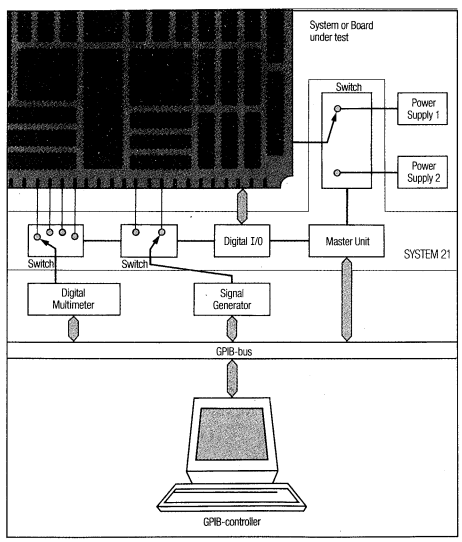
PC-based Controllers

The PC, with its excellent price/performance ratio, and wide range of software and hardware options, is now very popular as a GPIB instrument controller for small to medium-sized applications. Philips and Fluke offer GPIB interfaces for the PC/XT and AT (PM 2201) and PS/2 (PM 2202). Software is provided to ease programming, such as the PM 2240 TestTeam and PM 2230 Series of Instrument Drivers; and the PM 2260 Oscilloscope Signal Processing Package extends the measurement capabilities of Philips DSOs with extensive waveform analysis, display and storage functions on the PC.

Switching and I/O

Philips and Fluke offer 2 types of GPIB controlled switching and I/O systems: System 21, a modular switching and I/O system for small to medium-sized GPIB systems; and the 2205A Switch Controller/Scanner tailored for applications in production testing, process monitoring, process automation, calibration etc.

Between them, System 21 and the 2205A cover virtually any switching applications in GPIB instrumentation systems.



The Main building blocks of a GPIB system are:
- *Instruments*
- *Switches to connect the instruments to the device under test*
- *A GPIB controller for controlling the system and processing and displaying the measured data*

Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 2240

GPIB IEEE-488



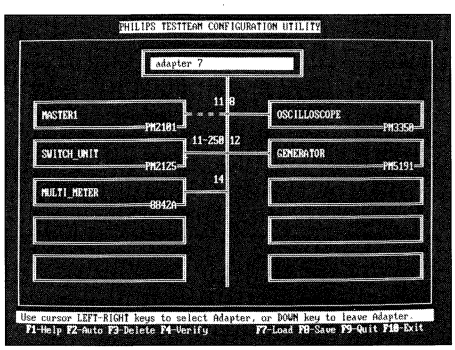
PM 2240 TestTeam

- Fast, simple program generation for GPIB/IEEE-488 instrumentation systems
- Easy to use, menu-oriented operation with pull-down menus and pop-up windows
- Extensive instrument library allows GPIB/IEEE-488 programming by selecting parameters on instrument panels
- Built-in graphics and analysis functions for simple presentation of measurement data
- Powerful debugging tools for error-free programs
- Available for IBM PC's or PS/2

PM 2240 TestTeam provides GPIB/IEEE-488* programmers with a complete, easy to use environment for the generation, interactive use and execution of application programs in QuickBASIC™ or C. It combines Fluke and Philips instrument libraries with the National Instruments Labwindows programming environment.

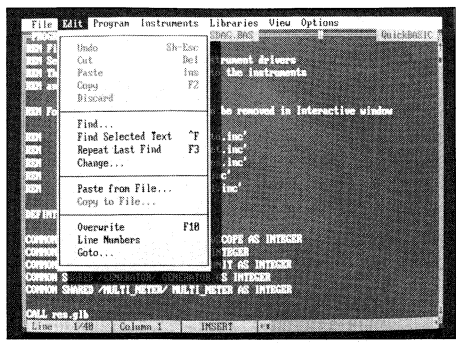
Fast system configuration and initialization

With TestTeam, getting started with programming is quick and easy. The TestTeam configuration utility automatically checks which instruments are connected, and at which addresses. It then assigns logical names to these instruments, and creates an initialization file. Programming can start immediately after execution of this initialization file.



Easy-to-use programming environment

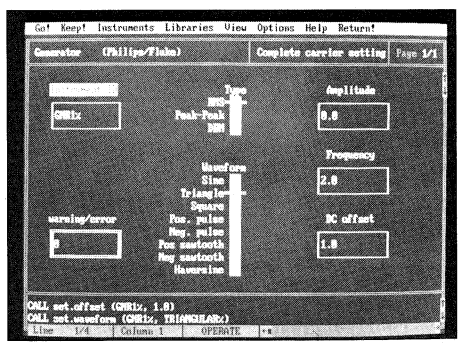
The TestTeam programming environment provides the programmer with an easy-to-use editor and a large number of standard functions and libraries, all of which greatly reduce programming time. These facilities are readily available via pull-down menus and pop-up windows.



You can create a program in either QuickBASIC or 'C' using the editor, and can insert graphics, analysis and instrument control functions at the location of the cursor by selecting and filling-in function panels. An on-line context-sensitive help facility guides the novice user through parameter entry in the function panels.

Instrument programming via on-screen function panels

In the instrument library, support is provided for numerous Philips and Fluke instruments in the form of specific instrument drivers. The programmer controls an instrument by simply entering parameters in the function panel displayed on the screen. The generated function call can be inserted in the program or executed immediately. The instrument drivers include thorough error-checking to obtain reliable test results. The availability of these ready-made instrument drivers removes the need for developers and users to have complete knowledge of the programming protocols for all the individual instruments to be used.



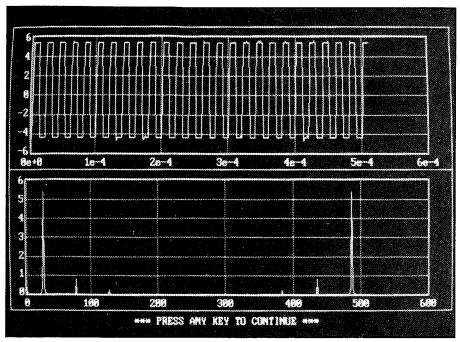
An extensive choice of drivers for instruments from other suppliers are available on request. Or alternatively, users can build their own custom drivers using the GPIB I/O drivers which are included in the TestTeam package.

11

PM 2240

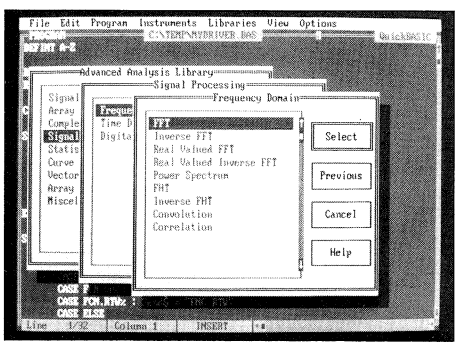
Programming a graph just by entering parameters

A standard part of the TestTeam package is a graphics library, which contains a wide variety of graphic routines. The graphic library allows the preparation of all kinds of charts, diagrams and statistical representations, and supports multiple-graph displays and hard-copy output.



Extensive math and analysis functions

As well as the standard analysis functions included in the TestTeam package, the optional PM 2241 library of advanced data analysis and signal processing functions offers a powerful combination of analysis and processing functions.

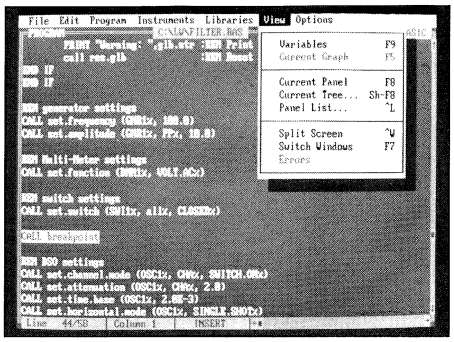


These functions include:

- Fourier Transforms (FFT) and inverse FFT
- Matrix, array and vector arithmetic
- Integration and differentiation
- Digital filters
- Linear equations
- Advanced statistics
- Polynomial and exponential curve-fitting

A clear view of error tracking

As well as providing a clear and convenient environment for writing test and measurement programs, TestTeam allows fast, effective program testing, with built-in facilities for syntax checking and interactive debugging. Sections of the program can be executed step-by-step or tested separately. Breakpoints can be inserted and program variables can be examined and changed to speed up program debugging.



TestTeam covers every step of the programming process, and is a big time-saver for beginning programmers and experienced users alike.

Creating an Executable

Programs created with TestTeam can not only be executed within the TestTeam environment, but can be saved as QuickBASIC or C files which can be compiled for execution in a different environment. The only option required is the instrument library for the selected programming language (PM 2231 for Microsoft C and PM 2233 for QuickBASIC).

System Requirements

IBM PC/XT/AT or compatible, or IBM PS/2 Model 30 with MSDOS:

- Minimum 640 kbytes of memory, a floppy and hard disk drive
- IBM CGA, EGA or VGA, Hercules monochrome or compatible graphics adapters to execute graphics functions
- Philips PM 2201/99 or National Instruments PC-IIA/PC-IIB GPIB interface cards

IBM PS/2 microchannel with MSDOS:

- Minimum 640 kbytes of memory, a floppy and hard disk drive
- Philips PM 2202/99 or National Instruments MC-GPIB interface cards

Ordering Information

Models

PM 2240/002 TestTeam
PM 2201/99 GPIB interface for PC
PM 2202/99 GPIB interface for PS/2

Options

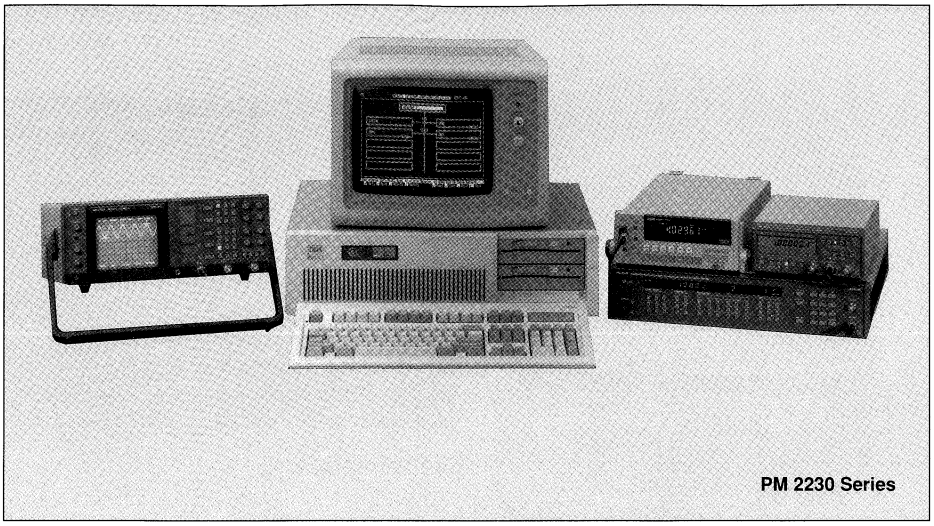
PM 2241/002 TestTeam Advanced Analysis Library (optional)
PM 2231/002 Instrument driver for Microsoft C
PM 2233/002 Instrument driver for QuickBASIC
PM 2235/001 Oscilloscope Instrument Drivers

The following are registered trademarks:
Labwindows: National Instruments
PC/XT/AT, PS/2: IBM Corporation
Hercules: Hercules Computer Technology Inc.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corporation

PM 2230 Series

GPIB IEEE-488

NEW



PM 2230 Series Instrument Drivers

- Automatic configuration utility for fast system configuration
- High level instrument commands ease programming and debugging
- Extensive built-in error checking and reporting
- Includes easy to use GPIB/IEEE-488 drivers
- Support for BASICA/GWBASIC, QuickBASIC, Pascal and C
- Available for IBM PC's and PS/2

GPIB/IEEE-488* system programming is simplified by the Philips Instrument Drivers for the IBM PC or PS/2 computers equipped with Philips GPIB interfaces. These drivers cover a range of specific Fluke and Philips GPIB instruments, including multimeters, frequency generators and synthesizers, digital storage oscilloscopes (DSOs), counters and switch units. Included in the instrument driver packages are GPIB procedures to program instruments not supported with specific drivers.

Auto-Configuration Utility

The auto-configuration utility automatically determines the GPIB system configuration, including instrument addresses and type, and assigns a user defined name to each instrument. After running this utility, the user can write his application program with the knowledge that the system is correctly configured.

Fast and Simple Development and Debugging of programs

High-level instrument commands,which are just as simple as using the front panel of the instrument, free the user from the task of learning the different GPIB mnemonics of each instrument and the details of GPIB control. This allows the user to concentrate on the application itself instead of the subtleties of GPIB programming.

Instrument drivers enhance the readability of the program. This results in code that is self-documenting and very easy to understand. Hence the use of instrument drives reduces time spent on program debugging and maintenance.

Instrument drivers also automatically check command validity. For example out-of-range parameters are trapped, resulting in error-free instrument operation.

```
1400 'Send the generator a new frequency between 50 Hz
1410 'and 1 kHz and have the counter take a reading.
1420 'Perform this action 20 times.
1430   FOR FREQ = 50 TO 1000 STEP 50
1440     CALL SET.FREQUENCY(GNR1, FREQ)
1450     CALL MEASURE(CNT1, VALUE)
1460     PRINT "Frequency = "; VALUE; " Hz"
1470   NEXT FREQ
```

"An example of code written using Instrument Drivers."

Supported Languages

Instrument drivers are available for the languages BASICA/GWBASIC (PM 2230), Microsoft C (PM 2231), Microsoft Pascal (PM 2232) and QuickBASIC (PM 2233). Instrument drivers for DSOs , supporting all languages, are available in a separate package, the PM 2235.

Supported Instruments

For PM 2230/31/32/33:

- Multimeters: Philips PM 2525/33/34, Fluke 8840/42, Fluke 45
- Generators: Philips PM 5191/92/93, PM 5138, Fluke 6060/62
- Counters: Philips PM 6652/52C/54/54C/65/66/69
- Switches: Philips PM 2120/21/22/23/24/2

For PM 2235:

- DSOs: PM 3320A/50/65/23/35

Philips continuously extends the range of instruments supported by their software packages.

System Requirements

IBM PC/XT/AT or 100% compatible and PS/2 Model 30 with MSDOS:

- Minimum 512 kbytes memory, a floppy and a hard disk drive
- Philips PM 2201/99 or National Instruments PC-IIA/IIB GPIB interfaces

IBM PS/2 microchannel with MSDOS:

- Minimum 512 kbytes memory, a floppy and a hard disk drive
- Philips PM 2202/99 or National Instruments MC-GPIB interface cards

For PM 2230: BASICA/GWBASIC rel. 2.02 or higher. PM 2231: Microsoft C rel. 4.00 or higher. PM 2232: Microsoft Pascal rel. 3.32 or higher. PM 2233: Microsoft QuickBASIC rel. 4.0

Ordering Information

Models

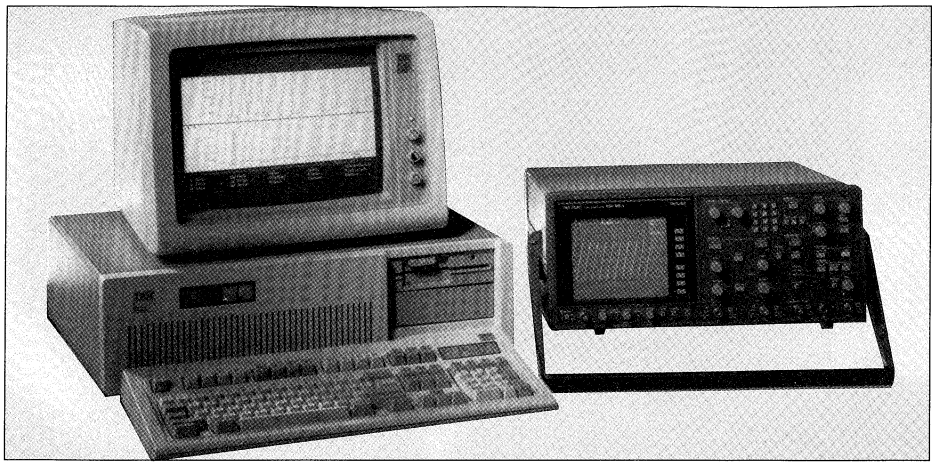
PM 2230/002 Instrument drivers for BASICA/GWBASIC
PM 2231/002 Instrument drivers for C
PM 2232/002 Instrument drivers for Pascal
PM 2233/002 Instrument drivers for QuickBASIC
PM 2235/002 Oscilloscope Instrument Drivers**
PM 2201/99 GPIB interface for PC
PM 2202/99 GPIB interface for PS/2

The following are registered trademarks:
PC/XT/AT, PS/2: IBM Corp.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corp.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*
***For use with the PM 2230, PM 2231, PM 2232 & PM 2233. Requires one of the above instrument driven packages.*

PM 2260

NEW

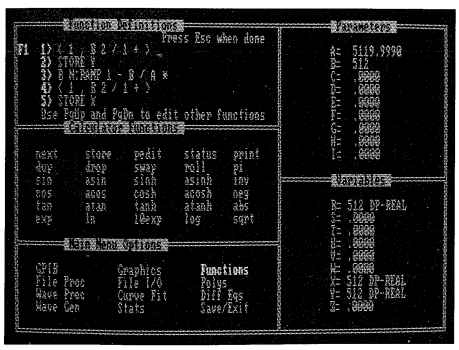


PM 2260 Oscilloscope Signal Processing

- Extensive waveform analysis and display functions all accessible via menus and function keys
- Menu driven data communication for Philips DSOs
- Data capture and analysis of waveforms
- Fast data transfer via GPIB/IEEE-488
- On-line help facility
- Available for IBM PCs

The PM 2260 Oscilloscope Signal Processing package is a complete software package for the analysis of measurement data from Philips Digital Storage Oscilloscopes (DSOs) on PCs. It is a combination of DSO drivers tailored for data transfer from the DSO to the PC and the ASYSTANT-GPIB™ software package.

ASYSTANT-GPIB is menu structured and offers an unprecedented range of mathematical, waveform analysis and processing, statistics, text editing, graphic functions and GPIB/IEEE-488* programming capabilities. An on-line help facility makes this powerful ready-to-run package very easy to use and increases the application range of Philips DSOs.

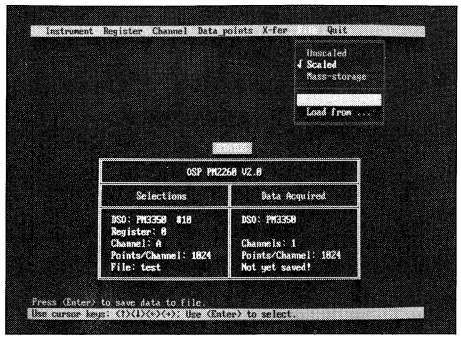


Data Transfer

Data can be transferred from the DSO to the PC via two methods. The first method uses menu-oriented instrument drivers for Philips DSOs which allow a user to simply select parameters like DSO channel, DSO register and number of data points via a menu. Channel, register, number of data points and name of destination file are the most important parameters which have to be entered in the data transfer menu. The result is a file on the PC with all the available and scaled information on the captured waveform. With the Philips DSO drivers no programming skill or effort is required.

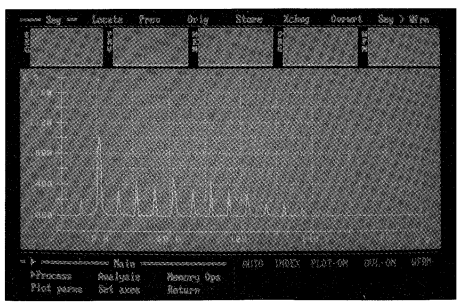
The second method involves using the built-in GPIB programming power of ASYSTANT-GPIB. ASYSTANT-GPIB allows a user to program the PC to capture a waveform from the DSO, scale the waveform and perform analysis all in real time. The user can create up to 30 different GPIB programs, which can call each other, enabling the user to build sophisticated GPIB programs.

Both of the two data transfer methods provide the user with support for the following Philips DSOs: PM 3308, PM 3310/11/15, PM 3320/20A, PM 3323, PM 3335, PM 3340, PM 3350 and PM 3365. The Philips DSO drivers provide support by including menu-oriented instrument drivers for each of the supported DSOs. Support for the GPIB programming power of ASYSTANT-GPIB is provided by including GPIB programs for each DSO showing how to capture and scale a waveform from the DSO.



Mathematics

The PM 2260 includes a full function array-based scientific calculator supporting single and double precision reals, integers and complex numbers. The many available functions include arithmetic functions, conversions (complex/real imaginary, complex/polar, polar/cartesian, cartesian/sperical), array operations (generating, editing, rotating, plus many more), and matrix and waveform analysis operations (FFT, inverse FFT, power spectrum, smooth, integration, differentiation, averaging, standard deviation, plus many more).



Waveform Processing

The waveform processor offers an extensive range of functions to interactively analyze signals captured with the DSO. On-screen graphic cursors isolate waveform segments and "visual" memories hold intermediate results. The processing functions include smoothing, enveloping, area under the curve calculations, power spectra, plus many more.

Graphics

On-screen graphical representation is vital for thorough data analysis. The PM 2260 offers a large number of graphic functions enabling the user to tailor the data representation to the format most suited to his application. Graphic functions include multiple windows, auto plotting

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

and scaling, linear, log and semi-log plots, axonometric and contour plots, labeling in eight directions plus many more.

. . .and More

Other standard PM 2260 functions include statistics, differential equations and polynomials. All signals and values can be stored on the PC, or output to a printer or plotter. The PM 2260 includes ready-to-run software drivers for popular printers with a centronic interfaces and HPGL plotters with serial interfaces.

System Requirements

IBM PC/XT/AT or 100% compatible and PS/2 model 30:

- Minimum 640 kbytes memory
- Floppy disk & hard disk
- 8087, 80287 or 80387 math coprocessor
- Philips PM 2201/99 (see page 379) or National Instruments PC-IIA/IIB GPIB Interface Card

IBM PS/2 microchannel with MSDOS:

- Minimum 640 kbytes memory
- Floppy disk & hard disk
- Math coprocessor
- Philips PM 2202/99 or National Instruments MC-GPIB interface Card

Ordering Information

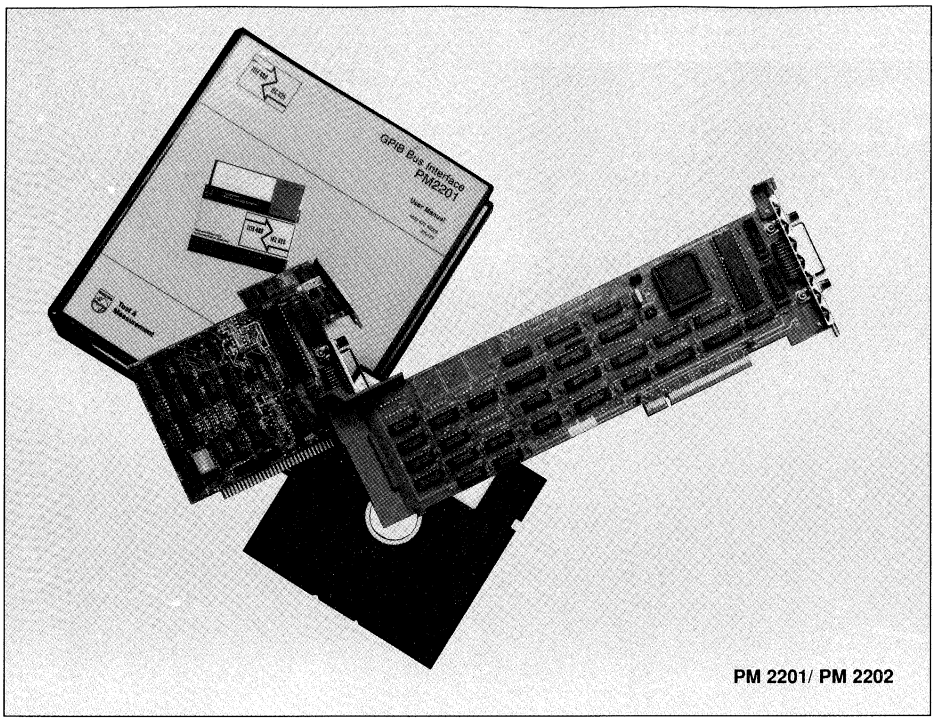
Models

PM 2260/002 Oscilloscope Signal Processing software package
PM 2201/99 GPIB Interface for PCs
PM 2202/99 GPIB Interface for PS/2

Notes:
PC/XT/AT, PS/2 is a registered trademark of IBM Corporation
MS-DOS is a registered trademark of Microsoft Corporation
ASYSTANT-GPIB: is a registered trademark of Asyst Software Technologies

PM 2201/PM 2202

GPIB
IEEE-488



PM 2201/ PM 2202

PM 2201 & PM 2202 GPIB/IEEE-488 Interfaces for PC and PS/2

- Turns IBM PC's and PS/2's into versatile GPIB/IEEE-488 controllers
- Includes easy to use GPIB/IEEE-488 drivers for BASICA, Pascal and C
- Supported by PM 2230 Series, PM 2240 and PM 2260 software packages for easy programming of GPIB/IEEE-488 instruments
- Supported by a large range of software packages from other suppliers

Hardware

The PM 2202 contains the extremely advanced MC-GPIB interface from National Instruments, for the IBM Personal System/2 equipped with Micro Channel plug-in slots. The PM 2201 contains the widely used PC-IIA GPIB interface from National Instruments for the IBM PC/XT/AT and 100% compatibles. Installing the cards is very simple and with the PM 2202, all settings are software programmable using the PS/2 Programmable Option Set facility.

Software

PM 2201 and PM 2202 include a set of GPIB/IEEE-488* drivers for writing application programs in GWBASIC/BASICA, Microsoft C and Microsoft Pascal. These GPIB routines include all commonly used functions like bus initialization, sending commands, sending and receiving messages, remote and local instrument setting, serial polling, time-out setting and others. Error checking is included in all drivers to enhance program reliability.

PM 2201 and PM 2202 are software compatible, so that a program developed on a PC with the PM 2201 will also run on a PS/2 equipped with a PM 2202 and vice versa. This greatly extends the use and life cycle of application programs.

System Requirements

For PM 2201: IBM PC/XT/AT or 100% compatible or PS/2 Model 30:

- Minimum 256 kbytes of memory, a floppy and hard disk drive
- GWBASIC/BASICA rel. 2.02 and higher or Microsoft Pascal rel. 3.32 and higher or Microsoft C rel. 4.00 and higher

For PM 2202: IBM PS/2 Microchannel:

- Minimum 256 kbytes of memory, a floppy and hard disk drive
- GWBASIC/BASICA rel. 2.02 and higher or Microsoft Pascal rel. 3.32 or Microsoft C rel 4.00 and higher.

Ordering Information

Models

PM 2201/02 GPIB Interface for PC including GPIB Driver Software
PM 2201/52 GPIB Drivers Software for PC with PM 2201/99 or National Instruments PC-2A/2B
PM 2201/99 GPIB Interface for PC, without software
PM 2202/01 MC-GPIB Interface for PS/2 including MC-GPIB Driver Software
PM 2202/51 MC-GPIB Drivers for PS/2 with PM 2202/99 or National Instruments MC-GPIB
PM 2202/99 MC-GPIB Interface for PS/2, without software

Accessories

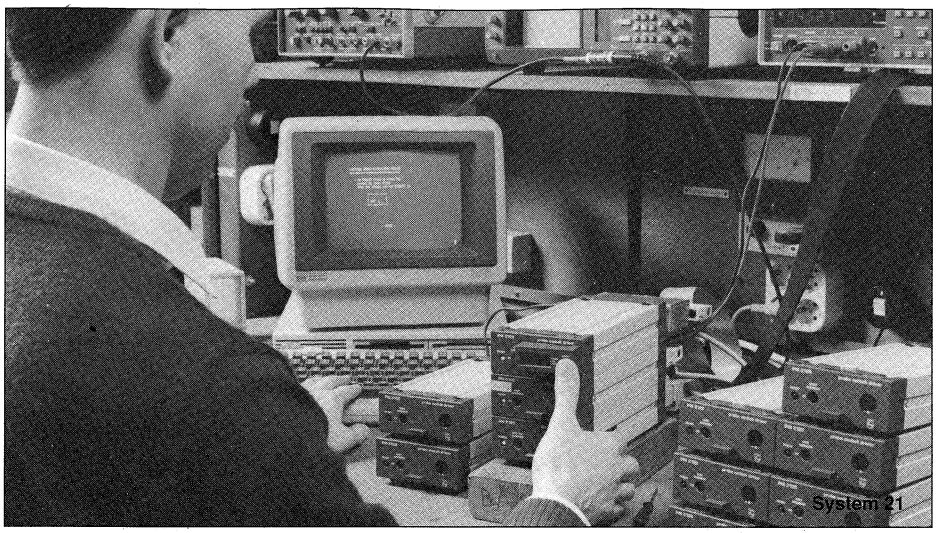
PM 2295/05 GPIB cable 0.5m
PM 2295/10 GPIB cable 1.0m
PM 2295/20 GPIB cable 2.0m

The following are registered trademarks:
PC/XT/AT, PS/2: IBM Corporation
Hercules: Hercules Computer Technology Inc.
Microsoft, MS-DOS, QuickBASIC: Microsoft Corporation

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

System 21

GPIB
IEEE-488



System 21 Modular GPIB Switching System

For small/medium-size instrumentation systems

Applications areas include:

- Research & development labs
- Quality control
- Small-scale production
- Education

A Simple System, Any Way You Stack It

Until now, automatic GPIB/IEEE-488* switching systems came in two varieties: big, but expensive, and small, but limited.

Now the Philips System 21 fills the gap with an expandable modular system that fits both your projects and your budget. And it fits your benchtop too.

System 21 is a complete family of fifteen stackable intelligent modules, each suited to a special function, all tied to a single GPIB address, all completely computer controlled.

It's so easy to use that you'll cut learning time dramatically compared to most mainframe systems. And it's so easy to change that you can perform nearly any small or midrange automated tests with ease.

Buy Only the Functions You Need

Perhaps the best thing about System 21 is that you need not buy a complete system to get the functions you want.

You can begin with just two units – a master and slave – and then expand as your needs grow. Start with, say, the master unit and a universal switch, then later add a digital input/output unit, then an 18 GHz switch, then maybe a user-configurable module for those special functions that you need from time to time.

You decide what you need, and buy only when you need it.

Easy to Start. Easy to Expand

The cost to begin building your system is naturally far less than for mainframe switching systems. So you get both the flexibility of mainframes and the affordability and convenience of off-the-shelf components.

And the cost to expand your system is lower still. You needn't break your budget to add functions.

On the Bench

System 21 is a great tool for prototype testing and benchtop experiments of all kinds.

Working with even a single multimeter and PC, System 21 brings affordable, versatile automatic switching to research and development departments and engineering staffs. Without the needless expense of mainframe switching systems, without the hassle of do-it-yourself switches.

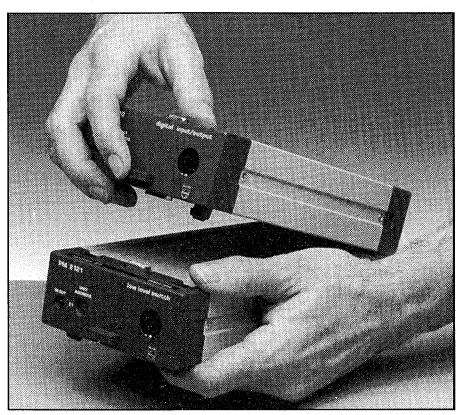


Figure 1

Or in the Rack

In production environments System 21 can be rack mounted for larger instrumentation systems, handling switching and I/O functions too small to warrant expensive mainframe equipment.

Also, System 21's modular design and easy software control allow quick reconfiguration for a host of different tasks. Production testing has never been so flexible.

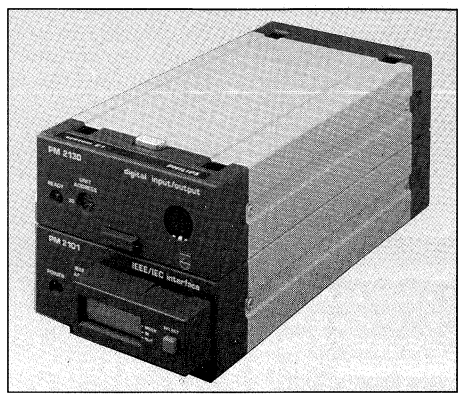


Figure 2

The System Behind the System

System 21 consists of a master module and up to fifty slaves, all tied to a single GPIB address.

The modules snap together top and bottom for easy connection, but they can be cabled as well.

Simple commands control everything. Each module works independently, and each can store commands, which can be triggered later by the controller.

That means simpler programming, and far less coding of repetitive tasks.

For example, the following command strings:

PRINT @7, "AID 203; CLOSE 4-6, OPEN 3";
PRINT @7, "AID 201; MODE 00, OPEN 5, CLOSE 1";
PRINT @7, "AID 301; STATUS ?"

are command strings, (from a Fluke 1722A Instrument Controller) to System 21 at GPIB address 7 with messages for:

PM 2120 with address setting 3 to CLOSE contact 4 to 6 and OPEN contact 3.

PM 2120 with address setting 1 to go to MODE 00 and OPEN contact 5 and CLOSE contact 3

PM 2131 with address setting 0 to send STATUS

Most modules have multiple operating modes, too. So you can make your system even more flexible by configuring each module several ways.

The Universal Switch, for instance, can be configured three ways; for twenty individual on/off switches, ten break-before-make switches or

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

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ten make-before-break switches. Similarly, digital input/output modules can be used in either direct or latching modes.

And all modules feature multiple execution modes, including a scan mode to activate individual switch inputs in sequence with minimum coding – another way to simplify your work.

Simple Yet Flexible

GPIB testing has never been so easy. You control all of System 21 through on master unit, using one controller and easy-to-use software. Intelligence is distributed throughout the system for easy programming. And you can reconfigure in a thousand ways.

It's one system you can't beat.

Specifications

Mechanical Construction: All units are housed in a separate box. Mechanical interconnection to the master and other units is by means of a bolt construction in the feet of each unit.
Dimensions: 105 mm W x 44.4 mm H x 226 mm L (4.3 in W x 1.7 in H x 8.9 in L) (excluding connectors and feet)
Height of Feet: 11 mm (0.43 in)
Display Module: The optional PM 2190 Display Module can be plugged into the front panel socket of each unit, except the Master Unit, to provide status information.
Terminal Connector: One or more terminal connectors are provided on the rear panel of each unit

Environmental Data

Operating Temperature: 0 + 55°C
Storage Temperature: -40 + 75°C
Humidity 80%: (0 + 55°C)
Dewpoint: 25°

Module Specifications

PM 2101 Master Unit

The PM 2101 Master Unit provides the power supply to the complete system and handles communication between the GPIB interface bus and the System 21 internal bus.

Bus Communication

Communication between the GPIB bus and the internal bus is fully transparent. Messages addressed to the Slave Units are not influenced by the Master Unit.

Power Supply

Power: 110, 120, 220 or 240 VAC ±10%, 50 or 60 Hz
Power Consumption: 16 VA max
Safety: Class II acc. to IEC 348
Secondary Power Supply to Slave Units: 7.5V (at full load) to 15V (unloaded)
Maximum Current Load: 750 mA (If higher currents are needed, additional PM 2198 power supply units can be used in parallel).

System Control Functions

Control functions of the Master Unit include identification, synchronization and service request handling.

Identification

On request, the Master Unit returns with:
a. Type number and version of the Master Unit
b. List of connected Slave Units

Trigger Facilities

Trigger commands from the GPIB bus can be distributed at choice to:
- Individual units
- All units with identical type numbers
- All units

If required, these trigger commands can be delayed until the ready line is "true".

Reading the Ready Line

On request, the Master Unit returns with the status of the ready line.

Resetting the System

The system can be reset to power-on conditions via the GPIB bus, or by means of a (protected) reset button on the Master Unit.

Service Request Handling

The Master Unit includes masking facilities to select from several reasons for service request messages. These include
- Power failure or illegal code
- Addressed unit is not present or has synchronization error
- A unit has data available, has reached end of block or has a functional warning
- Changes in ready or trigger line

The Master Unit returns with detailed information on the source of the service request call by means of a polling procedure after a service request is received.

GPIB Interface Data

Interface functions:

Description	Function	Capability
Source handshake	SH1	Complete
Accepter handshake	AH1	Complete
Talker function	T6	No talk only
Listener function	L4	No listen only
Service request	SR1	Complete
Remote/Local	RLO	No local control
Device clear	DC1	Complete
Device trigger	DC1	Complete

Address setting: 10 to 19
Accepted input data:
- Control data for Slave Units, Master Unit and interface
- General multiline commands; DCL, SPE, SPD, GET, SDC

Output Data: Functional messages, status and error messages of the units.
Separators: Record separators can be software programmed to one or two characters. At power-on, record and block separator are "NL".
Service Request: The following reasons for a service request can be enabled or disabled under software control: illegal header or body, System 21 request.
Connector: Standard GPIB connector.

PM 2120 Universal Switch

The PM 2120 Universal Switch offers 20 switches grouped in 10 pairs, each with a common contact. Depending on the switching mode setting, the switches can be used as:
- 20 individual on/off switches with one common contact per pair; or
- 10 single pole double throw (SPDT) break-before-make or make-before-break switches.

The contacts are high quality reed relays able to handle 200 mA, 30V and frequencies up to 100 kHz.

Technical Specifications

Configuration: 10 elements of 2 switches with a common output
Operating Modes
Mode 0: 20 individual switches (with common output per pair) for multiplexing or matrix switching
Mode 1: 10 SPDT make-before-break
Mode 2: 10 SPDT break-before-make
Max. Switching Voltage: 30V rms
Max. Switching Current: 200 mA
Max Switching Power: 10 VA (resistive load)
Max. Common Mode Voltage between Terminals or between Terminal and Ground: 30V rms AC or 40 VDC
Frequency Range: DC to 100 kHz
Series Resistance: <0.5Ω
Open Contact Resistance: $>10^9\Omega$
Isolation Resistance: $>10^9\Omega$
Crosstalk Isolation: 60 dB at 100 kHz, R_0=50Ω
Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms, break-before-make or make-before-break; 10 to 20 ms
Terminal: 37-pin female D-type connector
Display Module: The optional RM 2190 Display Module shows
- Switching mode, synchronization mode and ready status
- Settings of individual switches

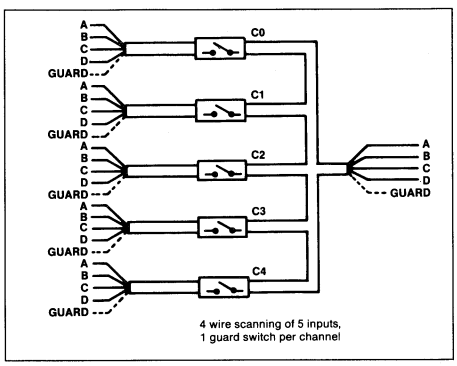
Current Consumption for System Supply: 25 mA (all switches open) to 125 mA (all switches closed)

PM 2121 Low-Level Switch

The PM 2121 Low-Level Switch offers 5 switches (each 4 wires + guard) at the input, and mode-switching at the output. Depending on the switching mode, the switches can be used for scanning of:

- 20 channels of 1 wire + guard (guard in com mon for 4 channels)
- 10 channels of 2 wires + guard (guard in common for 2 channels)
- 5 channels of 4 wires + guard

Switch contacts are matched to the special requirments of switching at low signal levels. The thermovoltage is <3 μV



Technical Specifications

Configuration: 5 elements of 4 contacts + guard at the input and a mode switching unit at the output

Operating Modes

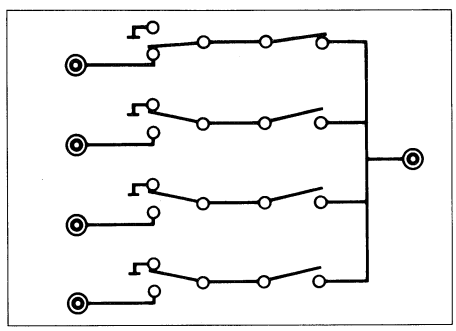
Mode 1: 1 wire (+ guard) scanning of 20 inputs
Mode 2: 2 wire (+ guard) scanning of 20 inputs
Mode 4: 4 wire (+ guard) scanning of 5 inputs. A common guard for 4 contacts is used in all modes
Max. Switching Voltage: 24V rms
Max. Switching Current: 500 mArms
Max. Switching Power: 12 VA (up to 1 MHz)
Max. Common Mode Voltage Terminals or between Terminal and Ground: 24V rms AC or DC
Frequency Range: DC to 1 MHz
Series Resistance: <1Ω
Open Contact Resistance: >10^9Ω
Isolation Resistance: >10^9Ω
Crosstalk Isolation: >90 dB (50/60 Hz); >40 dB (1MHz)
Switching Time Individual Relay: <10 ms, until last relay has settled in any mode: <25 ms
Order of Contact Closure and Opening: Input guard, input contacts, output guard, output contacts and inverted
Terminal: 37-pin female D-type connector
Display Module: The optional PM 2190 Display Module shows

- Switching mode, synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typcial 25 mA, max. 50 mA

PM 2122 50Ω Coaxial Switch

The PM 2122 50Ω Coaxial Switch Unit offers facilities for the selection of one of four inputs to the output.
The unit is suitable for switching VHF signals up to 500 MHz and 24 V rms. Matching impedance is 50Ω



Technical Specifications

Switch Configuration: 4 single pole double throw switches selecting 1 of 4 inputs
Operating Mode: Fixed
Matching Impedance: 50Ω (open inputs are not terminated)
Max. Switching Voltage: 24V rms AC
Max. Switching Current: 250 mA rms
Max. Switching Power: 3 VA (50Ω load)
Max. Common Mode Voltage between Terminals or between Terminal Ground: 24V rms AC or DC
Frequency Range: DC to 500 MHz
VSWR: <1.2 at 100 MHz; <1.5 at 500 MHz
Series Resistance: <1Ω
Open Contact Resistance: >10^8Ω
Isolation Resistance: >10^8Ω
Crosstalk Isolation: >50 dB at 100 MHz, >25 dB at 500 MHz
Switching Time Individual Relay: <10 ms, until last relay has settled: <25 ms
Terminals: 50Ω BNC connectors
Display Module: The optional PM 2190 Display Module shows

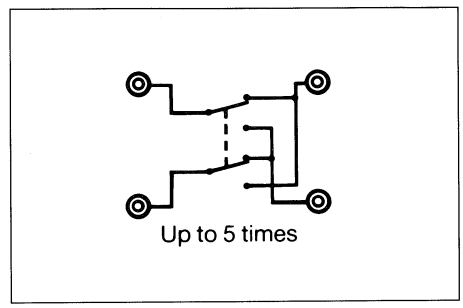
- Synchronization mode and ready status
- Selected channel

Current Consumption from System Supply: Typical 35 mA, max. 60 mA

PM 2123 18 GHz Switch

The PM 2123 18 GHz Switch Unit provides facilities for driving up to five microwave switches, one of which can be mounted inside the PM 2123. Four others (or all five) can be connected via connectors.

As supplied, PM 2123 includes one switch mounted inside the unit. Additional switches can be ordered separately under part number PM 7551 (switch type as included with PM 2123) or PM 7550 (see separate specification).



Technical Specifications

Switch Configuration: 2 inputs and 2 outputs enabling straightforward or cross connection
Operating Mode: Fixed
Matching Inpedance: 50Ω
Max. Switching Power: 15W average, <1 kW peak
Frequency Range: DC to 18 GHz
VSWR: <1.1 at 1 GHz, <1.5 dB at 18 GHz
Isolation: >80 dB at 1 GHz, >60 dB at 18 GHz
Insertion Loss: <1.1 dB at 1 GHz, <1.5 dB at 18 GHz
Switching Time Individual Relay: <40 ms
Min. Time Between Successive Switch Operations: 500 ms
Terminals: 50Ω SMA jack
Display Module: The optional PM 2190 Display Module shows

- Synchronization mode and ready status
- Selected channel

Current Consumption From System Supply: Typical 35 mA, max. 60 mA
Specification of PM 7550 When Driven by PM 2123: Switch configuration. SPDT with 2 inputs.

PM 2124 High Current Switch

The PM 2124 High Current Switch offers 6 independently controlled bistable switches in groups of three connected to two terminals. It can switch AC power up to 2500 VA and DC up to 300W. The high current switch is for testing motors and other electro-mechanical devices, and the switches are provided with earth connections. They meet the IEC 348, Class 1 safety specifications.

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Technical Specifications

Configuration: 6 independently controlled bistable switches in 2 groups of 3
Operating Mode: Fixed
Max Switching Voltage: 250 Vrms AC, 400 VDC
Max. Switching Current: 10A AC at up to 250V 10A DC at up to 30V 25A per terminal
Max. Switching Power: 2500 VA AC, 300W DC
Contact Resistance: 50 MΩ relays only 25 mΩ (including wiring and terminal)
Isolation Resistance: 2 MΩ
Cross Talk Isolation: Negligible up to 1 kHz
Inrush Current: 50A
Switching Time: Bistable relays switched in sequence - total switching time 50 ms + (n x 50 ms) for n contacts
Terminals: 2 x Amphenol series 97 terminals. Two corresponding plugs also supplied
Display Module: Optional PM 2190 shows position of relays.
Current Consumption From System Supply: Typically 25 mA

PM 2125 Probe Switch Driver

Where oscilloscope measurements have to be made at a number of points in an automatic GPIB system, the available instrument input channels often form a limitation. Now, with the PM 2125 Probe Switch Driver and PM 2195 Probe Switch, a single-channel instrument can accept up to four separate inputs, while the capacity of a four-channel oscilloscope can be increased to 16 inputs.

The PM 2125 Probe Switch Driver allows up to 4 PM 2195 Probe switches, for a total of 16 probes, to be connected to a GPIB system. Programming of the probe driver is made very simple by easy-to-interpret command strings. The probe switch driver is made very simple by easy-to-interpret command strings. The probe switch driver can operate in two modes: one for individual probe selection, and the other for parallel probe switching. The optional PM 2190 Display Module can show either the selected probes, the operating mode or the probe and switches that are not present in the system.

Technical Specifications

Operating Modes: 1 - individual probe selection. 2 - parallel switching of corresponding probes from 4 switches.
Contact Closure: Automatic closing of the 'ON' probe when a new probe is selected in the same probe switch unit
Switching Time: 50 ms
Read Back Facilities: Status of received commands: warning of illegal commands; warning of probe/switch selected but not present
Display Module: (optional PM 2190): Shows selected probes; operating mode; probes and switches not present
Current Consumption: 70 mA

PM 2195 Probe Switch

The PM 2195 Probe Switch provides an answer to problems which occur when waveforms are switched in typical GPIB systems. In general, switching waveforms before the signal is applied to the input probe causes load and interference problems, and switching between probe and oscilloscope input results in a significant degradation of bandwidth.

The PM 2195 Probe Switch consists of a 4-input selector switch and 4 attenuator probes. The switch is so compact that it can be plugged directly into the oscilloscope input socket and offers 4 probe inputs with individual adjustment facilities. Each probe can therefore be tuned for optimum response, so that a bandwidth of 400 MHz (3 dB) is ensured with an oscilloscope which has an input capacitance of less than 10 pF. As a result, only slight degradation of the bandwidth (5%) takes place for oscilloscope up to 300 MHz.

Technical Specifications

Input Probes

Number of Probes: 4
Attenuation Factor: 10 ±2%
Input Impedance: 10 MΩ/13 pF
Bandwidth: Including switch for scope with input capacitance <10 pF: DC to 400 MHz
Cable Length: 1.5 mP
Remote Probe Switch Required Output Load: 1MΩ//9 to 35 pF
Switch Control: PM 2125 probe switch driver (GPIB) or directly with 5V/12 mA supply

PM 2130 Digital I/O Unit

The PM 2130 Digital Input/Output Unit provides 8-bit input and output with optical isolation for signal levels from 0-5 to 0-30V. Outputs can be loaded up to 100 mA. The inputs can be used as latching input, and can set a warning flag when they match a reference pattern.

Technical Specifications

Configuration: 2 groups of 4-bit input and 1 group of 8-bit output with a common return line per group
Operating Modes
Mode 0: 8 input bits and 8 output bits
Mode 1: 8 latching input bits and 8 output bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of >1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "dont' care", Low, High or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to set "match reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Synchronization mode and ready status
- Data sent to the output
- Logic states of the inputs

Current Consumption: <100 mA

PM 2131 Digital Input Unit

The PM 2131 Digital Input Unit provides 16-bit optically isloated input subdivided into 4 groups of 4 bits. Signal level is 0-5 to 0-30V. The inputs can be used as latching input. The inputs can be compared with preset reference to check on state or change of state.

Technical Specifications

Configuration: 4 groups of 4-bit input with optical isloation, and a common return line per group
Operating Modes
Mode 0: 16 input bits
Mode 1: 16 latching input bits
Latching Mode: In the latching mode a latch is set when the corresponding input is high for a period of <1 ms. The latches are reset by the RSL command.
Reference Facility: By setting a reference for the individual inputs to "dont' care", Low, High or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
For Input/Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Response Time on Read Commands: <8 ms
Minimum Pulse Width to set "match reference" Flag: 5 ms
Minimum Pulse Width to Set Latch: 0.5 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Operating mode, sychronization mode and ready status
- Logic states of the inputs

Current Consumption: <80 mA

PM 2132 Digital Input Unit

The PM 2132 Digital Output Unit provides 16-bit optically isloated output subdivided into 2 groups of 8 bits. Signal level is 0-5 for 0-30V. The outputs can be loaded up to 100 mA.

Technical Specifications

Configuration: 2 groups of 8-bit output with optical isolation, and a common line per group
For Output Details: See Table 1

Timing

Response Time on Setting Commands: <8 ms
Terminal: 37-pin female D-type connector
Display Module: The optional Pm 2190 Display Module shows
- Synchronization mode and ready status
- Data sent to the output

Current Consumption from System Supply: <200 mA

PM 2140 Analog Input

The PM 2140 Analog Input offers a 3-range input channel for DC voltages up to 25V, and a separate single-range current input up to 250 mA. The two inputs have a common floating low and are provided with a guard.

Maximum resolution is 10 μV in the 200 mV range and 10 μA in the current range. Measuring speed is 1.5 or 10 measurements per second. An input filter can be switched on for increased SMRR.

PM 2140 also includes two relays that can be activated by the input signal when passing a programmable high or low limit. The contacts of these relays are connected to rear-mounted terminals.

Technical Specifications

Configuration: 3-range DC voltage and single range DC current input with floating low and a guard. High and low limit detection with relays for external signalling.

Operating Modes

Mode 0: Measurements with 4 digit resolution
Mode 1: Measurements with 3 digit resolution
For Ranges and Accuracy: See Table 2

Limit Detection

Limit Setting Range: -25,000 to +25,000 counts

For both high and low limit:
Max. Limit Relay Load: 10W
Max. Voltage: 30V rms or 42 VDC
Max. Current: 500 mA

Start of Measurements: Free-running or triggered via the systems bus. Measuring results are available 80 ms (mode 1) or 600 ms (mode 0) after start of measurement
Terminal: 37-pin female D-type connector
Display Module: The optional module PM 2190 shows:
- Operating mode, trigger mode and ready status
- Measured value
- High limit setting
- Filter on/off

Current Consumption from System Supply: Max.<100 mA

PM 2141 Digital Input Unit

The PM 2141 is a 12-bit Digital-to-Analog Converter, which offers a choice of both voltage and current output modes. The voltage output mode has two ranges, ±2V and ±20V and the current output mode has one range, ±20mA. The voltage and current output modes have a resolution of 2000 digits. Both of the outputs are floating with respect to the system and safety grounds. For safe operation, the output voltage must never exceed 42V (DC or DC + AC peak). The voltage output has optional separate sensing wires to eliminate voltage drop across the output wires. This option allows a power supply to be added to increase output power.

Technical Specifications

Programmed Output Voltage (Mode 1)

Output Voltage Range: -2 to +2 V
Current Range: -10 to +10 mA
Resolution: 10 mV (1:4000)
Accuracy: +(0.1% of value + 0.1% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)

Programmed Output Voltage (Mode 2)

Output Voltage Range: -20 to +20V
Current Range: -10 to +10 mA
Resolution: 10 mV (1:4000)
Accuracy: +(0.1% of value + 0.05% of range)
Output Impedance: 0.1Ω (or 1 mV/10 mA)
Output Voltage (max): +20.5V

Programmed Output Current (Mode 3)

Output Voltage Range: -20 to +20 V
Current Range: -9 mA to +9 mA
Resolution: 10 μA (1:4000)
Accuracy: +(0.1% of value + 0.05% of range)
Output Impedance: 0.1 μA/V
Output Admittance: 0.1 μA/V/K
Temperature Coefficient: +(0.0%/K of value +0.005%/K of range)

General Specifications

Response Time: Approx. 50 ms after master unit
Setting Time: Time between old and new output
Display Module: Optional display adapter PM 2190 shows:
- Mode
- Output voltage
- Output current

Input Voltage: 7 to 15 VDC
Current Consumption from System Supply: Approx. 200 mA at 12 VDC, no load approx. 250 mA at 12 VDC, max. load

PM 2160 Temperature Unit for Pt 100

The PM 2160 offers temperature measurment with Pt 100 sensores from -200°C to +850°C to a resolution of 0.1°C. The result is linearized and output in ASCII for direct input to a system controller.

Results can be compared to preset high and low limits. If they are exceeded, a warning is sent to the controller and the respective relay in the unit is activated.

Technical Specifications

Configuration: Single 4-wire connection to Pt 100 sensor. Current source/voltage input float w.r.t. main system
Operating Mode: Fixed
Measurement Range: -200°C to +850°C, resolution 0.1°C
Overload Indication: 999.9°C
Accuracy (not inc. sensor): +0.1% +0.5°C (-100°C to 850°C) +0.1% + 1°C (200°C to -100°C)
Temperature Coeff.: +(0.01% + 0.1°C)/°C
Common Mode Voltage: Floating sensor connection max. 30V rms or 42 Vpeak or DC w.r.t.
Measurement Time: 0.5s (-50°C to +250°C) 0.63S max. at -200°C 1.25s max. at +850°C
Measurement Trigger: Free running or triggered by systems bus
Limit Relay Output
Max. Switching Voltage: 30V AC or 42V DC
Max.Switching Current: 0.5 A
Max. Switching Power: 10 W

Table 1. Input and Output Specifications for PM 2130, 2131, 2132

	Input	Output
Common Mode Voltage Between Groups and Ground	30V rms AC or 42 VDC	30V rms AC or 42 VDC
Supply Voltage	5 to 30V	5 to 30V
Supply Current	<10 mA (per group of 4 bit)	<1A (per group of 8 bits and including max. load current)
Logic	Positive	Positive (current source)
Levels	Low for <30% of supply voltage High for >70% of supply voltage	
Hysteresis	0.4V to 1.7V	
Input Voltage Range **Input Resistance** **Input RC Time**	-30 to +30V 100 kΩ 0.1 ms	
Max. Load Current		100 mA (outputs may be used in parallel)
Output Voltage		Supply voltage -1V at 100 mA load
Current at Output Low		<1 mA
Output Protection		Short-circuit protected and flyback diodes

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Limit Parameters: The output can be compared with a high and low limit (+850°C or -200°C). Out of limit generates an SRQ signal for the controller, and activates high or low relays, accessible on the rear panel
Contact Resistance: 100 mΩ
Terminals: 37-pin female D-type connector
Display Module: Optional PM 2190 shows trigger mode and ready stauts; measured value (or overload); and high and low limit value
Current Consumption from System Supply: Max. 100 mA

PM 2150 User Adaptable Unit

The User Adaptable Unit allows the connection of a user-build function to the IEEE-488 bus. For this reason, fixing facilities, power supply and a connector for a standard Eurocard are provided in the unit. For interfacing to the user-build function, 16 I/O lines are available for use in most any configuration of inputs and outputs.

Technical Specifications

Configuration: Two groups of 8 I/O lines, read or written in groups, and with a common return
Signal Levels: CMOS 5V compatible with 10 kΩ pull-up
Power Supply: A maximum of 200 mA at 5V ±5% is available for user-build circuitry
Use of I/O Lines: The 16 I/O lines can be used in any I/O line configuration
Reference Facility: A matching state of I/O lines can be detected by reference setting. The corresponding warning flag can be used to generate a service request message. The reference pattern can consist of: "don't care", Low, High or "changing state" bits.

Timing

Response Time on Read or Write Command: <8 ms
Min. Pulse Width to set "match reference" Flag: 5 ms
Control Commands: All I/O lines can be set or read individually or in combination in binary, decimal, hexadecimal or ASCII code. The reference can be set in binary, decimal or hexadecimal codes ("don't cares" and "change state" in binary code only)
Display Module: The optional Display Module shows:
- Synchronization mode and ready status
- Data sent to the I/O lines
- Status of the I/O lines

Current Consumption from System Source: 50 to 250 mA depending on circuitry

Accessories

PM 2190 Display Module

The PM 2190 Display Module has an 8-digit LCD to show programmed modes and settings of the Slave Units during debugging. The module can be plugged onto the front panel connector of each Slave Unit.
(The parameters shown on the Display Module are specified for each Slave Unit).

PM 2191 Terminal Adapter

The PM 2191 Terminal Adapter adds a screw-connection terminal to Slave Units which have a 37-pin D-type terminal.

PM 2192 Extension Cable Set

A set of flat cables and connectors enabling the System 21 internal bus to be extended so that units can be used at different places in a rack. The set contains:
- 1M flat cable with an internal bus connector at one end
- 3 additional connectors

PM 2193 19"Rack-Mount Kit

This rack-mount kit allows up to 8 System 21 units to be mounted in a standard 3E high rack unit. Wiring for interconnection of the units is provided as standard.

PM 2194 Blank Panels for Rack-Mount Kit

PM 2194 provides blank panels for the PM 2193 Rack-Mount Kit. The rack-mount kit holds up to eight System 21 modules. If less than eight modules are used the blank panels will cover any of the empty locatons in the rack-mount kit.
The PM 2194 provides enough pieces to cover seven locations of the rack-mount kit, if only one System 21 module was used.

PM 2198 Additional Power Supply Unit

In extensive systems requiring more current than the 750 mA capacity of the PM 2101 Master Unit, additional PM 2198 Power Supply Units can be connected in parallel. Each additional PM 2198 provides an additional 750 mA.

Technical Specifications

Power: 110, 120, 220 or 240 VAC ± 10%, 50 or 60 Hz
Power Consumption: 16 VA max.
Safety: Class II acc. to IEC 348
Secondary Power Supply for Slave Units: 7.5V (at full load) to 16V (unloaded)
Maximum Current Load: 750 mA

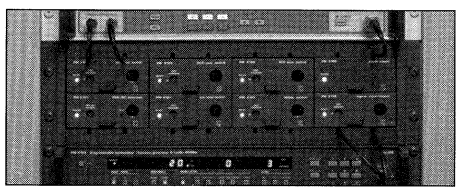


Table 2. PM 2140 Ranges & Accuracy

	VDC 200 mV	VDC 2V	VDC 20V	IDC 200 mA
Reading Ranges				
Mode 0	±250.00 mV	±2.5000V	±25.000V	±250.00 mA
Mode 1	±250.0 mV	±2.500V	±25.00V	±250.0 mA
Max. Resolution	10 µV	100 µV	1 mV	10 µV
Accuracy: % of Reading ±% of Range	0.1 ±0.02	0.1 ±0.02	0.1 ±0.02	0.25 ±0.05
Temp. Coeff. %/°C	0.01	0.005	0.005	0.05
Input Characteristic	1 MΩ	10 MΩ	10 MΩ	1Ω
SMRR (at 50 Hz)				
Mode 0 filter on	>60 dB	>70 dB	>70 dB	
filter off	>40 dB	>50 dB	>50 dB	
Mode 1 filter on	>50 dB	>60 dB	>60 dB	
filter off	>30 dB	>40 dB	>40 dB	
Input Settling Time for Last Digit				
Mode 0 filter on	750 ms	750 ms	750 ms	450 ms
filter off	150 ms	150 ms	150 ms	100 ms
Mode 1 filter on	550 ms	550 ms	550 ms	350 ms
filter off	75 ms	75 ms	75 ms	75 ms
CMRR	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)	100 dB at DC 80 dB at AC (50 Hz)
Avg Measuring Speed				
Mode 0	1.6 per second	1.6 per second	1.6 per second	1.6 per second
Mode 1	10 per second	10 per second	10 per second	10 per second
Maximum Load	42 VDC (tested up to 250V rms)	42 VDC (tested up to 250V rms)	42 VDC (tested up to 250V rms)	1.5A average and 10A peak

Ordering Information

Models

PM 2101/013 Master Unit

Switches

PM 2120/01 Universal Switch
PM 2121/01 Low Level Switch
PM 2122/01 50Ω Coaxial Switch
PM 2123/01 1Ω Ghz Switch
PM 2124/01 Current Switch
PM 2125/01 Probe Switch Driver
PM 2195/09 Probe Switch

Digital I/O

PM 2130/01 Digital I/O Unit
PM 2131/01 Digital Input Unit
PM 2132/01 Digital Output Unit

Data Acquisition & Custom Units

PM 2140/01 Analog Input Unit
PM 2141/01 Analog Output Unit
PM 2150/01 User Adaptable Units
PM 2160/01 Pt-100 Temperature Unit

Accessories

PM 2190/01 Display Unit
PM 2191/01 Terminal Adapter (qty: 3)
PM 2191/10 Teminal Adapter (qty: 1)
PM 2192/01 Bus Extension Cables
PM 2193/01 Rack Mount Kit
PM 2194/01 Blank Panel for Rack Mount
PM 2198/013 Additional Power Supply

System 21 Selection Chart

Master and Custom Units							Maximum Power	Connector Type	Description
PM 2101	GPIB Master Unit						16VA	GPIB	Controls and powers up to 50 slave units. Uses only one GPIB address.
PM 2150	Customer Adaptable Unit						200 mA at 5V ±5%	Euroconnector for a Eurocard	Allows the development of custom slave units. Uses 5V CMOS or TTL chips.

Switches		Number of Switches				Switching Speed	Maximum Switching Power	Connector Type	Description
		Mode 1	Mode 2	Mode 3					
PM 2120	Universal Switch	20	10	10		10 to 20 ms Note 1	30V 200 mA	37 pin (D) female	20 individual ON/OFF switches. 10 SPDT over switches.
PM 2121	Low Level Switch (3 µV Thermal Offset)	20	10	4		<10 ms Note 1	24V 500 mA	37 pin (D) female	1, 2 or 4 pole switching, with guard lines protected against current transitions.
PM 2122	50Ω Coaxial Switch	4	—	—		<10 ms Note 1	24V 500 mA	BNC	A VHF coaxial switch with a 50Ω impedance for DC to 500 MHz.
PM 2123	18 GHZ Coaxial Switch	5	—	—		<40 ms Note 1	15W	SMA jack	Controls 5 microwave switches, one of which is mounted inside the unit.
PM 2124	Current Switch	6	—	—		(50 + 50 x n) ms n=1 to 6 Note 1	2500VA AC 300W DC	Amphenol 97 Series	Allows the switching of high currents and high voltages, 10A and 250V.
PM 2125	Probe Switch Driver	4	—	—		50 ms Note 1	—	8-pole DIN female	Controls four PM 2195 probe switches, each of which can select 4 probes.
PM 2195	Probe Switch	—	—	—		See PM 2125	400 MHz bandwidth	8-pole DIN male	Provides four probes which are suitable for oscilloscopes, counters, timers, etc.

Digital Input/Output		Number of Channels			Switching Speed	Maximum Voltage	Connector Type	Description
		Inputs	Outputs					
PM 2130	Digital Input/Output	2 x 4	8		<8 ms Note 1	30V rms	37 pin (D) female	2x4 optically isolated inputs and 8 optically isolated outputs.
PM 2131	Digital Input	4 x 4	—		<8 ms Note 1	30V rms	37 pin (D) female	4x4 optically isolated inputs, externally powered.
PM 2132	Digital Output	—	2 x 8		<8 ms Note 1	30V rms 42V peak	37 pin (D) female	2x8 optically isolated outputs, protected against short circuiting & inductive loads.

Data Acquisition		Input/Output Ranges				Measurements Per Second	Maximum Power of the Switching Relay	Connector Type	Description
		Voltage			Current				
		Range 1	Range 2	Range 3	Range 1				
PM 2140	Analog Input Resolution:	200 mV 10 µV	2V	20V	250 mA 10 µA	1.6 to 10	10W	37 pin (D) female	A Analog-to-Digital converter with programmable High and Low limit relays.
PM 2141	Analog Output Resolution:	±2V 1 mV	±20V 10 mV	—	±20 mA 10 µA	—	—	37 pin (D) female	A 12-bit Digital-to-Analog converter with two voltage and one current range.
PM 2160	Pt-100 Temperature Unit	Pt-100 RTD	—	—	—	.8 to 2	10W	37 pin (D) female	An input module for Pt-100 RTDs with programmable High and Low limit relays.

Note 1: These times work out to approximately 6 per second for an average combination of slave units programmed in BASIC on a PC, using block programming mode.

11

1722A

GPIB
IEEE-488



1722A With Keyboard

1722A Instrument Controller

- Microcomputer architecture designed for system control
- Touch display operator interface
- C, BASIC, FORTRAN, and Assembly programming language options
- Rack mountable with removable keyboard
- 136K RAM memory expandable to over 5.0 megabytes
- High resolution graphics with graphics print capability
- RS-232-C, IEEE-488, RS-422, or 20 mA current loop and bit parallel interfaces
- High speed floating point processing implemented in firmware
- Soft-loaded operating system

The 1722A represents the evolution of a concept pioneered and introduced by Fluke in 1979 – the concept of using a touchscreen as the primary interface between an operator and a high-performance instrument controller. Few things could be more user-friendly. And it allowed the keyboard to be treated as a programming tool, usually unplugged and removed from an operating instrumentation system. Rack mounting was simple.

Fluke's first instrument controller was the 1720A. The 1722A has improved capabilities. But, because we are committed to maintaining the highest possible level of software compatibility consistent with evolutionary improvements, the 1722A runs programs that were developed for even the first 1720As delivered.

High Performance Microcomputer

The 1722A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1722A is an entirely new design internally. The high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory work space, functions as an independent graphics display terminal for the central processor.

When powered on, the 1722A looks to its internal floppy disk (or to optional non-volatile RAM) for operating software. Updating to newer software is a simple matter of inserting a disk and restarting. You are not tied to permanently-installed ROMs. Yet the 1722A is easily set up to automatically start running your application. After loading operating software, it looks for a start-up command file. The file is treated as keyboard inputs, instructing the controller to perform any task sequence. If software is stored in optional non-volatile RAM memory, you never need to bring a disk near it.

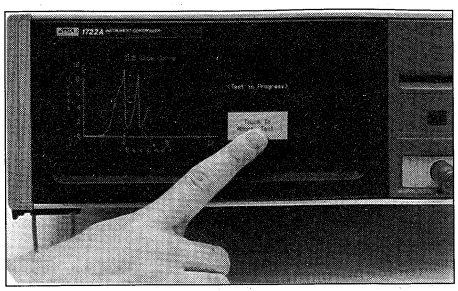
RAM memory in the 1722A can be partially allocated as a file-structured electronic disk, for high speed task overlays and large, fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1722A includes five slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3.0 megabytes. The 1722A-440 Internal Hard Disk provides an additional 40 megabytes of on-line storage. The 1765B Series of Winchester disk drives provides 20M bytes of file storage, in two models. Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 5.0M bytes of non-volatile memory, may be installed.

Touchscreen Display System

With its touchscreen display, the 1722A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. The predictability of procedures allows true trend analysis to be performed, pinpointing common failure modes or process impediments. Systems based on this concept are easily updated for new tasks. The cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touchscreens goes back to 1979. It has proven to be a rugged, reliable component.



Touchscreen interactive display

Characters Plus Graphics

The graphics display capability of the 1722A is independent of its character display, and of the 1722A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1722A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1722A character display is an independent function that can overlay graphics data displays for labels, or be used alone for test and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1722A includes an industry standard composite video output that will display what ever is on the 1722A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Interfacing

The 1722A includes an GPIB/IEEE-488 bus interface port and an RS-232-C serial port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1722A programming language. The 1722A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either config- uration, the 1722A can pass control to another controller and take it back when offered. As system controller, the 1722A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an additional IEEE-488 interface and an additional RS-232-C serial data port. The 1722A can accomodate up to four IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Memory Expansion Modules (-006, -007, -016, -017)

Internal program and data space may be expanded to over 3M bytes with RAM expansion options. Memory may be added in the following increments:

17XXA-006 256K bytes
17XXA-007 512K bytes
17XXA-016 1M bytes
17XXA-017 2M bytes

Application programs can assign any part of this memory to function as an "Electronic Disk." Programs and data may be loaded to this E-Disk, allowing faster transfer rates and no disk wear.

Non-volatile RAM Options (-018, -019, -020)

These options provide either 256K bytes (-018) or 512K bytes (-019) or 1M bytes (-020) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM -- over 1M bytes per second. Up to 5M bytes non-volatile RAM may be installed in the 1722A.

Non-volatile RAM is solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Non-volatile RAM is battery backed up for up to five years to retain its file contents through a power loss. Non-volatile RAM provides a write protection switch to protect its file contents.

Internal Hard Disk

The optional 1722A-440 Internal Hard Disk provides 40M bytes of on-line storage. This option includes a rugged drive designed to meet demanding industrial and portable applications. Reliable performance is guaranteed – even at ambient temperatures of 40°C. Self-parking heads prevent disk crashes if the unit is transported. High performance is provided through low access times (29 ms) and the high speed SCSI (Small Computer Systems Interface) bus. One option slot of the 1722A is required by this option.

The Internal Hard Disk can also be installed in existing 1722A. For more information, please contact your Local Sales Representative.

External Winchester Disk Drive

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1722A Instrument Controller:

1765B/20 20M byte Winchester Disk Drive
1765B/20M Multi-User 20M byte Winchester Disk Drive

Both models provide for easy connection to the 1722A Instrument Controller through a standard IEEE-488 interface, and are rack-mountable, using the optional rack-mount kit. More information is available in the following "Disk Drive" section.

Software

For information regarding 1722A Software, see the following "Software" section.

Module-Level Diagnostics

The 1722A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1722A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Local Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1722A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Local Sales Engineer or Representative to let you evaluate the 1722A through its manuals. You will be pleasantly surprised.

OEM Sales 1722A in Your Products

The 1722A is used as a component part of many products manufactured by companies other than Fluke. Custom packaging and matching paint colors are routinely negotiated. Fluke offers the discounts, policies, and worldwide support to make it work, too. If you are designing a product that would be more competitive with a touchscreen and a high performance microcomputer system, call your Local Sales Engineer or Representative for more information.

1722A

Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating
Relative Humidity: 20% to 80% non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating
EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975
Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum
Size: 13 cm H x 43 cm W x 55 cm L (5.25 in H x 17 in W x 21.5 in L) plus feet
Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)

Included with Instrument: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, and a pad of 50 display worksheets

Ordering Information

Model

1722A Instrument Controller
1722A-1 Instrument Controller w/o Keyboard

Options (for 1722A & 1722A-01)*

-002 Dual 16 Bit Parallel Interface
-006 256K Byte RAM Expansion
-007 512K Byte RAM Expansion
-008 IEEE-488/RS-232 Interface
-009 Dual Serial Interface
-016 1M Byte RAM Memory Expansion
-017 2M Byte RAM Memory Expansion
-018 256K Byte Non-Volatile RAM
-019 512K Byte Non-Volatile RAM
-020 1M Byte Non-Volatile Ram

Language Systems

-200U System S/W Update
-201 Assembly Language Development System
-202 FORTRAN Development System
-203 Compiled BASIC Development System
-205 Extended BASIC Development System
-912 Non-ANSI C Development System
-913 Non-ANSI C Compiler

Software Options

-900 Software Binder
-901 Gabby
-902 Touchscreen Toolbox
-903 Compiled MenuBASIC
-905 Extended MenuBASIC
-907 Transport->PC
S1703 Compiled MenuBASIC Development Package
S1705 Extended MenuBASIC Development Package

Peripherals

1020 Touch Control Screen (includes a desk-top enclosure)
1021 Touch Control Screen
1722A-440 Internal 40M Byte Hard Disk Drive
1765B/20 20M Byte Winchester Disk Drive
1765B/20M Multi-User 20M Byte Winchester Disk Drive
1780A InfoTouch® Display

Accessories (Also see Section 20)

Y1700 Programmer's Keyboard
Y1702 RS-232-C Null Modem Cable, 2m
Y1703 RS-232-C Null Modem Cable, 4m
Y1704 Circuit Board Extender
Y1705 RS-232-C Null Modem Cable, 0.3m
Y1706 Double-Sided Blank Disks (package of 10)
Y1707 RS-232-C Interface Cable, 2m
Y1708 RS-232-C Interface Cable, 10m
Y1709 Printer Cable, 2m
Y1790 Rack Mount Kit w/24" Slides
Y1795 Carrying Handle for portability
Y8021 IEEE-488 Interface Cable, 1m
Y8022 IEEE-488 Interface Cable, 2m
Y8023 IEEE-488 Interface Cable, 4m

1700 Series Software

The power of any computer system lies in the software that is supported with the system. The 1722A Instrument Controller and 1752A Data Acquisition System support a variety of software development systems, utilities and applications packages. Each package is designed to help the programmer develop software to fit the system to his particular application. Fluke also offers training and consulting services to help get your system up and running in the shortest possible time.

System Software

- File Utility Program
- SET
- Alias File
- Command Files
- TCOPY
- EDIT
- SHELL

Fluke's FDOS operating system combines the best features of both benchtop computers and minicomputers. Like a benchtop unit, the user can power-up the system and immediately begin programming in BASIC. No further knowledge of the operating system is required. For the advanced programmer, powerful utilities allow the user to perform complex functions with a minimum of keystrokes. Features include:

File Utility Program – Simplifies management of file structured devices such as the floppy disk, or bubble memory. Its concise, simple commands allow the user to transfer the contents of files or whole disks with a single command. Other features include wildcards, interactive commands, and file protection.

SET – Allows software set-up of serial port communications parameters, including baud rate, timeouts, and XON/XOFF handshaking.

Alias File – Allows the user to define his own commands for the system.

Command Files – Allows the user to define command sequences for the system. Flexible features allow the user to develop interactive sequences which can interface with the operator through either the keyboard or the touchscreen. Command files may also be used to automate the controller's start-up sequence.

TCOPY – The touch copy utility allows the user to perform file management through the touchscreen. It allows copying of files by name, date of creation, etc.

EDIT – The system editor is a powerful screen editor, with capabilities for searching, replacing, and cut-and-paste.

SHELL – The user may set the default console program with the SET SHELL command. This allows the programmer to design a system where his application program is the only software that the operator can see.

Other utilities allow the user to configure the operating system, check compatibility between various versions of software, and set the time and date through the touchscreen.

Language Systems

- Interpreted BASIC
- Compiled BASIC
- Extended BASIC
- FORTRAN
- Assembly Language
- Non-ANSI C

BASIC

The 1700 Series supports three BASIC packages. Compiled BASIC and Extended BASIC are available as options. Each package provides the programmer with the development tools necessary to take on the task of developing industrial control systems.

Compiled BASIC

The 17XXA-203 Compiled BASIC Option provides greater flexibility and speed while maintaining the ability to compile Fluke Interpreted BASIC. Programs can be run three to five times faster with Compiled BASIC than with Fluke Interpreted BASIC, while using less memory. Compiled BASIC includes the capability of linking subroutines in FORTRAN or Assembly Language.

Compiled BASIC permits large multiple-line statements, and long descriptive variable names. It also permits labels to be used in place of line numbers for branch targets while leaving the use of line numbers optional. Compiled BASIC subroutines exchange parameters, and use local variables and common variables for true modularity. This freedom of format allows BASIC programs to be written in a readable, structured form. Multiple-line statements can be especially useful, for example, when a program requires many lines following an IF statement. Key features include:

- Program execution 3 to 5 times faster
- True subroutines with local variables
- Use of program overlays for large programs
- Three dimensional arrays
- Alphanumeric labels for lines and/or statements
- Long variable names
- Continuation lines – up to 200 lines per line number
- Powerful screen editor

Extended BASIC

The 17XXA-205 Extended BASIC Option provides a compiler that allows the 1722A programmer to easily develop large BASIC programs without having to use a complex overlay structure that can be required when using Fluke Compiled BASIC. (Program space can be over two megabytes.) The statements and syntax are the same as those found in our Compiled BASIC. Key features include all those mentioned for Compiled BASIC except execution speed is only twice as fast as Fluke Interpreted BASIC, while eliminating complex program overlays.

Comparison of Fluke BASIC Offerings

Feature	Interp'd BASIC	Compiled BASIC	Extended BASIC
Program Size	28K bytes	35K bytes	>2M bytes
Execution Speed Ratio (appx)	1	3-5	2-3
Program Expansion Method	Chaining	Overlays	None req
Immediate Mode Commands	Yes	No	No
3-D Arrays	No	Yes	Yes
Continuation Lines	No	Yes	Yes
Long Variable/ Statement Names	No	Yes	Yes
True Subroutines	No	Yes	Yes
Program Libraries	No	Yes	Yes
Option To Omit Numbers	No	Yes	Yes
Input Line Statement Capacity	80	510	510
Import/Export Statements (Global Variables)	No	No	Yes
Step Mode Debugging	Yes	No	No

FORTRAN

The Fluke 17XXA-202 offers a complete system for development of FORTRAN programs or subroutines with performance rivaling many minicomputers. Fluke FORTRAN makes it easy to use the features of the 1700 Series. Libraries provide routines for numeric and text manipulation, touchscreen and graphics support, and communications, including GPIB/IEEE-488.* Fluke FORTRAN can also interact with the operating system to provide functions such as file management and interaction with the system's command line interpreter.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Typical Statement Execution Times

	BASIC	Compiled BASIC	FORTRAN
Math Functions Execution Time, msec*			
= (Assignment)	0.460	0.152	0.004
+	0.474	0.353	0.237
—	0.477	0.353	0.224
*	0.506	0.383	0.209
/	0.682	0.554	0.221
^	4.821	4.652	2.902
SIN	2.301	2.052	1.332
COS	2.431	2.202	1.242
TAN	4.771	4.512	2.802
ATN	3.361	3.122	1.422
SQR	1.611	1.382	0.842
LOG	2.351	2.112	1.462
LN	2.461	2.222	1.542
EXP	2.411	2.172	1.512
Control Statements			
FOR Loop (integer counter)	0.189	0.076	0.004
IF-THEN	0.622	0.121	0.110
GOSUB/RETURN	0.254	0.142	0.036

**Data may vary depending on application*

Assembler

The 17XXA-201 allows the programmer to develop high speed or specialized routines in assembly language. The package includes a structured preprocessor which allows the use of high level constructs for program flow control. Using Macrostore,* double- and single- precision floating point arithmetic instructions become part of the language, simplifying code development. Also provided is the Hex Debugging Tool (HDT), with disassembly capability to speed program development.

C

The 17XXA Non-ANSI C Development System supports features such as user defined data structures, full complement of math functions, bit fields, string manipulation and Whitesmith I/O. For real-time and instrument control applications, the system supports a full complement of interrupt processing structures, IEEE-488 I/O commands, and a complete interface to the FDOS operating system.

This package requires the 17XXA-201 Assembly Language Development System. Due to this, the package is available two ways; as the 17XXA-913 Non-ANSI C Compiler or as the 17XXA-912 C Development System, which includes both the 17XXA Non-ANSI C Compiler and the 17XXA Assembly Language Development System.

** Macrostore is a trademark of Texas Instruments Incorporated.*

Linkers and Library Management

Linking and Library Management utilities are provided standard with the following software packages:

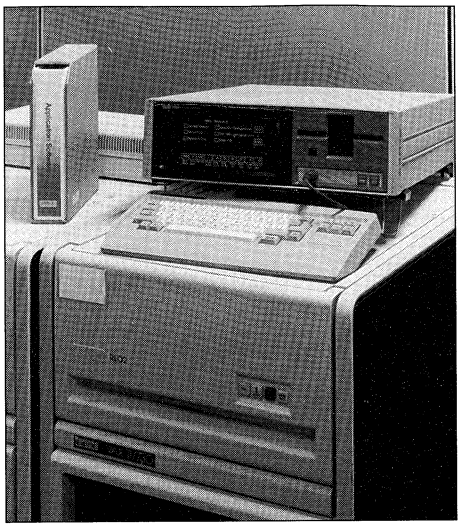
- 17XXA-201 Assembly Language Development System
- 17XXA-202 FORTRAN Development System
- 17XXA-203 Compiled BASIC Development System
- 17XXA-205 Extended BASIC Development System

Fluke's Linking programs allow the user to modularize his program, by compiling routines one at a time, and then linking the final software package. This simplifies the management of projects requiring multiple software engineers. Support for overlays is offered through the Linkage Editor. The Library Manager may be used to build libraries of user defined routines.

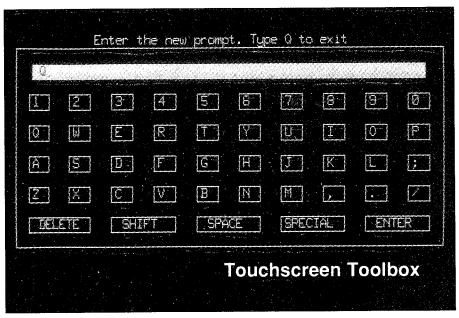
Selection Guide — Language Systems

Language	Item Number	Program Space	Data Space	Touch-screen Support	IEEE-488 Support	Comments	Compilation speed (stmts/min)	Real-Time Interrupts	Hardware
BASIC									
Interpreted	n/a	28K bytes [1]	to 3M bytes	Std	Complete		n/a	Yes	
Compiled	17XXA-203	35K bytes [1]	to 3M bytes	Std & Adv [3]	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM [2]
Extended	17XXA-205	to 3M bytes	to 3M bytes	Std & Adv [3]	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM [2]
FORTRAN	17XXA-203	64K bytes [1]	to 3M bytes	Std	Complete	FORTRAN IV	~300	No	17XXA-016 1M byte RAM [2]
Assembler	17XXA-201	64K bytes	64K bytes	Std	Std	Hex Debugging Tool Provided	~4500	Yes	
Non-ANSI C	17XXA-912	64K bytes [1]	to 3M bytes	Std	Complete	Whitesmith C I/O	~1000	Yes	17XXA-016 1M byte RAM [2]

[1] *Can be increased using overlays or chaining*
[2] *Recommended hardware*
[3] *Advanced Support available through Touchscreen*



Gabby



Touchscreen Toolbox

Fluke Application Software

- Gabby
- Touchscreen Toolbox
- MenuBASIC
- TransPort–>PC

Gabby

The Gabby Terminal Emulation Program (17XXA-901) is a communications program which provides a simple method of transferring 1700 Series files to and from almost any host computer. Gabby emulates a terminal attached to the host computer and also allows uploading and downloading of files between the 1700 Series and the host computer. With Gabby, all commands are accessed through the touchscreen, relieving the user from the task of learning cryptic command sequences. Gabby includes three appendices showing step by step instructions for use with the UNIX,* RSTS,* and VAX/VMS.*

Touchscreen Toolbox

Fluke's expertise in developing human interfaces using the touchscreen is made available to the programmer through the 17XXA-902 Touchscreen Toolbox package. The package cuts the time required to develop a menu based system, while ensuring that the resulting menus will be simple for the operator to use. The package also includes calculator-style and alphanumeric keypads to simplify the tasks of entering data such as process control parameters, operator identification, or serial numbers.

MenuBASIC

MenuBASIC is a tool designed to simplify the task of developing programs for the 1700 Series. It provides access to a powerful BASIC language, complete with advanced structures such as CASE statements and true subroutines, and features designed to simplify systems development such as full IEEE-488 support and multilevel interrupt structure. MenuBASIC also features a powerful editor which can search, search and replace, and merge programs interactively.

MenuBASIC makes these and other features easy to use by allowing the programmer to select actions from a menu presented on the screen. Memorizing the commands is not required, since they are displayed on the screen as part of the menu. This makes learning how to use MenuBASIC a simple task, as well as allowing single key commands to perform functions which require long command strings on most systems.

MenuBASIC is also available as Development Packages which provide everything you need to meet MenuBASIC software and memory requirements. Both include MenuBASIC software, a manual, a 512K Byte Memory Expansion Module, and a Compiled or Extended BASIC language package.

MenuBASIC features include:

- **BASIC Language:**
  Full IEEE-488 Support
  Multiple-Level Interrupt Structure
  Virtual Arrays
  Line Numbers Optional
  True Subroutines with Local Variables
  Long Variable Names
  Advanced Control Structures (IF-THEN, WHILE, CASE, etc.)
- **Program Development:**
  Interactive Environment
  Advance Editor with Search Replace Cut and Paste
  Interactive File Merging
  Simplified, Single Key Commands
- **System:**
  Ability to link other MenuBASIC, FORTRAN or Assembly Modules
  Full File Control (Copy, Delete, etc.)
  Complete Serial Port Control (Baud Rate, Parity, etc.)

MenuBASIC Options

17XXA-903	Compiled MenuBASIC:Compiled MenuBASIC software & manual.
17XXA-905	Extended MenuBASIC:Extended MenuBASIC software & manual.
S1703	Compiled MenuBASIC Development Package: Software and manual for Compiled MenuBASIC (17XXA-903); Compiled BASIC Language (17XXA-203) and 512K byte Memory Expansion Module (17XXA-007).
S1705	Extended MenuBASIC Development Package: Software and manual for Extended MenuBASIC (17XXA-905); Extended BASIC Language (17XXA-205) and 512K byte Memory Expansion Module (17XXA-007).

TransPort–>PC

TransPort–>PC is a communications software program for the 1700 Series. TransPort–>PC provides a simple method for translating any ASCII text file from a disk configured by the Fluke Floppy Disk Operating System (FDOS) into a format acceptable to the IBM PC, IBM XT, or other highly-compatible microcomputer.

TransPort–>PC allows you to combine the computing and controlling power of the versatile, high-speed 1722A and 1752A with the flexibility and resources of data manipulation programs available for the personal computer.

The export utility provided with TransPort–>PC allows you to transfer numeric virtual arrays from the 1700 Series to the personal computer. Programs such as Lotus 1-2-3® can be used to display the file in spreadsheet form or as a bar, stacked-bar, pie, line or XY graph.

Selection Guide – Application Software

Package Name	Item Number	Features	Required Hardware	Required Software
Gabby	17XXA-901	• Communication between 1722A/1752A and Host Computer • Terminal Emulation • File Upload/Download • SImple Touchscreen Menu Interface • Documentation for use with: UNIX 4.1, 4.2 BSD RSTS/RSX-11 VMS	1722A with graphics print capability (all units shipped after February 1,1985) or all 1752As	Cable to Host Computer
Touchscreen Toolbox	17XXA-902	• Simplifies development of menu-based systems • Provides numeric and alphanumeric keypads • Cuts programming time from days to minutes • Provides ergonomic menu design • Frees graphics plane for other uses	1722A/1752A	17XXA-203 Compilied BASIC or 17XX-205 Extended BASIC
MenuBASIC	17XXA-903 or S1703 [3] 17XXA-905 or S1705 [3]	• Supports Compiled BASIC (see Selection Guide for Language Systems) • Supports Extended BASIC (see Selection Guide for Language Systems) • Interactive Program Development Environment • Integrated Menu Based System • Advanced Editor • Automatic, Fast Compilation and Linking • File/Memory Management	1722A/1752A 17XX-007 512K byte RAM Expansion [1] 17XXA-016 1M byte RAM Expansion [2]	17XX-203 Compiled BASIC or 17XXA-205 Extended BASIC
TransPort–>PC	17XXA-907	• Allows transfers of data disks from 1722A/1752A to IBM-PC, IBM-XT or highly-compatible microcomputer • Transfer of numerical 1722A/1752A data files into LOTUS 1-2-3 or dBase III formats	1722A/1752A IBM-PC, PC/XT or highly-compatible microcomputer with 2 floppy drives, or 1 floppy and Winchester, 256K bytes RAM	

[1] Required hardware
[2] Recommended hardware
[3] S1703 and S1705 Packages include 17XXA-007 512K byte RAM Expansion and all required software

**UNIX is a trademark of AT & T Bell Laboratories*
***RSTS, RSX-11, and VMS are trademarks of Digital Equipment Corporation*

IBM is a trademark of International Business Machines, Inc.
LOTUS and 1-2-3 are trademarks of Lotus Development Corporation
dBase III is a trademark of Ashton-Tate Corporation

Ordering Information

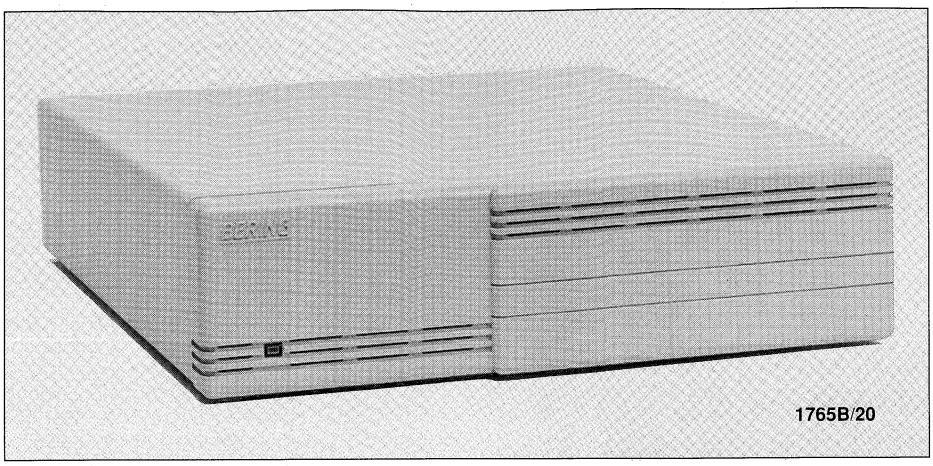
Language Systems

17XXA-201 Assembly Language Software Development System
17XXA-202 FORTRAN Software Development System
17XXA-203 Compiled BASIC Software Development System
17XXA-205 Extended BASIC Software Development System
17XXA-912 Non-ANSI C Development System
17XXA-913 Non-ANSI C Compiler

Application Software

17XXA-900 Applications Software Binder
17XXA-901 Gabby Application Software Package
17XXA-902 Touchscreen Toolbox
17XXA-903 Compiled MenuBASIC
17XXA-905 Extended MenuBASIC
17XXA-907 TransPort–>PC
S1703 Compiled MenuBASIC Development Package

1765B/20



Winchester Disk Drive Systems

- IEEE-488 commands transparent to user
- Average data transfer rate over IEEE-488 bus: 30K bytes/sec
- Complete self-test capability
- Rack mountable

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the Fluke 1722A Instrument Controller and 1752A Data Acquisition System. Both models provide for easy connection to the Controller or Data Acquisition System through a standard GPIB/IEEE-488* interface. Both models are also rack-mountable. The 1765B Series is supplied to Fluke by a major disk drive subsystem manufacturer.

When used with a Fluke 1722A or 1752A, accommodating the 1765B Series is a snap. After connecting the 1765B to an IEEE-488 port of the controller or data acquisition system, you will have 20 megabytes of on-line storage.

When used with a Fluke 1722A Instrument Controller or 1752A Data Acquisition System, you will not need to be concerned with commands to the drive over the IEEE-488 bus. The system software created by the FDOS system generation program allows the Winchester drive to be treated by applications programs as if it were simply an additional drive installed within the mainframe.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Model Number 1765B/	Capacity M Bytes	No. of Users	Storage/ User M Bytes	Max Dis. to Contr.
20	20	1	20	14m
20M	20	3	5 + 5 Shared	20m*

** At least one 1722A or 1752A connected to the 1765B/20M must be located within 4m of the drive.*

1765B/20 20M Byte Winchester Disk Drive

The Fluke model 1765B/20 is divided into eight logical devices of 2.5M bytes each. These logical devices are addressed as WD0: through WD7:.

1765B/20M Multi-User 20M Byte Winchester Disk Drive

The 1765B/20M is a multi-user version of the 1765B/20. It has the capability of supporting up to three 1722As or 1752As. Each user has access to 5M bytes of Winchester disk storage. The other 5M is shared among all of the users connected to the system. The shared space can be used to transfer files between controllers, or to store files which are needed by more than one user connected to the system. 1722As or 1752As connected to the 1765B/20M can be located up to 20m away from the drive (one controller or data acquisition system must be located within 4m of the 1765B/20M).

Specifications

Maximum Sustained Transfer Rate: 30K bytes/second
On-line Capacity: 20M bytes divided into eight logical devices of 2.5M bytes each
Track Density: 588 tracks per inch
Rotational Speed: 3600 rpm
Recording Format: 256 bytes per sector, 34 sectors per track
Error Rates: Head read errors – 1 per 1012 reads
Temperature: 10°C to 40°C, operating; 40°C to 60°C, non-operating
Humidity: 20% to 80%, operating; 5% to 95%, non-operating
Shock: 10.0g
Vibration: 0.5g
Elevation: 0 to 4572m (0 to 15,000 ft), operating; -304 to 15,240m (-1000 to 50,000 ft), non-operating
Power: Selectable: 90 to 132V ac, 198 to 264V ac. 47 Hz-63 Hz. 1.1 amp @ 120V ac, 0.6 amp @ 240V ac
Weight: 10.58 kg (23.5 lb)
Size: 107mm H x 394mm W x 446mm D (4.2 in H x 115.5 in W x 115.5 in D)

Ordering Information

Models

1765B/20 20M Byte Winchester Disk Drive
1765B/20M 20M Multi-User Winchester Disk Drive

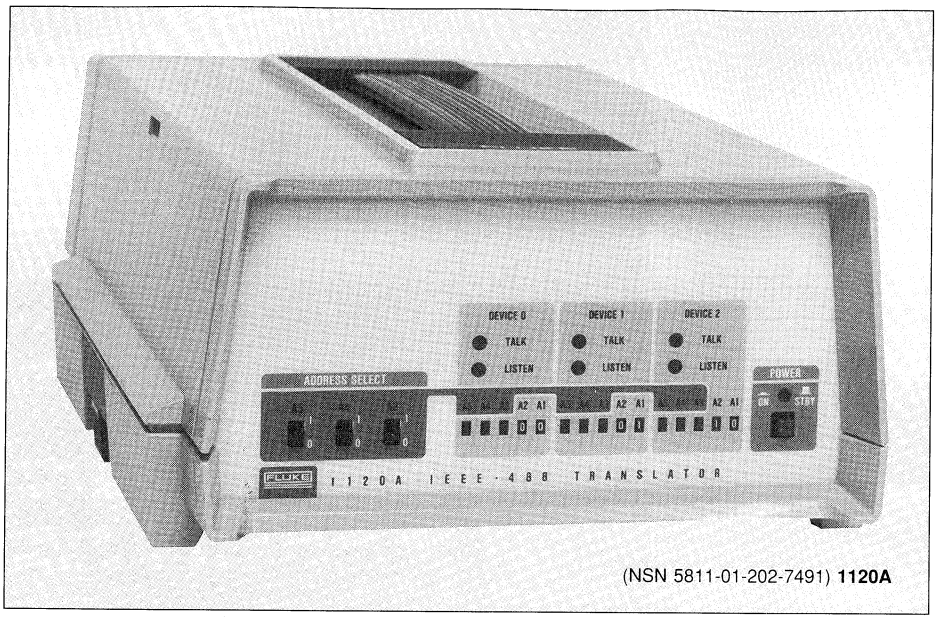
Accessories (Also see Section 20)

Y1765B Rack Mount Kit
Y1765M IEEE-488 Cable,* 16m

** This IEEE cable only works with the 1765B/20M*

1120A

GPIB
IEEE-488



(NSN 5811-01-202-7491) **1120A**

1120A GPIB/IEEE-488 Translator

Fluke's Portable Test Instrumentation (PTI) system puts low cost instruments on the GPIB/IEEE-488* bus. The benefit is that you only pay for system capability if and when you need it. And neither size, weight, nor performance of the basic instrument is compromised for system capabilities you may not need. Instead of building interface capabilities into each low cost unit, we have designed a single instrument called the 1120A IEEE-488 Translator to do the interfacing job for you.

The 1120A is the communications link between IEEE Std 488-1978 and a variety of Fluke instruments. Operating between one or more instruments and the IEEE bus, the 1120A converts codes and signals on the bus to corresponding codes and signals compatible with the particular instrument. It passes address and control commands to an instrument or outputs data, or both, depending on the capabilities of the particular instrument being interfaced.

The 1120A is a translator for a number of Fluke instruments including universal counter/timers, communications counters, digital thermometers, frequency synthesizers, and digital ac voltmeters. Up to three instruments can be interfaced to the bus with a single 1120A, and multiple 1120As can be used in a system.

The 1120A connects instruments to the bus through an optional data output unit in the instrument and a "personality card" in the 1120A. Each personality card is individually addressable and "transparent" to other instruments. Each corresponds to a particular Fluke instrument model and is sold as an option to that instrument. The cards simply plug in to an 1120A which provides the necessary power and microprocessor-based circuits for their operation. The 1120A personality cards, accessory cables, and instrument data output units are designed to be easily assembled by the user. As your needs change, you can quickly change cards to accommodate other Fluke instruments. Many of the instruments and cables are sold as Option -521. If so numbered, they will operate directly into a Fluke 2020A (with Option -004) or 2030A Printer without an 1120A IEEE-488 Translator.

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Building A System

Instruments that presently operate through the 1120A Translator to work in an IEEE-488 system are: 2180A, 2190A, 6160B, 7220A, 7250A, 7260A, 7261A, 8920A, 8921A, and 8922A. Ordering Option -529 with most any of those instruments will get you all the things you need to connect the instrument to an 1120A Translator. However, check the catalog pages pertaining to each instrument to be sure.

For example, if you wanted to connect both a Fluke 7261A Counter and a Fluke 8920A Digital Voltmeter to other instruments on the IEEE-488 bus you could do so by ordering an 1120A Translator and checking the option descriptions for the 7261A and 8920A. You would find you need Option 892XA-529 (for the 8920A) and Option 72XXA-529 (for the 7261A).

Optional 1-meter, 2-meter, or 4-meter cables connect the 1120A Translator to other "bus instruments."

See the instrument index in the front of this section for a complete listing of IEEE-488 compatible instruments.

A17-4 Bit Parallel Interface

A special circuit card may be fitted into an 1120A Translator that converts it into a general purpose translator between IEEE-488 bus systems and bit parallel data systems.

One A17-4 card handles up to 32 digital inputs and/or outputs and up to three A17-4 cards will fit in one 1120A Translator.

Any, or all, of the 32 bits may be used as input and/or output. However, these bits must be organized in groups of four or eight. BCD, binary and hexadecimal modes may be chosen, or for status outputs any single bit may be set or reset without altering other bits in the binary or hex mode.

The A17-4 can be set to continuously monitor any designated single port (8 or 4 bits). It will then request service whenever any bit of that port, which is enabled by the SRQ mask, changes to a logic True.

The A17-4 has an output strobe line which may be used to trigger or latch external devices when the data on the output lines is valid. Similar capability is optional in the 2400B, 2280B, and the 1722A with Option -002.

For more information ask for Bulletin A0143.

Ordering Information

Model

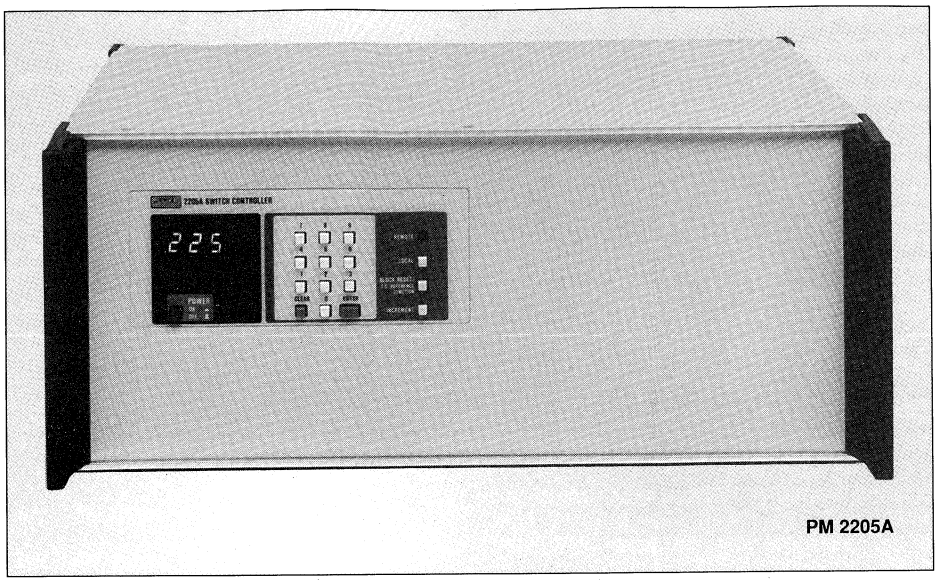
1120A IEEE-488 Translator
A17-4 Bit Parallel Interface

Accessories (Also see Section 20)

Y8021 Shielded Cable 1m (39.4 in)
Y8022 Shielded Cable 2m (78.8 in)
Y8023 Shielded Cable 4m (13 ft)

2205A

GPIB
IEEE-488



PM 2205A

2205A Switch Controller/Scanner

- Plug-in modules that expand the versatility of the 2205A
- Channel expansion (up to 1000)
- Matrix latching
- Low level and thermocouple scanning
- Two-wire or four-wire resistance scanning
- Actuator/Relay control
- Remote operation via IEEE-488 interface (included)

Versatile Switching, Latching, Scanning

The microprocessor-based 2205A Switch Controller offers a wide variety of switching, scanning, and matrix-latching capabilities for applications in production testing, process monitoring, process automation, calibration, etc.

The 2205A may be operated or programmed from the front panel to perform periodic switching operations. Or it may be directed remotely in a system compatible with GPIB/IEEE-488* to perform complex switching operations.

Five Switching Options

Five kinds of switching module options are available. They plug into the 2205A mainframe and any combination of up to ten modules may be plugged in at the same time. Model 2201A or 2202A Extender Chassis allows for expansion of a system to accommodate up to 100 modules.

Three of the five types of switching options are for scanning analog signals and measuring them with a DMM. One of the three is for measuring low level signals such as the output voltage from thermocouples (-600), one is for general-purpose scanning (-300), and one is for measuring resistances using 4-wire connections (-400). Four wires are needed for precision measurements of low resistance values through long input wires. The latter option uses a pair of modules: a general-purpose module for the current-source leads and a low-level module for the voltage-sense leads.

Each module has ten reed relays and will scan ten points. The low-level reed relays switch a guard line as well as a pair of input leads.

Option -100 is an actuator module with five medium-power relays for controlling external and remote devices like indicators, actuators, alarms, power supplies, and other relays.

Option -200 is a matrix latching module that may be configured in one of three ways: either as a 1 by 8 matrix, as two 1 by 4 matrixes, or as a 2 by 4 matrix. This option features an 8 millisecond break-before-make switching speed and less than 10 microvolts of thermal offset.

Integrated Stimulus, Measurement, Control

The modularity of the 2205A makes it easy to configure switching in numerous ways. And that makes it a worthy building block for automated systems of various kinds. With the standard GPIB/IEEE-488 interface the 2205A becomes an integral part of a sophisticated system. Fluke offers numerous IEEE-488-compatible instruments including the 1722A or 1752A Instrument Controller, signal sources, power sources, calibrators, digital voltmeters, counters, thermometers, data loggers, and printers. The IEEE-488 interface supports the following subset: AH1, L2, RL1, DC1, E2.

Specifications

2205A Specifications

Control: Manual, panel-programmed scan, or via IEEE-488 Interface

Panel Controls: Select channels to be scanned, actuated, or latched. Scan rate selectable in 0.1 second increments from 0.2 seconds to 3.3 seconds per channel using behind-the-panel control

Switch-Module Slots: Ten, expandable to 100 using several 2201A (12-slot) or 2202A (10-slot) Extender Chassis

Display: 3-digit LED. Shows active channel number. Also shows assigned address (using IEEE-488 Interface) at time of power-up

Trigger Output: Rear panel BNC connector. TTL level. Adjustable delay. To trigger measurements following moments when switching occurs

Analog Output: To digital multimeter via rear panel output connector. Guarded 2-wire or guarded 4-wire connections. Common-mode voltage 170V dc or peak ac

Other Inputs and Outputs: Via module connectors included with modules

Internal Scanning Bus: Two 3-wire buses. One is common to even-numbered module slots; the other is common to odd-numbered slots. Goes to analog output. Input resistance is greater than 10 GΩ on HI or LO with respect to power line ground.

2201A Specifications

Switch-Module Slots: 12 in each 2201A. Up to 100 slots (1000 channels) per system. One or more 2201A Extender Chassis may be connected to a 2205A via a six-foot cable supplied with each 2201A. Power and control for the modules is supplied by the 2205A.

2202A Specifications

Switch Module Slots: 10 in each 2202A. Up to 100 slots (1000 channels) per system. Power for the modules is supplied from an ac line via internal dc supply. Requires 2200A-7001 and 2200A-7002 cable.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2205A

Option Specifications

Actuator Control Module (-100)

Relays: Five, SPDT
Switching Time: 20 ms*
Contact Rating: 1A maximum at up to 26V dc or 30V rms ac. 3A fuse in each common line
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -110K and -010K

Matrix Latching Module (-200)

Relays: Eight, latching, DPST with unswitched guard, break-before-make
Switching Time: 8 ms*
Rating: 40 mA maximum to 170V dc or peak ac, max
Bandwidth: DC to 1 MHz (±0.1 dB) into 600Ω to 1 MΩ load
Thermal Offset: <10 μV
Configurations: One 2x4 matrix, two 1x4 matrixes, or one 1x8 matrix
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -210K and -009K.

General-Purpose Scanning Module (-300)

Relays: Ten, reed type, DPST with unswitched guard
Scan Rate: 125 channels per second, max*
Rating: 40 mA maximum. A 0.5A fuse in each input line
Thermal Offset: <10 μV
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Com prised of -310K and -009K.

Low-Level Scanning Module (-600)

Relays: Ten, reed type, 3 PST, switched guard
Scan Rate: 80 channels per second, maximum*
Rating: 15 mA maximum to 35V peak
Reference Junction Output: 540 mV at 25°C
Thermal Offset: <1 μV
Connectors: Screw terminals on isothermal block to minimize temperature differences between terminals when scanning thermocouples. Reference junction temperature-sensing circuit on isothermal block provides automatic compensation to thermocouple output signals. Terminals are mounted on edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -610K and -008K

Four-wire Ohms (-400) (-300 plus -600)

Two modules per option, used in adjacent slots. Switch both current-source and voltage-sense connections for precision resistance measurements. Specifications for current sourcing are the same as for Option -300. Specifications for voltage sensing are the same as for Option -600, except reference junction temperature sensing circuits are not available. Comprised of -310K and -009K plus -610K and -008K. For applications requiring more than 50 four-wire ohm circuits, the 2200A-7000/AU adapter and pairs of 2201A Extender Chassis are required.

**These times are 2205A times and do not necessarily reflect system specs*

General Specifications

Temperature: 0°C to 50°C, operating; -55°C to +75°C, non-operating
Relative Humidity: ≤80% to 40°C, operating
Power: 100, 120, 220, or 240V ac ±10%, 50 to 60 Hz, selectable from rear panel. 25W maximum
Size: 17.8 cm H x 43.2 cm W x 44 cm D (7 in H x 17 in W x 17.4 in D)
Safety: IEC 348 Protective, Class 1
Weight: 7.1 kg (15.6 lb)

Included with Instrument
2205A: Manual, power cord, 3-foot Y8076 analog output cable for 8502A-16, 8505A, 8506A, 8520A, or 8860A-06 DMM
2201A: Manual, six-foot cable for connecting to 2205A
2202A: Manual, power cord but no cable

Ordering Information

Models

2205A Switch Controller including IEEE-488 Interface
2201A Extender Chassis

Options

-100 Actuator Control
-200 Matrix Latching
-300 General-Purpose Scanning
-400 4-Wire Ohms Scanning
-600 Low-level Scanning

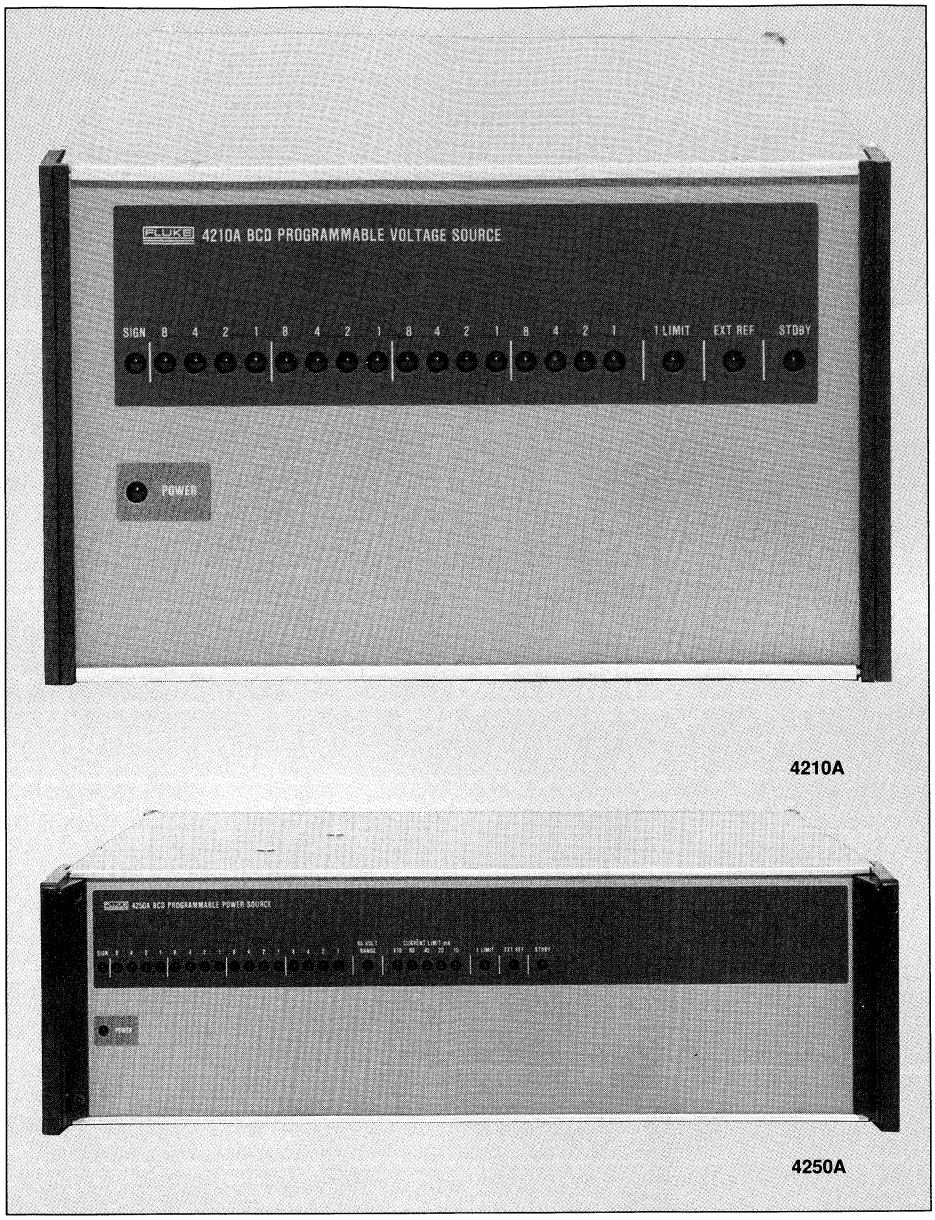
Accessories (Also see Section 20)

2205A-008K Spare Low-Level Connector
2205A-009K Spare General-Purpose Connector
2205A-010K Spare Actuator Connector
2205A-110K Spare Actuator Card
2205A-210K Spare Matrix Latching Card
2205A-310K Spare General-Purpose Scanner Card
2205A-610K Spare Low-Level Scanner Card
2200A-7000/AU Multi-Channel 4-Wire Ohms Adapter
Y8021 Cable for IEEE-488 Bus, 1m
Y8022 Cable for IEEE-488 Bus, 2m
Y8023 Cable for IEEE-488 Bus, 4m
Y8004 RS-232-C Cable, 1.5m
Y8013 Trigger Output Cable, 4-foot
Y8076 Analog Interface Cable (included w/ 2205A) 3-foot
M07-205-600 7" Rack Mount Kit
M00-260-610 18" Rack Slides (needs M07-205-600)
M00-270-610 20" Rack Slides (needs M07-205-600)
M00-280-610 24" Rack Slides (needs M07-205-600)

** -7001 and -7002 both required with 2202A*

4200 Series

GPIB
IEEE-488



4200 Series Programmable Power Supplies

- GPIB/IEEE-488 or parallel interfaces
- BCD or binary 2s complement coding
- Isolated digital control of ac and dc external sources
- Up to 65V at 1 amp or 110V at 1/2 amp
- Fully guarded
- ±0.01% accuracy
- 100 μV resolution capability
- 30 to 110 μs response time

The 4200 Series Programmable Power Sources are more than just precision digital-to-analog converters. They incorporate features that are not available in typical programmable power supplies: speed, accuracy, low programming noise, true current limiting, isolated control logic, output proportional to an external reference voltage.

These power sources may be operated in series or parallel, just like batteries. They will operate with up to 1000 volts between chassis ground and guard (250 volts with GPIB/IEEE-488* interface). That allows you to use them as a programmable vernier for high voltage power supplies. Current sink capability, coupled with programmable current limits, allows four of the six models to be used as a dynamic load.

Isolated Control Logic Option (-01)

Isolated control logic is parallel BCD for the 4210A, 4250A, and 4270A and 14-bit or 16-bit parallel binary for the 4216A, 4265A, and 4275A and is available as Option -01. However, any of the six models may be ordered with multi-strobe logic (Option -09) or with an interface for compatibility with GPIB/IEEE Std 488-1978 (Option -05).

Multi-Strobe Logic Option (-09)

Allows programming directly from any 16-bit or 18-bit program source with addressing capabilities for up to eight 4200-Series Power Sources. The power sources may be in series as well as parallel. The control lines are electrically isolated from the output.

GPIB/IEEE-488 Interface Option (-05)

The GPIB/IEEE-488 interface allows the user to program the following functions using command character format: Voltage, current limit, external reference, range, polarity, SRQ response on errors, operate and standby. In addition to the normal command string format of programming, the GPIB/IEEE-488 interface offers a "Direct Ladder Access" mode of programming. This mode is a 4-byte transfer sequence with limited GPIB/IEEE-488 error and syntax checking, but with fast output results. The repertoire is SH1, AH1, T6, L4, SR1, DC1, and DT1.

External Reference Option (-03)

Output may be ac as well as dc. And, with Option -03, you have the ability to amplify or attenuate, by digital control, either an ac or dc voltage supplied by an external source. Output polarity matches input polarity. The 3 dB bandwidth is 100 kHz for the 4210A and 4216A, and 30 kHz for the other models.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

11

Current Limit Option (-06)

To protect devices being powered, the output current can be automatically limited to any value between 10% and 110% of maximum output current in 10% steps and 1% steps to 11%. Current is automatically limited at 120% of rated output when Option -06 is not installed.

High Resolution Option (-07)

To be able to program output voltage with 10 times better resolution than normal, Option -07 may be ordered for models 4210A, 4250A, and 4270A. Option -06 cannot be installed at the same time, however.

A4200 Manual Control Unit

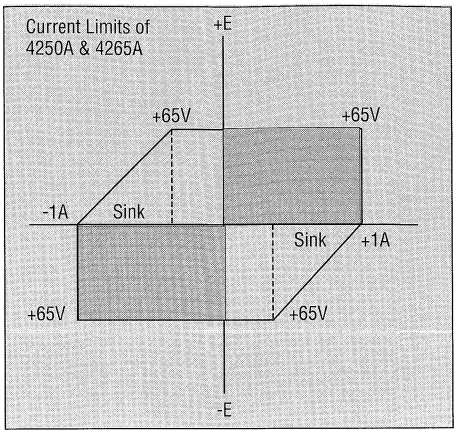
For bench operation and calibration the A4200 is available as an accessory. It allows the operator to manually select each control line as well as monitor flag lines available from a power source. To view such characteristics as programming noise, settling time, rise time etc., an automatic mode is provided. When all the bits in any 8-4-2-1 decade are set, the power source will generate a staircase at the analog output which may be examined on an oscilloscope. The A4200 is not compatible with Option -09 or the IEEE-488 Interface Option (-05).

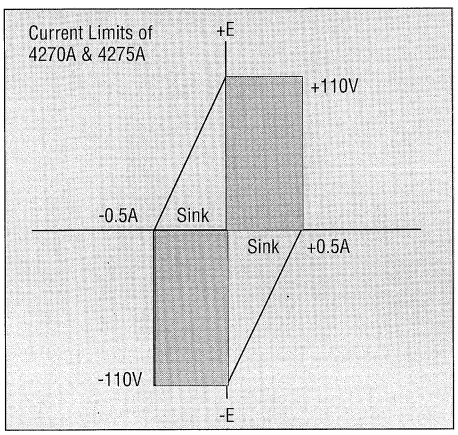
Specifications

Technical Specifications

Characteristics	1/2 Rack		Full Rack Width			
	4210A	4216A	4250A	4265A	4270A	4275A
Display	BCD	Binary	BCD	Binary	1BCD	Binary
Current Range	±100 mA	±100 mA	±1A	±1A	±0.5A	±0.5A
Option -06 Limit*	–	–	10% steps*	10% steps*	10% steps*	10% steps*
Regulation [1]	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%
Settling Time						
Within 0.1% of step	18 µs	18 µs	70 µs	70 µs	80 µs	85 µs
Within 0.01% of step	30 µs	30 µs	100 µs	100 µs	110 µs	110 µs
Low Voltage Range						
Voltage Range	±9.999	±16.383	±9.999V	±16.383V	±9.999V	±32.7675V
Resolution	1 mV	1 mV	1 mV	1 mV	1 mV	0.5 mV
W/Option -07	100 µV	–	100 µV	–	100 µV	–
90-Day Accuracy [2] ±0.01% of Output	±100 µV	±100 µV	±100 µV	±100 µV	±100 µV	±160 µV
90-Day Stability [3] ±0.003% of Output	±60 µV	±60 µV	±70 µV	±70 µV	±70 µV	±105 µV
Ripple and Noise [4]	300 µV rms	300 µV rms	500 µV rms	500 µV rms	500 µV rms	500 µV rms
Programming Noise	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p	130 mV p-p
High Voltage Range						
Voltage Range	–	–	±65.00V	±65.53V	±99.99V	±110V
Resolution	–	–	10 mV	4 mV	10 mV	2 mV
W/Option -07	–	–	1 mV	–	1 mV	–
90- Day Accuracy [2] ±0.01% of Output	–	–	±700 µV	±300 µV	±700 µV	±530 µV
90-Day Stability [3] ±0.003% of Output	–	–	±490 µV	±210 µV	±490 µV	±370 µV
Ripple and Noise [4]	–	–	1 mV rms	1 mV rms	1.2 mV rms	1.2 mV rms
Programming Noise	–	–	260 mV p-p	260 mV p-p	260 mV p-p	260 mV p-p

** Also 1% steps to 11%. Limit at 120% of range without Option -06*
[1] Percent of output, no load to full load, ±10% line change
[2] 15°C to 35°C
[3] At constant line, load, and temperature
[4] 10 Hz to 10 MHz bandwidth





General Specifications

Shock: 120G, 11 millisecond half-sinewave
Vibration: 14.5G, 10 Hz to 55 Hz
Altitude: ≤10,000 feet, operating; ≤50,000 non-operating
Temperature: 0°C to 50°C operating; -40°C to <75°C non-operating
Power: 115V or 230V ac ±10%, 48 Hz to 62 Hz. 4210A and 4216A 15W; 4250A and 4265A 100W; 4270A and 4275A 200W
Size
4210A and 4216A: One half 19-inch rack width, 13.3 cm H x 21.6 cm W x 40.9 cm D (5.25 in x 8.5 in x 16.13 in)
Others: Full 19-inch rack width, 13.3 cm H x 43.2 cm W x 49.7 cm D (5.25 in x 17 in x 19.56 in)
Weight
4210A and 4216A: 5.5 kg (12 lb)
Others: 15.9 kg (35 lb)

Included with Instrument: Instruction manual, power cord, mating digital input cable connector, screw terminal outputs. Order Y8021, Y8022, or Y8023 cable separately for Option -05

Ordering Information

Models

4210A Programmable Power Source, 100 mA
4216A Programmable Power Source, 100 mA
4250A Programmable Power Source, 1A
4265A Programmable Power Source, 1A
4270A Programmable Power Source, 500 mA
4275A Programmable Power Source, 500 mA
Interface Option -01, -05, or -09 is also required

Options (for above Models)*

-01 Isolated Control Logic
-03 External Reference
-05 IEEE-488 Interface
-06 Programmable Current Limit
-07 1100 µV Resolution (4250A only)
-09 (BCD/Binary) Multi-strobe Logic

** See chart below for compatibility*

Accessories (Also see Section 20)

Rack Mount Kit for 4210A and 4216A
M05-200-603 5¼", Dual
M05-203-601 5¼", Offset
M05-203-602 5¼", Centered
Rack Mount Kit for 4250A, 4265A, 4270A, 4275A
M05-205-600 5¼",single
Rack Slides for M05-200-603 or M05-205-600
M00-260-610 18"
M00-270-610 20"
M00-280-610 24"
A4200 Manual Control Unit w/Cable
4210A-4014 PCB Extender Board
4270A-4303 PCB Extender Cable
Y8021 IEEE-488Cable, 1m
Y8022 IEEE-488Cable, 2m
Y8023 IEEE-488Cable, 4m

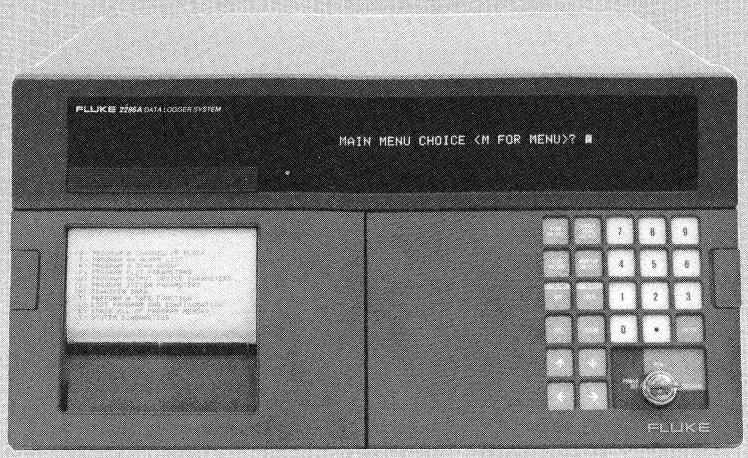
4200 Series Option Compatibility

Option	Description	4210A	4216A	4250A	4265A	4270A	4275A
42**A-01	Isolated Control Logic	1	1	1	1	1	1
42**A-03	External Reference	•	•	•	•	•	•
42**A-05	Interface for IEEE-488 Bus	1	1	1	1	1	1
42**A-06	Programmable Current Limit	–	–	2	•	2	•
42**A-07	100 Microvolt Resolution	•	–	2	–	2	–
42**A-09	Multistrobe Logic (BCD/Binary)	1	1	1	1	1	1
Other Items							
M05-205-600	Rack Adapter	–	–	•	•	•	•
M05-203-601	Rack Adapter, left or right side	•	•	–	–	–	–
M05-203-602	Rack Adapter, centered	•	•	–	–	–	–
M05-200-603	Rack Adapter, dual, left & right	•	•	–	–	–	–
M00-260-610	18-Inch Rack Slides	3	3	3	3	3	3
M00-270-610	20-Inch Rack Slides	3	3	3	3	3	3
M00-280-610	24-Inch Rack Slides	3	3	3	3	3	3

Notes: All options are customer-installable. However, add the suffix letter K if option is not to be installed at the factory. Order -07K and/or -09K through the parts department.
•Compatible option
1. -01, -05, or -09 is required. Only one may be installed in one instrument
2. Option -06 and -07 cannot be installed in the same instrument
3. Used with Rack Adapter -600 or -603
*42**A Use appropriate model number as prefix for option number*

Data Acquisition

NEW



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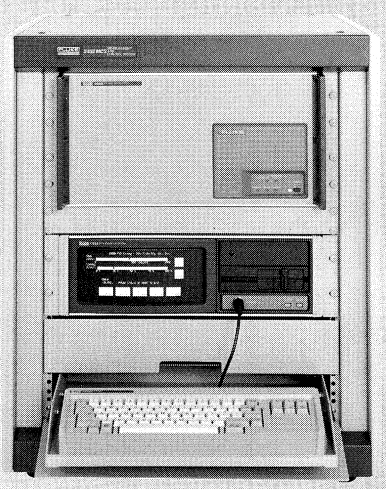

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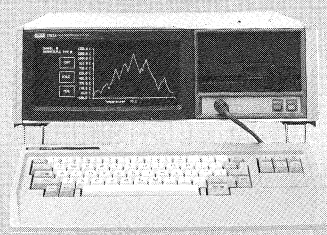

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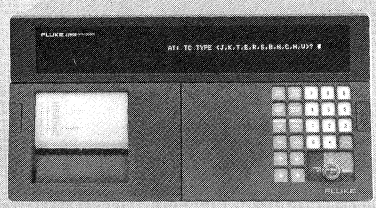

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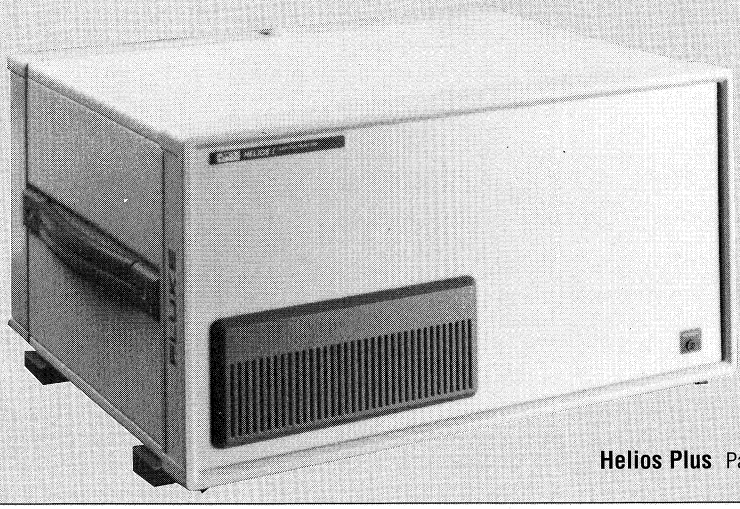
NEW



Helios Plus Page 414

Whether you need a complete system or an OEM component, Fluke has a reliable measurement and control solution. Aids like industry standard communications, software tools, and PC-compatible analysis packages make our data acquisition equipment simple to set up, integrate and use.

The 2280 SERIES Data Loggers feature menu-prompted set-up, totally eliminating software programming. They support a wide range of analog and digital options. The 2286A has an internal MS-DOS compatible 3½ inch floppy disk drive. This feature allows the user to record data on the disk, load the disk directly into a PC and then import the file into a spreadsheet program for data analysis.

Our 1752A Data Acquisiton System, with powerful real-time processing, is Fluke's highest-speed system for manufacturing and product testing.

Helios-I and Helios Plus Computer Front Ends, with application software convert your PC into a powerful data acquisitiion system. Menu prompted Helios-I Computer Front End and application software team up for a complete PC-based system. Menu-prompted setup eliminates the need for programming. Integration with Lotus 1-2-3™ helps you present a clear picture of your test results.

The 2400B Intelligent Computer Front End conditions over two dozen signal types, and frees your host computer from time-consuming monitoring and control tasks.

The 2452MCS Measurement and Control System is Fluke's most powerful data acquistion solution for a wide variety of tests and processes. It provides the user with the computing power of the 1752A and monitoring and control of the 2400B.

The 2280 SERIES Data Loggers feature menu-prompted set-up, totally eliminating software programming. They support a full range of analog and digital options.

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Data Loggers	Page 407
Computer Front Ends	Page 414
Data Acquisition System & Software	Page 424
Measurement & Control System	Page 428
Option Compatibility	Page 433

Selection Guide

Measurement	2285B	2286A	1752A	2400B*	2452MCS	2289A	2287A	PM 8238††
Thermocouples	11 Types	11 Types	7 Types**	12 Types	12 Types	11 Types	11 Types	11 Types
RTDs	All Types	All Types	100Ω Pt. 385**	All Types	All Types	All Types	All Types	100Ω Pt
Resistance	To 64K	To 64K	–	To 64K	To 64K	To 64K	To 64K	To 3.9K
DC Voltage Ranges	64 mV-64V	64 mV-64V	1V-10V	100 mV-100V	100 mV-100V	64 mV-64V	64 mV-64V	30 mV-30V
Max DC Resolution	1 μV	1 μV	124 μV	1 μV	1 μV	0.5 μV	0.5 μV	1 μV
AC Voltage Ranges	250V	250V	250V**	250V	250V	250V	250V	–
DC Current	0 to 64 mA	0 to 64 mA	0 to 65 mA	0 to 20 mA	0 to 20 mA	0 to 64 mA	0 to 64 mA	–
Strain Gage	Yes	Yes	Yes**	Yes	Yes	Yes	Yes	–
BCD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–
Binary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–
Status (Contacts)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–
Counter	To 1 kHz	To 400 kHz	To 900 kHz	To 900 kHz	To 900 kHz	To 400 kHz	To 400 kHz	–
Event Totalize	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–
Sequence of Events	–	–	–	Yes	Yes	–	–	–
Control								
Status or Alarms	0-100	0-1500	0-256	0-1024	0-1024	0-1500	0-1000	0-32
Int Relays (Max)	1	1	–	0-1024	0-1024	–	–	32
User-Defined BCD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–
Analog Voltage	–	To ±10V	To ±10V	To ±10V	To ±10V	To ±10V	To ±10V	–
Analog Current	–	4-20 mA	4-20 mA	4-20 mA	4-20 mA	4-20 mA	4-20 mA	–
Analog Resistance	–	–	–	To 102K	To 102K	–	–	–
PID	–	–	Yes	Yes	Yes	Yes	Yes	–
Stepper Motor	–	–	–	Yes	Yes	–	–	–
Page Number	407	407	424	419	428	413	413	468

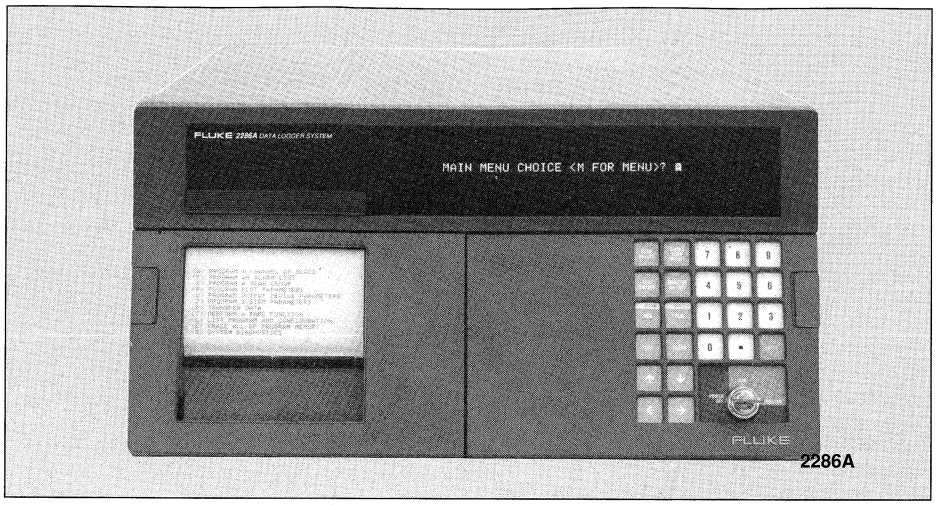
**Also requires host computer such as Fluke 1722A, 1752A or IBM PC (IBM is a registered trademark of International Business Machines, Inc.)*
***Using external signal conditioning*

Features

Features	2285B	2286A	1752A	2400B*	2452MCS	2289A	2287A	PM 8238††
Basic Accuracy (dc V)	±.005%	±.005%	±.02%	±.002%	±.002%	±.005%	±0.005%	±0.1%
Speed Channels/s	15	15†	1000†	25	25 (High Res) 1000 (Med Res)	16†	1000 (Med Res)†	10
Programming Environment	Menu Prompted	Menu Prompted	BASIC FORTRAN Assembly C	Fluke Measurement & Control Language	BASIC FORTRAN Assembly Pro Gen & C	Dependent on Host	Dependent on Host	Function Keys + Six Digit Display
Operator Interface	Membrane Keypad	Membrane Keypad	Touch-Screen	Via Host	Touch-Screen	Via Host	Via Host	4 Digit Display + Functional LEDs
Analog Input Channels	100	1500	128	1000	128	1500	1000	
RS-232/IEEE-488	Opt	Opt	Std	Opt	Std	RS-232-C Std	RS-232-C Std	Opt
12V dc Operation	Yes	Yes	Opt	–	Opt	Opt	Opt	–
Memory Expansion	None	None	3.0M + Bytes	None	3.0M + Bytes	–	Yes	–
Graphics	Plot	Plot	Dot Address	Via Host	Dot Address	Via Host	Via Host	1000 Point Chart Recording
Permanent Data Storage	Host	3.5" Disk	Disk Non-Volatile RAM	Eprom Host	Disk Non-Volatile RAM	Host	Host	Hard Copy
Built-in Printer	Yes	Yes	–	–	–	–	–	Yes
Battery Back-up	Program, Clock	Program, Clock	Clock	None	Clock	Definitions, Clock	Data Definitions	Program, Clock
Software for IBM PC	Yes	Yes	–	Yes	–	Yes	Yes	Yes

†In burst mode A/Ds operate in parallel for even higher effective reading rates
††Specifications also applicable to KS 8238

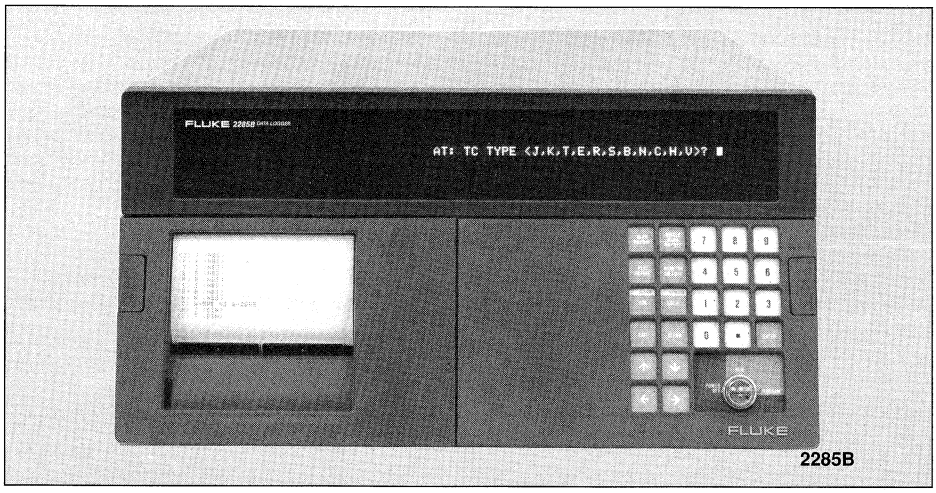
NEW



2286A

2286A Data Logging System

- Fluke's most powerful stand-alone data logger
- Expandable to 1500 channels*
- Precision measurements and control
- 3.5" floppy drive, MS-DOS compatible
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software



2285B

2285B Data Logger

- Economical solution for simpler applications
- Expandable to 100 channels
- Precision measurements
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

The 2280 SERIES, a family of advanced data loggers, combines high measurement accuracy, exceptional configuration flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2286A Data Logging System, offers solutions for demanding data acquisition and reporting problems.

The 2286A Data Logging System, Fluke's most powerful data logger, features a MS-DOS compatible microfloppy drive for data and program storage. The disk can be taken from the 2286A, inserted directly into a PC and the data files stored in DIF format may be imported into Lotus 1-2-3™ or other spreadsheets. The 2286A is expandable from a simple 20 channels data logger to a distributed 1500 point data acquisition system. All of the 2280 SERIES options are accepted by the 2286A for a powerful and flexible system.

For applications that do not require all the power or expansion capabilities of the 2286A Data Logging System, the 2285B Data Logger is a more economical solution. Expandable to 100 points, the 2285B accepts all 2280 SERIES options, except the Analog Output (-170), Counter/Totalizer (-167), and Math Coprocessor (-211) options.

Programming Ease

Both the 2285B and 2286A are programmed by responding to a series of prompted menus. Simple front panel responses to the displayed questions configure the 2280 SERIES to perform the required tasks. Instead of limiting the user to pre-defined functions, or requiring the development of libraries of application software, the 2280 SERIES employs pseudo-channels. An exclusive 2280 SERIES feature, pseudo-channels allow any mathematical relationship between channels, such as group averages; or between a channel and time, such as rate of change; to be described as a simple algebraic equation. With pseudo-channels, application problems that previously required the power of a computer, and an investment in software, are now possible in a stand-alone data logger.

Power to Get the Job Done

Accenting this computational power, the 2280 SERIES offers excellent documentation features. Each measurement channel, output channel or pseudo-channel can be uniquely identified with a 15 character label, clearly describing the point being logged. Adding further clarity, 6 character, user defined, engineering units for each point are a standard feature. Also standard is the ability to check every input, output or pseudo-channel against alarm limits. Four high/low limits are available for each channel, and each limit can cause a user defined 40 character message describing the alarm condition to be recorded.

**Depending on programming requirements.*

2280 Series

Report Generation

The 2280 SERIES allows its recording function to be easily tailored to the requirements of the job. Collected data, the results of calculations, or outputs can be viewed on the bright, 40 column vacuum fluorescent display, or logged on the wide format 40 column internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232-C or GPIB/IEEE-488* interfaces. A 3.5" floppy drive is a standard feature of the 2286A. The MS-DOS compatible drive allows the user to save data on a disk and be able to insert that disk directly into the PC for data manipulation. Both programs and data can be stored on a disk.

For Demanding Environments

Applications that require more input or output points than can be housed in the mainframe are satisfied by using the 2281A extender chassis. These extender chassis are connected to the mainframe with a simple six twisted pair cable, and communicate via a high speed, fault tolerant, communication network. Since all communication is digital, signal integrity is assured in electrically noisy environments. Furthermore, any input or output options housed in an extender chassis have an operating range of -20°C to +70°C.

Portable Operation

Another standard feature is full operation from 12V dc power, making the 2280 SERIES a natural for mobile data acquisition. Additionally, connecting a 12V battery allows this dc operating mode to function as an uninterruptable power supply. The 2280 SERIES trickle charges the battery when on line power and bumplessly transfers to battery operation when line power fails, assuring measurement integrity for critical applications.

Specifications

2280 SERIES System

Maximum Inputs & Outputs: ≤1500 channels per system (2286A); ≤100 channels per system (2285B)
Analog Inputs: ≤1500 channels per system (2286A), ≤100 channels per system (2285B)
Status, Binary, or BCD Inputs: ≤1500 channels per system (2286A), ≤100 channels per system (2285B)
Status Outputs: ≤1500 channels per system (2286A); ≤100 channels per system (2285B)
Alarm Outputs: ≤1500 channels per system (2286A); ≤100 channels per system (2285B)
Analog Outputs: ≤600 channels per system (2286A only)
Computation Power: Besides built-in thermocouple and RTD linearizations, the 2280 SERIES will handle equations involving addition, subtraction, multiplication, division, and parentheses. Math Coprocessor Option (-211) (2286A only) adds square root, exponent, logarithm, trigonometric, standard deviation, interpolation tables, logic functions, equal-to, less-than, greater-than, etc.
Tasks: Up to 10 independent, prioritized scan groups
Scanning Speed: Depends on the number of A-to-D Converter Options (-161) per system and the system configuration. Scanning dc voltage inputs for alarms at full accuracy:
Up to **16** channels per second with **1** A/D
Up to **30** channels per second with **2** A/Ds
Up to **42** channels per second with **3** A/Ds
Up to **65** channels per second with **5** A/Ds
Temperature: 0°C to 50°C operating (2286A/2285B); -20°C to 70°C operating (2281A)
System Communications: High speed digital data transferred between 2281As and a 2286A/2285B is via noise-immune twisted wire-pairs. May be linked in star and/or daisy-chain configurations
Distance To Extender Chassis: Any 2281A may be up to 1 km away from a 2286A/2285B
Failures: System component failures are reported as an alarm. All properly operating equipment continues with normal tasks

The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

2280 SERIES Mainframe

I/O Capacity: Six slots for input and output options. One of the six slots must contain an A-to-D converter option when one or more analog input options is used. Each analog input option will scan 20 channels and each status or digital input or output option will handle 20 lines. If no A-to-D converter option is needed the 2286A will handle up to 120 points of status inputs or outputs. Two additional plug-in slots are for any combination of one or two IEEE-488 or RS-232 options
Program Memory: 32K bytes (2286A); 20K bytes (2285B). Non-volatile. Battery back-up for at least 30 days, 90 days typical. Program may also be printed using internal printer or with optional interface to external devices
Internal 3.5" Disk Drive: MS-DOS compatible disk drive used to store both data and programs. User can select high or low density disk format. The data can be stored in DIF or ASCII text format. Four data compression formats are selectable for data recorded. Storage capacity is up to 150,000 channel readings dependent upon disk density, data format and number of channels in a scan group. The data stored on disk may be transferred to the internal printer, peripheral devices or the disk may be placed directly into a 3.5" drive attached to a PC and read. One blank micro-floppy is included with the 2286A.
Internal Printer: Uses thermosensitive paper, 110 mm (4.4 in) wide. Up to 40 alphanumeric characters per line printed from 5x7 dot matrix, 2.6 lines per cm (6.7 lines per in). Each line printed below the previous line. Will plot one to four graphs from scanned or calculated data, instead of alphanumeric characters, using distinctive symbol for each graph in any of 276 discrete positions across width of paper. Automatic paper take-up reel prevents spilling and allows withdrawal of any printed portion for review
Power: 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz. Or 10.5 to 15V dc. Ac power will trickle-charge 12-volt battery for uninterrupted power. Less than 120W fully loaded
Size: 22.23 cm H x 43.94 cm W x 66.17 cm L (9.35 in H x 17.30 in W x 26.05 in L)
Weight: 20-29 kg (45-66 lbs) depending on configuration

Included with Instrument: Manual set, Getting Started Guide, one roll of printer paper, one pad of programming forms and power cord

2281A Extender Chassis

Capacity: Same plug-in options as 2286A/2285B
Power: Normally supplied by 2286A/2285B via 2281A-402 cable or equal. An optional built in power supply (2281A-431) may also be used and may be required for remote operation
Operating Temperature: -20°C to +70°C
Cables: 1 meter cable included
Size: 22.23 cm H x 43.94 cm W x 35.88 cm D (9.35 in H x 17.30 in W x 14.125 in D)
Altitude: Operating: 3050 M (10,000 feet); non-operating: 12,200 M (40,000)

Options

Math Coprocessor Option (-211) (2286A only)

Functions: Absolute value, square root, exponential, sine, cosine, tangent, arc sine, arc cosine, arc tangent, common logarithm, natural logarithm, e^x, exponentiation, integer part, maximum value, minimum value, standard deviation, elapsed time
Logical Operators: AND, OR, NOT, EXCLUSIVE OR
Relational Operators: <, ≤, >, ≥, =, ≠
Interpolation Tables: ≤10, user-entered. Number of points per table is limited only by system memory

High Performance A/D Converter Option (-161)

One per 2286A/2285B and 2281A required for any analog measurement inputs. ≤15 total per system
Dynamic Range: 80,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V dc
Resolution: 1 µV on 64 mV range, 10 µV on 512 mV range, 100 µV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: ≥170 dB at 50 or 60 Hz ±0.1%; ≥160 dB at dc; 100 ohm unbalance
Normal Mode Noise Rejection: ≥60 dB at 50 or 60 Hz ±0.1%
Operating Temperature: -20°C to +70°C

2286A, 2285B & 2281A Input Options

For These Inputs	Use Connector Option	With Scanner Option	Maximum Inputs Per Scanner
Thermo-couples	-175	-162**	20
DC Voltage	-176 or -175	-162**	20
DC Current	-171	-162**	20
AC & DC Voltage	-160	-162**	10 AC 10 DC
RTDs or Ohms	-177	-163**	20
RTDs, Ohms Strain	-174*	-164**	20
Status	-179	-168	20
BCD Digits	-179	-168	5
Binary	-179	-168	17 Bits & Sign
Frequency	-179	-167/AA	4
Frequency	Non Req	-167	6 (2286A only)
Totalize Events	-179	-167/AA	4
Totalize Events	Non Req	-167	6 (2286A only)

**A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements*

*** A/D Converter (-161) required in chassis*

Voltage, Thermocouple Inputs

Thermocouple and DC Scanner Option (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64 ranges
Thermal Offset: ≤1 μV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between Hi or Lo and ground or between two adjacent channels

Isothermal Input Connector Option (-175)

Channels: Twenty 3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as reference junction
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162
DC Voltage Accuracy: ±(% of Rdg + Counts)*

Range	90 Days 15°C°C to 35°C	1 Year 15°C to 35°C	1 Year** -20°C to 70°C
±64 mV	0.005% + 7	0.01% + 8	0.03% + 9
±512 mV	0.005% + 3	0.01% + 4	0.03% + 5
±8V	0.005% + 7	0.01% + 8	0.03% + 9
±64V	0.009% + 3	0.02% + 4	0.05% + 5

**Total instrument accuracy using Option -162 and -176*
***A/D Converter must be in 2281A for operation to -20°C or 70°C*

Temperature Measurement Accuracy, Thermocouples

Thermocouples		Accuracy [1] [3]		
Type & Range °C	Temperature °C	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year [2] -20° to70°C
J	-100 to -25	0.45	0.5	0.8
-200 to 760	-25 to 760	0.35	0.4	0.7
K	0 to 900	0.4	0.45	0.7
-275 to 1350	900 to 1350	0.52	0.65	1.3
T	-100 to 75	0.58	0.65	1.1
-230 to 400	75 to 150	0.35	0.39	0.7
	150 to 400	0.3	0.34	0.6
E	-100 to -25	0.47	0.54	0.9
-250 to 900	-25 to 750	0.3	0.33	0.6
	750 to 900	0.33	0.4	0.8
R	250 to 450	0.9	1.0	1.3
0 to 1767	450 to 1767	0.8	0.9	1.4
S	200 to 1767	0.97	1.1	1.6
0 to 1767				
B	600 to 800	1.4	1.6	1.9
200 to 1820	800 to 1820	0.96	1.1	1.3
N [4]	-100 to 150	0.6	0.7	1.1
-200 to 400	150 to 400	0.4	0.44	0.7
C	200 to 1000	0.57	0.66	0.94
0 to 2315	1000 to 2000	0.90	1.2	2.1
	2000 to 2315	1.3	1.7	2.9
JDIN	-100 to -25	0.5	0.56	0.9
-200 to 900	-25 to 900	0.4	0.45	0.7
TDIN	0 to 200	0.48	0.53	0.8
-200 to 600	200 to 600	0.37	0.41	0.7

[1] *Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.*
[2] *Total instrument accuracy using Option -162 and -175 in 2281A chassis.*
[3] *A/D Converter must be in 2281A for operation to -20°C or 70°C.*
[4] *For AWG 28 wire.*

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 to 20 mA or 10 to 50 mA inputs
Maximum Measurable Current: 64 mA per channel
Current-Sense Resistors: 8Ω ±0.02Ω
DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days
Compatibility: Plugs onto scanner module, Option -162

AC & DC Voltage Input Connector Option (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days. Average-responding conversion; calibrated for rms value of sinewaves
Voltage Range for DC: 64V maximum measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for precision measurements of RTDs and/or resistances.
Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance compensation). One 3-wire mode eliminates reed resistance errors
Ranges: Three; 256Ω, 2048Ω and 64 kΩ (or user selectable), software programmed
Current Sources: Two; 1 mA and 32 μA (or user selectable)
Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module. 250V dc or ac rms between all channels in two of the three measurement modes. 30V dc or 24V ac rms between terminals of a channel

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires.

RTD Specifications, Six Classes

A–User-defined high resolution Platinum RTDs
B–High resolution Platinum 385 DIN RTDs
C–User-defined high temperature Platinum RTDs
D–High temperature Platinum 385 DIN RTDs
E–Ten ohm Copper RTDs, not grounded, electrically insulated
F–Ten ohm Copper RTDs, grounded (special, consult factory)

RTD Class	Temperature	System		
		Resolution	Accuracy*	Repeatability*
A	-200 to +150°C +150 to +420°C	0.006°C 0.006°C	0.1°C** 0.15°C**	0.04°C** 0.04°C**
B	-200 to +150°C +150 to +420°C	0.006°C 0.006°C	0.10°C** 0.15°C**	0.04°C** 0.04°C**
C	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200 to +600°C	0.05°C	0.27°C***	0.16°C***
E	-75 to +150°C	0.06°C	0.3°C**	0.17°C**
F	-75 to +150°C	0.06°C	1.25°C**	0.3°C**

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*
***RTD Temperature ≤150°C*
****RTD Temperature ≤600°C*
Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

Ohms Specifications Option (-163,-177)

Range	Resolution	±(% of Rdg + Ω)	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6Ω	0.06% ±1.22Ω	0.0075% ±1.22Ω

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for 1/2- and 1/4-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in Helios-I or 2281A, usually adjacent to the corresponding Scanner Option -162, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications Option (-164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω 512Ω	0.02% + 7 0.02% + 30	1 mΩ 10 mΩ	1 mA 1 mA
Other ranges that may be set by user			
5.12 kΩ 51.2 kΩ	Depends on user's resistor	0.1Ω 1Ω	0.1 mA 0.01 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

RTD Mode Specifications Option (-164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C
Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100Ω Platinum RTDs	
-200°C to +200°C 200°C to 600°C	0.1°C 0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Strain Mode Specifications Option (-164, -174)

Full-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges with 2V supply or ten 120Ω bridges with 4V supply
Resolution: 0.25 microstrain
Total System Accuracy: ±(0.05% of rdg + 2 microstrain)*
Temperature Coefficient: ±10 ppm/°C

1/2-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 13 microstrain)*
Temperature Coefficient: ±15 ppm/°C

1/4-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 25 microstrain)*
Temperature Coefficient: ±20 ppm/°C

**20°C to 30°C for 90 days*

Frequency Measurement and Event Totalization (-167) (2286A only)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair

Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution

Event Counting
Maximum Counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan
Connector: Screw terminal connector supplied

Frequency Measurement and Event Totalization (-167/AA)

Channels: Four
Functions: Event counting and frequency, selectable by channel

Inputs
Signal Types: TTL or contacts
Adjustments: None
Isolation: Each group of four channels isolated from ground
Frequency Measurement: 1000 kHz maximum frequency, 1 Hz resolution

Event Counting
Maximum Counts: 65,534
Operation: Count is reset after each scan. Pseudo channels are used for count accumulation
Counting Rate: DC to 1 kHz
Connector: Uses -179 Digital/Status & Input Connector (not supplied)

Digital & Status Inputs & Outputs

Digital Input/Output Module Option (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, 5 groups of 4-wire BCD digit inputs, or one 17-bit binary number (and sign). Or handles 20 status outputs.
Inputs: Zero volts or contact closures for low, +6 volts maximum for high
Common Mode Voltage: 30V rms ac or dc, maximum
Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V
Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also terminal provided for clamping diodes when used to drive relays

Analog Output

Analog Output Option (-170) (2286A only)

Outputs: Four per module. Each output has a selectable choice of mode: -5V to +5V, 0V to +10V, or 4 to 20 mA
Resolution: 2.44 mV in voltage range, 3.9 µA in current range
Accuracy: ±0.1% of range for 90 days, 15°C to 35°C
Isolation: Each group of four channels isolated from ground
Compliance Current: 5 mA in voltage mode
Compliance Voltage: 10V in current mode
Temperature Range: -20°C to +70°C, operating in 2281A
Connector: Included with option

Other 2280 SERIES Options

RS-232-C Interface Option (-341)

Data may be output via the RS-232-C interface at 110 to 19,200 baud, selectable from the front panel. May be configured to operate on a 20 mA current loop and can serve as the 20 mA current source.

Other RS-232-C parameters selected via the front panel include: Data compression format, channel readings per line, start of data sequence, end of data sequence, line termination sequence, and parity.

Acts as a terminal (DTE) or, with an included adapter, as a modem (DCE), or both (with two Options).
Baud: 110, 300, 600, 1200, 4800, 9600, or 19,200
Parity: Odd, even, or neither
Option -341 includes a Y1707 2-meter cable and a Y1705 null modem cable

IEEE-488 Interface Option (-342)

Operates as either a talker only, or talker/listener. Easy-to-read thumbwheel switches are used to set the IEEE-488 address and are accesible from the rear panel. Data output parameters selected from the front panel include data compression format and the number of channel readings per line.
Repertoire in Port A: SH1, AH1, T5, L4, SR1, RL1, DC1, E2
Repertoire in Port B: SH1, AH1, T5, L4, SR1 and E2
Order Y8021, Y8022, or Y8023 IEEE-488 cables separately

2281A Power Supply Option (-431)

Although power for a 2281A is normally supplied by a 2286A/2285B via a 2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery backup in the event of a power failure. Ask your Local Sales Office or Representative for Configuration Form F605 to determine what options may be installed in a 2281A at what distances without Option 2281A-431.
Operating Temperature: -20°C to +70°C

2280 SERIES Accessory Descriptions

Y2044: Rack Slide Kit for mounting 2280 SERIES or 2281A in a standard 42 cm (19 inch) rack with 61 cm (24 inch) depth. Contains all necessary hardware including a Y2045. Height is 22.2 cm (8.75 in).
Y2045: A rack mounting kit for 2280 SERIES or 2281A. Does not include rack slides. Fits standard 42 cm (19 inch) rack with 61 cm (24 inch) depth. Height is 22.2 cm (8.75 in).
Y2046: Package of ten rolls of thermal print paper for 2286A/2285B's printer/plotter. Capacity is 4000 lines of print, 12,000 channel readings using compressed mode.
Y2047: Three-connector device needed for "star" configurations.
Y8091: 3.5" Micro-floppy diskettes, package of 10 low-density diskettes.
A22-300: A heavy-duty transit case constructed from high-density polyethylene specifically for the 2286A/2285B. Foam padding, cut to conform to the 2286A/2285B mainframe, insulates the data logger from shock encountered in shipping.
Dimensions: 30.5 cm H x 64 cm W x 76.8 cm D (12 in H x 25.1 in W x 30.1 in D)

S2280 ProLogger Software

ProLogger Software is a tool which links the IBM-PC, XT, or AT with a Fluke 2280 SERIES Data Logger to form a data collection and analysis system. This package emulates the 2280 SERIES' front panel on the screen of the IBM and allows the user to program the data logger through the same menu prompting that is available on the 2280 SERIES itself. Other utilities allow the user to transfer data to a disk in Lotus 1-2-3 format or ASCII, upload data from the 2280Bs option -214 Cartridge Tape Drive, download programs from disk on the IBM-PC to the 2280 SERIES, and perform any other functions that can be accomplished from the 2280 SERIES' front panel.

The IBM-PC must have a serial interface, graphics card, and MS-DOS 2.1 or higher. A color monitor is not a necessity, but will enhance the appearance of ProLogger. The IBM-PC needs 128K of memory, however. Lotus 1-2-3 will require additional memory. The 2280 SERIES Data Logger must have -341 RS-232-C Interface Option.

Included with Instrument: Manual set, programming forms, paper, power cord, connector and certificate of calibration

2280 Series

Ordering Information

Models

2286A* Data Logging System
2285B* Data Logger
2281A** Extender Chassis

** Not functional without at least one input and connector option.*
***One meter extender cable supplied unless -402/-403 option is ordered.*

Options

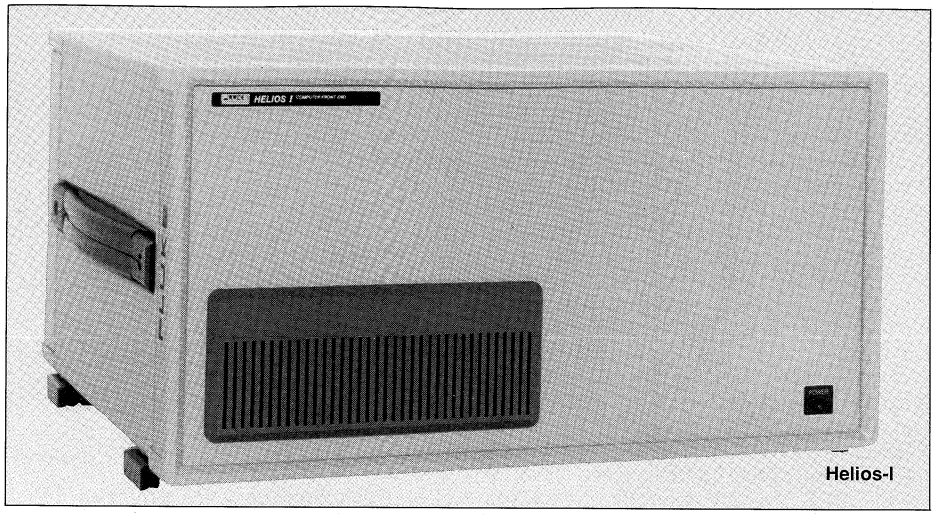
228XX-160 AC & DC Input Connector
228XX-161 High Performance A/D Converter
228XX-162 Thermocouple & DC Voltage Scanner
228XX-163 RTD & Ohms Scanner
228XX-164 RTD, Ohms, & Strain Excitation
228XX-167 Counter/Totalizer, 6 Channel
228XX-167/AA Counter/Totalizer, 4 Channel
228XX-168 Digital Input/Output Module
228XX-169 Status Output Connector
228XX-170 Analog Output
228XX-171 Current Input Connector
228XX-174 Transducer Excitation Connector
228XX-175 Isothermal Input Connector
228XX-176 DC Voltage Input Connector
228XX-177 RTD & Ohms Connector
228XX-179 Digital/Status Input Connector
2286A-211* Math Coprocessor
228XX-341 RS-232 Interface
228XX-342 IEEE-488 Interface
228XX-402** Connecting Cable (per meter)
2281A-403** Connectors for Option -402
2281A-431 Power Supply for 2281A

** Factory of Service Center installation only. Others user-installable.*
***1 meter cable included. To obtain a longer 2281A extender cable, order the desired length of 228XA-402 cable in meter increments and one set of 2281A-403 connectors.*

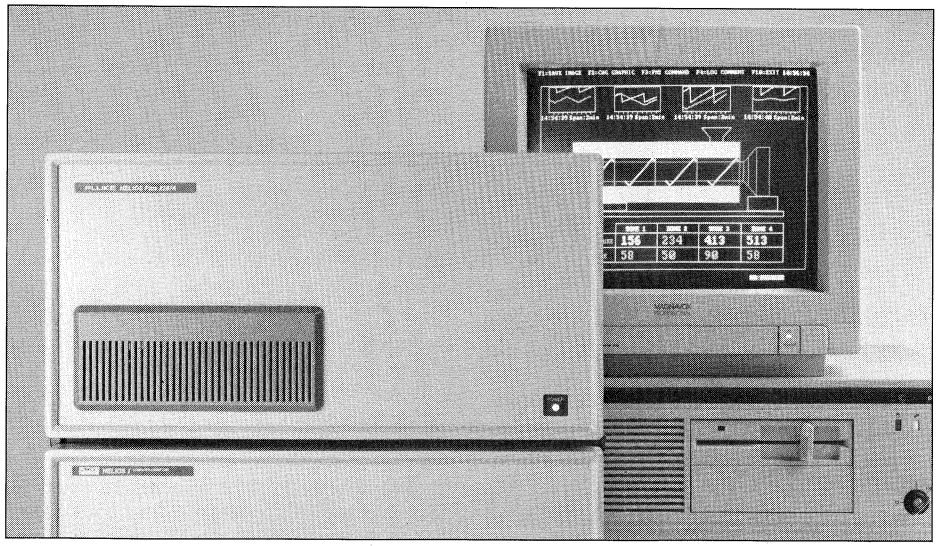
Accessories (Also see Section 20)

Y2044 24" Rack Slide Kit
Y2045 8 3/4" Rack Mount Kit
Y2046 Rack of 10 Rolls Printer Paper
Y2047 Extender Chassis Multi-Connector
Y8091 Package of 10 3.5" Micro-Floppy Diskettes
A22-300 Transit Case for 2280A
S2280 ProLogger Software

RS-232



Helios-I



Helios Series Data Acquisition Front Ends

- Helios-I offers high accuracy for lower speed applications
- Helios Plus offers higher speed and more intelligence
- Wide range of measurement and control options
- PC application software available for a complete system
- Ruggedized dc powered version for mobile applications

Performance

The Helios Series of Data Acquisition Front Ends add high performance measurement capability to computer, from lap-top to mainframe.

The Helios Series, composed of Helios-I (2289A) and the more powerful Helios Plus (2287A) gives your computer the power to read:

- Voltage
- Strain
- Temperature
- Frequency
- Pressure
- Speed
- Open Flow
- Many more

The **Helios Data Acquisition Hardware and Software Series** gives you an immediate, cost-effective way to meet your data acquisition goals. With the wide selection of I/O options and software packages you tailor your data acquisition system to fit your application.

Helios-I (2289A)

Helios-I is a data acquisition and control subsystem, easy to use with any computer. It combines measurement accuracy, excellent noise immunity, and exceptional configuration flexibility in a rugged package.

Helios Plus (2287A)

Helios Plus offers all the features of Helios-I as well as special features for more autonomous scanning, data buffering and alarm checking. Measurement speed is faster too – up to 1000 readings per second.

Helios Software

A wide range of general purpose and application specific software gets your data acquisition system up and running in hours, not weeks. Choose from such industry standards as Labtech Notebook™ from Laboratory Technologies, CIM-PAC™ from Action Instruments, Measure from National Instruments and many others. In addition the Helios Series is supported by application specific software for special needs.

A Wide Range of Measurements

Choose your sensor type. Thermocouples, RTDs, strain gages, pressure, flow, contact closure, frequency, voltage, current, speed, or resistance. The modular architecture of Helios lets you configure your system with all the sensors you want without paying extra for the ones you don't want. It also provides user-defined tables for unusual sensors.

The conversion routines resident in Helios makes your system more cost-effective and efficient. Because you do not have to develop routines for the engineering units conversions, software development is reduced saving you both time and money. And with Helios to take care of those tasks, the host computer is free to do other tasks, improving the system's realtime performance.

These proprietary conversion algorithms, optimized for Helios hardware, are efficient and very accurate to get the most out of your system. It would be difficult to match this performance with a host computer running similar routines.

Choose accuracy: You can add the -161 High Accuracy A/D option to Helios-I or Helios Plus, for extreme accuracy and isolation in low-level measurements. This is especially important when making thermocouple measurements where high common-mode voltages are present.

Choose speed: With Helios Plus, the -165 Fast A/D option makes measurements at 1000 readings per second in burst mode and 70 readings per second continuous throughput. In both cases the accuracy is unmatched by comparable instruments operating at these speeds. With Helios Plus, you can combine the -165 with the -161 High Accuracy A/D, to give you precise measurements and fast measurements in a single instrument.

Helios Series

Choose your output type: Analog and binary outputs to control valves, motors, relays, annunicators, alarms and set-point controllers. Manipulate these outputs with simple assignment commands from the host computer, to control your test or process.

Extended Systems

Remote expansion chassis are available to bring the total configuration to 1000 channels in a 2287A system and 1500 channels in a 2289A system. The distance between an extender chassis and the mainframe may be up to 1.2 km. Connections may be made in daisy chain, star and maze configurations for adaptable cable routing

Optional dc powered Helios. The 2287A/AA and 2289A/AA are designed for mobile testing and remote data gathering at sites that lack line power. Both are powered from either a 12V dc or 24V dc supply (8-18 or 21-28V dc respectively) and have extended operating range to +70°C.

Application Software

The flexibility of Fluke's versatile set of hardware offerings, combined with our selection of software packages, helps you precisely match system capabilities to your application requirements. Each of our software packages runs on an IBM PC or compatible, and addresses a particular type of application with different data gathering, analysis and display capabilities.

CIM-PAC™ is a highly capable monitoring and control package, well-suited to data acquisition in a manufacturing or engineering environment. Its real-time animated graphics, networking and powerful event processor make it easy to customize to large or small applications.

Labtech Notebook™ is a flexible data acquisition package for research applications. Its triggering and scanning functions, in combination with a comprehensive set of analysis tools, make it ideal when you require fewer channels and intensive mathematical reduction.

Helios Toolbox for BASIC Programmers, a set of software utilities, speeds software development in almost any application. Take advantage of these programming shortcuts when you need the top performance only custom software can deliver.

Other general purpose data acquisition software packages as well as those for specialized applications are available for the Helios Series.

Enhance System Performance with Helios Plus (2287A)

For higher performance or remote data acquisition systems consider the benefits of Helios Plus.

Acquire data rapidly using the Fast A/D Option (2287A-165). The 2287A-165 provides the 2287A-165 may be operated in a high throughput "continuous mode" or in a burst mode.

Higher continuous throughput. Each 2287A-165 normally provides readings to the host computer at continuous throughput of up to 70 readings per second.

Burst Mode gives you 1000 readings per second. With the external triggering capability several 2287A-165 A/D Converters will freeze their data buffers for multiple synchronized measurement snapshots used in this way. To get just the data you need you specify the amount of pre- and post-trigger data to be captured on each A/D. With the addition of a 2287A-265 Memory Expansion Option, each A/D can store up to 75,000 readings for later retrieval.

Automatic sensor scanning, data buffering and alarm detection make Helios Plus ideal for applications that require more local intelligence.

With this added intelligence your host computer will have more time for operator interaction, data analysis, and report generation. Helios Plus can be commanded to schedule its own measurement scans, buffer data and check for alarms. Since memory is battery backed, you can be sure that Helios Plus will save your latest readings.

Remote/Mobile Data Acquisition Applications

The rugged design of Helios Plus combined with the intelligence to automatically take measurements, check for alarms, buffer data, then provide them on request, makes it ideally suited for remote-site data acquisition. Measurement data may be sent to the local printer port, providing data available to on-site operators.

Specifications

Helios Mainframes (2287A & 2289A)

Both Helios mainframes are card cages that include CPU, power supply, RS-232C and RS-422 interfaces.

Channel Capacity: 100 Analog and 120 Digital
Battery Back-up: 15 days typical, 10 days min
Host Computer Interface: RS-232C or RS-422 (switch selectable) with multidrop capability
Temperature: Operating, 0°C to 65°C; storage, -40°C to 70°C
Humidity: Non-condensing, below 25°C <95%; to 40°C <75%; to 50°C <45%
Altitude: Non-operating, 12 km (40,000 ft); operating, 3 km (10,000 ft)
Shock and Vibration: Meets MIL-T-28800C, Class 5, Style F Standard
Size: 23.8* cm H x 43.9 cm W x 35.9 cm D (9.35* in H x 17.3 in W x 14.13 in D)
**H = 22.3 cm or 8.75 in without feet*
Weight: 8.5 kg (18.7 lb) without options
AC Power: 90V to 132V, 180V to 264V, 47 Hz to 440 Hz
DC Power: 12V or 24V (optional)

Interface Specifications
Type: RS-232C or RS-422; asynchronous; selectable baud rate, parity, character bits and stop bits.
Protocol: XON/XOFF or none; terminal or computer mode
RS-232C: Compatible with auto-answer, full duplex modems; automatic hangup
RS-422: Allows operation at extended distances from the host computer up to 1.2 km; point to point or multidrop configurations

2281A Extender Chassis

Capacity: Same as mainframe
Multiple Extender Chassis Allows System Channel Expansion: 2287A System, 1000 channels; 2289A System, 1500 channels

Helios-I and Helios Plus Options

High Performance A/D Converter Option (-161)

Dynamic Range: 100,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, ±64V dc
Resolution Using DC Scanner Option: 1 μV on 64 mV range, 10 μV on 512 mV range, 100 μV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: 2170 dB at 50 Hz or 60 Hz ±0.1%; 2160 dB at dc; 100Ω unbalance
Normal Mode Noise Rejection: 260 dB at 50 Hz or 60 Hz ±0.1%
Operating Temperature: -20°C to 70°C

AC Voltage Input Connector Opt (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days; average-responding conversion; calibrated for rms value of sine waves
Voltage Range for DC: 64V maximum measurable; 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

Thermocouple & DC Scanner Opt (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: 64 mV, 512 mV, 8V, and 64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64V ranges
Thermal Offset: ≤1 μV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between hi or lo and ground or between two adjacent channels

Measurement and Output Selection Guide

Measurement	I/O Module	Connector	Channels	Max Channels Per Chassis
Thermocouples	-161 and -162	-175	20	100
Thermocouples	-165	-175	20	100
DC Voltages	-161 and -162	-175 or -176	20	100
DC Voltages	-165	-175 or -176	20 DE or 40 SE	100 DE PR 200 SE
DC Current	-161 and -162	-171	20	100
DC Current	-165	-176*	20	100
AC Voltages	-161 and -162	-160	10 AC and 10 DC	50 AC and 50 DC
RTDs	-161 and -163	-177	20	100
RTDs	-161 and -162 and -164	-176 and -174	20	40
RTDs	-165 and -164	-176 and -174	20	60
Resistance	-161 and -163	-177	20	100
Resistance	-165 and -164	-176 and -174	20	60
Resistance	-161 and -162 and -164	-176 and -174	20	40
Strain Gage	-161 and -162 and -164	-176 and -174	20	40
Strain Gage	-165 and -164	-176 and -174	20	60
Frequency/ Event Counting	-167	Included	6	30
Status Input	-168	-179	20	120
Binary Input	-168	-179	1	6
BCD Input	-168	-179	5	30
Status Output	-168	-169	20	120
Analog Output	-170	Included	4	24

**Required: 8Ω shunt on each terminal pair, Fluke Part No. 641449.*

RTD Class	Temperature	System		
		Resolution	Accuracy*	Repeatability*
A, B	-200°C to +150°C +150°C to +420°C	0.006°C 0.006°C	0.1°C** 0.15°C**	0.04°C** 0.04°C**
C	-200°C to +600°C	0.05°C	0.27°C***	0.16°C***
D	-200°C to +600°C	0.05°C	0.28°C***	0.16°C***
E	- 75°C to +150°C	0.06°C	0.3°C**	0.17°C**
F	- 75°C to +150°C	0.06°C	1.25°C**	0.3°C**

** Total Instrument Accuracy, 15°C to 35°C for 90 days.*
*** RTD Temperature≤150°C*
**** RTD Temperature ≤600°C*
Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.03°C for 390 and 392 RTDs. The same procedure for a 385 DIN RTD yields total system accuracy to be the sum of repeatability plus 0.03°C plus the RTD probe conformity error.

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires. RTD Specifications, Six Classes

A - User-defined high resolution Platinum RTDs
B - High resolution Platinum 385 DIN RTDs
C - User-defined high temp Platinum RTDs
D - High temperature Platinum 385 DIN RTDs
E - Ten Ohm Copper RTDs, not grounded, electrically insulated
F - Ten Ohm Copper RTDs, grounded (special, consult factory)

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for 1/2- and 1/4-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in Helios or 2281A, usually adjacent to the corresponding -162 or -165, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications (Option -161, -164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω	0.02 + 7	1 mΩ	1 mA
512Ω	0.02 + 30	10 mΩ	1 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

Option -165, -164, -174

Max Resistance	(±% of Input ± mΩ)		
	90 Days 15°C-35°C	1 Year 15°C-35°C	1 Year -20°C-+70°C
64Ω	.03 ±25	.04 ±25	.06 ±60
512Ω	.03 ±100	.04 ±100	.06 ±140

RTD Mode Specifications (Option -164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C

Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100Ω Platinum RTDs	
-200°C to +200°C 200°C to 600°C	0.1°C 0.15°C
10Ω Copper RTDs	
-75°C to +150°C	1.0°C

**Total Instrument Accuracy, 13°C to 33°C for 90 days.*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Temperature Measurement Accuracy, Thermocouples

Thermocouples		Accuracy: Helios w/Option -161 [1] [3]			Accuracy: Helios Plus w/Option -165		
Type & Range	Temperature °C	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year [2] -20°C to +70°C	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year -20°C to +70°C
J -200°C to 760°C	-100 to -25 -25 to 760	0.45 0.35	0.5 0.4	0.8 0.7	1.11 0.95	1.16 1.0	2.46 2.04
K -275°C to 1350°C	0 to 900 900 to 1350	0.4 0.52	0.45 0.65	0.7 1.3	1.2 1.51	1.33 1.7	2.83 3.6
T -230°C to 400°C	-100 to 75 75 to 150 150 to 400	0.58 0.35 0.3	0.65 0.39 0.34	1.1 0.7 0.6	1.3 0.95 0.85	1.35 1.0 0.9	3.0 2.05 1.9
E -250°C to 900°C	-100 to -25 -25 to 900	0.47 0.3	0.54 0.33	0.9 0.6	1.1 0.88	1.15 0.94	2.4 1.93
R 0°C to 1767°C	250 to 450 450 to 1767	0.9 0.8	1.0 0.9	1.3 1.4	3.0 2.71	3.0 2.76	7.0 6.3
S 0°C to 1767°C	200 to 1767	0.97	1.1	1.6	3.26	3.3	7.7
B 200°C to 1820°C	600 to 800 800 to 1820	1.4 0.96	1.6 1.1	1.9 1.3	4.3 3.4	4.3 3.42	10.3 8.12
N [4] -200°C to 400°C	-100 to 150 150 to 400	0.6 0.4	0.7 0.44	1.1 0.7	1.7 1.17	1.75 1.2	3.9 2.55
C 0°C to 2315°C	200 to 1000 1000 to 2000 2000 to 2315	0.57 0.90 1.3	0.66 1.2 1.7	0.94 2.1 2.9	1.86 3.0 4.1	2.0 3.35 4.55	4.43 7.4 10.1
JDIN -200°C to 900°C	-100 to -25 -25 to 900	0.5 0.4	0.56 0.45	0.9 0.7	1.13 0.9	1.17 0.98	2.5 2.04
TDIN -200°C to 600°C	0 to 200 200 to 600	0.48 0.37	0.53 0.41	0.8 0.7	1.04 .82	1.07 0.85	2.3 1.81

[1] *Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.*
[2] *Total instrument accuracy using Option -162 and -175 in 2281A chassis.*
[3] *A/D Converter must be in 2281A for operation to -20°C or 70°C.*
[4] *For AWG 28 wire.*

Strain Mode Specifications (Option -164, -174)

Strain Measurement Accuracy

Bridge Type	Accuracy (± % Input ± με) 90 Days, 20°C to 30°C		Resolution (με)		Capacity (Bridges)
	-161, -162	-165	-161, -162	-165	
Full	0.05 ±2	0.1 ±6	.25	1	20 (350Ω or 120Ω)
1/2	0.05 ±13	0.1 ±18	.5	2	20 (350Ω or 120Ω)
1/4	0.05 ±25	0.1 ±30	.5	2	20

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 mA to 20 mA or 10 mA to 50 mA inputs
Maximum Measurable Current: 64 mA per ch
Current-Sense Resistors: 8Ω ±0.02Ω
DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days
Compatibility: Plugs onto scanner module, Option -162

Isothermal Input Connector Opt (-175)

Channels: 20/3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as ref junction
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for prevision measurements of RTDs and/or resistances.
Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance companesion); one 3-wire mode eliminates reed resistance errors
Ranges: Three; 256Ω, 2048Ω and 64 kΩ (or user selectable), software programmed
Current Sources: Two; 1 mA and 32 μA (or user selectable)
Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module; 250V dc or ac rms between all channels in two of the three measurement modes; 30V dc or 24V ac rms between terminals of a channel

Ohms Specifications (Opt -163, -177)

Range	Resolution @ 60 Hz	±(% of Rdg + Ω)*	
		Accuracy	Repeatability
256Ω	2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
2048Ω	19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
64 kΩ	0.6 Ω	0.06% ±1.228	0.0075% ±1.228

**Total Instrument Accuracy, 15°C to 35°C for 90 days.*

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires
Maximum Measureable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162
DC Voltage Accuracy: ±(% of Rdg + Volts)*

Range	90 Days	1 Year	1 Year**
	15°C to 35°C		-20°C to +70°C
64 mV	0.005+7μV	0.01+8μV	0.03+9μV
512mV	0.005+30μV	0.01+40μV	0.03+50μV
8 mV	0.005+700μV	0.01+800μV	0.03+900μV
64V	0.009+3mV	0.02+4mV	0.05+5mV

** Total instrument accuracy using Option -162 and -176*
***A/D Converter must be in 2281A for operation to -20°C to 70°C*

Frequency Measurement and Event Totalization Option (-167)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair
Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution
Event Counting
Maximum Counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan
Connector: Screw terminal connector supplied

Digital & Status Inputs & Outputs

Digital Input/Output Module Opt (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, (one 5-digit BCD input) or one 17-bit binary input, or handles 20 status outputs.

Inputs: Zero volts or contact closures for low, +6 volts maximum for high
Common Mode Voltage: 30V rms ac or dc, maximum
Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V
Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

DC Accuracy Fast A/D (2287A-165)

DC Volts		Accuracy ±(% Input ± μV) (Continuous Mode)			Burst Mode
Range	Resolution	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year 15°C to 35°	Add to Continuous Mode Spec
±64 mV	2 μV	.02% ±25 μ	.03% ±25 μV	.06% ±60 μV	±10 μV
±512 mV	16 μV	.02% ±100 μV	.03% ±100 μV	.06% ±140 μV	±50 μV
±8V	0.25 mV	.02% ±1.2 mV	.03% ±1.2 mV	.06% ±1.5 mV	±0.5 mV
±10.5V	0.32 mV	.02% ±1.7 mV	.03% ±1.7 mV	.06% ±2.0 mV	±0.5 mV

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also, terminal provided for clamping diodes when used to drive relays

Analog Output Option (-170)

Outputs: Four per module. Each output has a selectable choice of mode: 0V to 10V, 4 mA to 20 mA, or 0 to 20 mA
Resolution: 2.44 mV in voltage range, 3.9 μA in 4 mA to 20 mA range, 4.8 μA in 0 to 20 mA range
Accuracy: ±0.1% of range for 90 days, 15°C to 35°C (calibrated on 0 to 10V range)*
Isolation: Each group of four channels isolated from ground and other channels up to 45V
Compliance Current in Voltage Mode: 5 mA sinking, 20 mA sourcing
Compliance Voltage in Current Mode: 10V
Temperature Range: -20°C to +70°C, operating in 2281A
Connector: Included with option
** 0.1% accuracy also obtainable on current ranges with recalibration. Current ranges have accuracy of ±0.25% when shipped from the factory*

2281A Power Supply Option (-431)

Although power for a 2281A Extender Chassis is normally supplied by a 2289A mainframe via a 2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery backup in the event of a power failure. Ask your Sales Office or Representative for Configuration Form F605 to determine what options may be in stalled in a 2281A at what distances without Option 2281A-431.
Operating Temperature: -20°C to +70°C

Helios Plus Options

Fast A/D Converter Option (-165)

Dynamic Range: ±16,384 counts

Common Mode Rejection
At DC: 0.02% of range per volt between Low and Common; 160 dB for voltages between Common and Earth
At Power Mains Frequency (50/60 Hz): 120 dB rejection of common mode voltage between Low and Common with 100Ω unbalance in Low lead; 160 dB rejection of common mode voltage between Common and Earth with 100Ω unbalance in Low lead

Normal Mode Rejection
In Burst Mode: None
In Continuous Mode: 40 dB at 50 Hz to 60 Hz ±0.1%

Input Impedance
Powered On: 100 MΩ in parallel with 0.01 μF for input voltages between +12V and -12V; 1 kΩ for voltages outside +12V to -12V
Powered Off: 1 kΩ in parallel with 0.01 μF

Input Overload Protection
Normal Reading Range: High and low inputs within ±10.5V with respect to common
Overloads: Up to ±50V on one channel have no effect on other channels and cause no damage. Overloads up to ±50V on multiple channels will cause no damage but will interfere with readings on other channels during the overload. Overloads up to 120V ac protected by a fusible resistor on each channel; will not damage other channels.
Operating Temperature Range: -20°C to +70°C
Storage Temperature Range: -40°C to +85°C
Humidity (Non-condensing): up to 95% RH for temperatures up to 25°C; up to 75% RH for temperatures up to 40°C; up to 50% RH for temperatures up to 50°C

Fast A/D Memory Expansion Opt (-265)

Expands the burst mode memory available to the 2287A-165 Fast A/D. Standard burst mode memory includes 65.5K bytes. The option expands onboard memory from a maximum of 17,000 readings to a maximum of 78,000 readings.

Helios Series

Ordering Information

Models

2287A Helios Plus Mainframe
2289A Helios-I Mainframe
2281A Extender Chassis
22810A Helios-I (inc -161, -162 & -175)
22811A Helios Plus (inc -165 & -175)

Options

-160 Alternating Voltage Options
-161 High Accuracy A/D
-162 Thermocouple/DC Voltage Scanner
-163 RTD/Resistance Scanner
-164 Transducer Excitation Assembly
-165 Fast A/D (2287A only)
-167 Counter/Totalizer, w/connector
-168 Digital I/O Assembly
-169 Status Output Connector
-170 Analog Output Assembly
-171 Current Input Assembly
-174 Transducer Excitation Assembly
-175 Isothermal Input Connector
-176 DC Voltage Connector
-177 RTD/Resistance Connector
-179 Digital/Status Connector
-265 Fast A/D Memory Expansion (2287A-165 only)
-402 Extender Chassis Cable
-403 Connector Pair for -402 Cable
-431 Extender Chassis Power Supply

Software Options

-901 Helios Toolbox for BASIC Programmers (PC, XT, AT)
-902 CIMPAC™ Data Multi-tasking System (AT compatible)
S2289 ProLogger_HCL Application Software (PC, XT, AT)
S2290 LABTECH™ Notebook Application (PC, XT, AT)

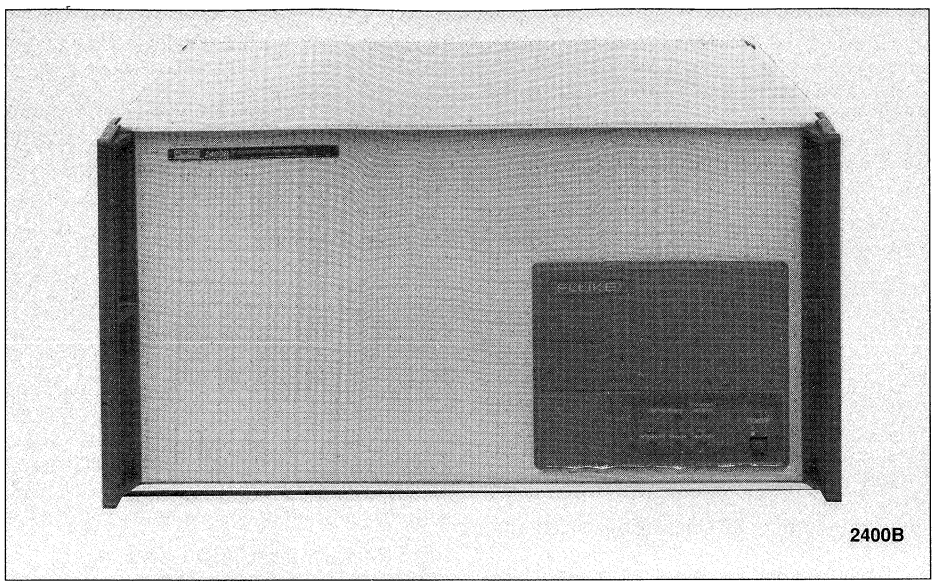
Accessories (Also see Section 20)

RS40 RS-232C Null Modem Cable
Y1703 RS-232C Null Modem Cable, 4m
Y1705 RS-232C Null Modem Cable, 30 cm
Y1707 RS-232C Standard Cable, 2m
Y1708 RS-232C Standard Cable, 10m
Y2044 24" Rack Slide and 8" Rackmount Kit
Y2045 8" Rackmount Kit
Y2047 Serial Link 3-Way Adapter

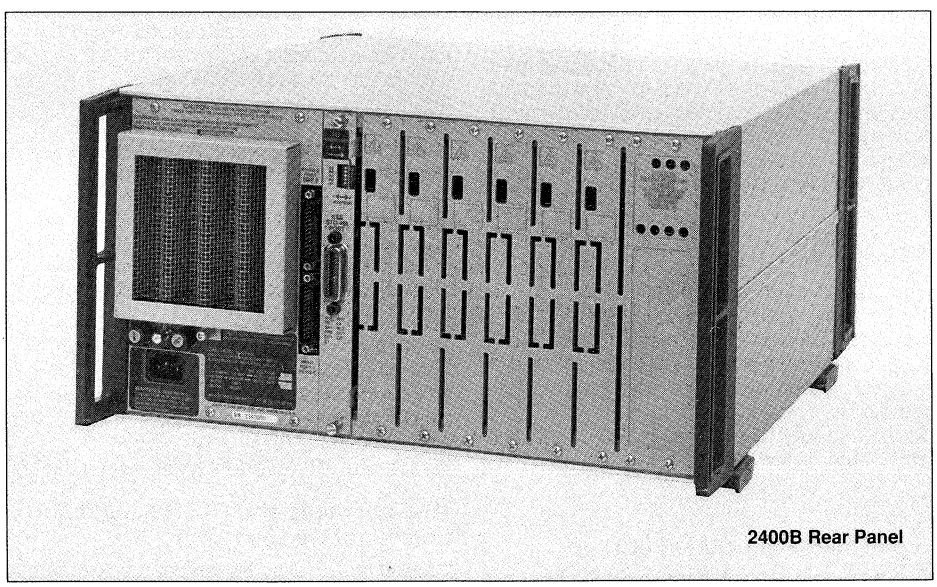
2400B

GPIB IEEE-488

RS-232



2400B



2400B Rear Panel

2400B Intelligent Computer Front End

- A data acquisition "computer" in itself — measures, alarms, and controls independent of host
- Handles nearly any I/O requirement with an extensive selection of options
- High accuracy analog measurements — even in electrically noisy environments
- Modularly expandable (over 3000 total channels) to meet future application demands
- Interface to nearly any computer via RS-232, RS-422, GPIB/IEEE-488, or current loop
- Self documenting, structured program language — optimized for measurement and control
- EPROM program storage available for stand-alone dedicated applications

The 2400B Intelligent Computer Front End is a very accurate microprocessor-based analog and digital data acquisition system. The system serves as an interface between a computer and both the measurement and control of a physical process.

The 2400B can receive a measurement and control program from the host computer and, upon command, execute it without further interaction with the computer. The 2400B relieves the host of routine, time consuming tasks and greatly simplifies the programmer's task of developing system software. Cost savings is the result, and greater throughput is possible because the computer can perform other tasks at "computer speed" without waiting for physical events.

The 2400B works well in applications requiring a distributed data acquisition and control system. With a Serial Interface Option (-001) 2400Bs may be located over 1220 meters (4000 feet) from the host computer in a star or daisy chain configuration.

Computers with which the 2400B will interface are those with either RS-232-C, RS-422, GPIB/IEEE-488,* or 20 mA current loop compatibility. The Fluke 1752A Instrument Controller interfaces well with the 2400B and the combination (called a 2452MCS) is described in following pages.

Hardware costs are reduced by having a wide range of user-configurable, input and output plug-in circuit cards plus different types of extender chassis and interface options to perform the necessary measurement and control functions of your application. The 2400B has a maximum system capacity of over 1000 analog inputs, 1000 digital inputs, 128 analog outputs, and 1000 digital outputs.

Inputs

The 2400B accepts inputs from a wide variety of sources and transducers. For analog inputs, the 2400B uses its 17-bit analog-to-digital converter to perform accurate measurements of ac or dc voltage, current, or temperature using thermocouples. Integral signal conditioners are used in conjunction with the A-to-D converter to perform measurements of resistance, temperature (RTDs), strain, and certain other transducers.

Built-in linearizations are available for a wide variety of thermocouples. RTD linearizations are software-selectable by individually selecting parameters for different probes, assuring high accuracy.

Totalizing, as well as frequency, period, and rotation speed measurements, are performed with one of the Counter/Totalizer Options. To sense switch closures or logic levels, you may use the Status Input Option. Or, for faster response, use the Interrupt Input Option or the Sequence of Events Recorder Option. The Interrupt Option causes the 2400B to respond to external events immediately while the Sequence of Events Option records events with up to 0.1

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

millisecond resolution. The Digital Input Option is used to read either 7-digit BCD or 24-bit binary words from devices with that output capability.

Outputs

The 2400B makes use of five different control output options. To light annunciators, or perform on-off control, use the Status Output Option or the Relay Output Option. Use the 2400B's other output cards for more complex process control. A Resistance Output Option may be programmed to supply resistances from 0 to 100,000 ohms. For -10V to +10V dc or 4 to 20 mA control loops, or driving analog recorders, use the Analog Output Option. To control stepper motors, use the Stepper Motor Output Option. Frequency and acceleration rates may be selected through the 2400B's software for stepper motor control.

Expandability

A 2400B system may be large or small, depending upon the application. The 2400B main frame has six slots for any combination of input, output, or interface plug-in modules. To expand the system, just add extender chassis. However, only one A-to-D converter is needed for a 2400B system to measure analog signals, even if the maximum number of channels is installed.

Several 2400Bs may be interfaced to a single computer. When equipped with either the RS-422, or 20 mA current loop interface, 2400Bs may be arranged in a multi-drop configuration at distances up to 1220 meters (4000 feet) from the host computer. Greater distances are possible utilizing the 2400B's RS-232-C interface and modems, over existing telephone lines.

Flexible Software

The 2400B can be utilized with two "levels" of software. The first level is for immediate-mode commands, those which cause an immediate response from the 2400B. The second level is the program stored in the 2400B, allowing the 2400B to monitor and measure inputs, perform calculations, make decisions, and set control outputs, all independent of the host computer.

Stand-Alone Capability

By loading the 2400B's stored program into EPROMs in the mainframe, the 2400B can be used to monitor inputs, perform calculations, and update control outputs, without being connected to a host computer. Using one or both of the 2400B's RS-232 ports in conjunction with the Fluke Touch Control Screen Series allows stored program data to be presented and modified by an operator, all under the program's control. Approximately 400 lines of 2400B program may be stored in EPROM.

Worldwide Support

Service centers for Fluke products are located in more than forty countries around the world. Many offer full service contracts for maintenance and repair at your site. Or training for your personnel can be arranged. We know how important it is to be assured of expert maintenance for systems you depend on, even though they may be among the most trouble free available — like those from Fluke.

Specifications

2400B System

Analog Inputs: ≤1000 isolated, 3-, 4-, or 6-wire channels
Digital Inputs: ≤1024 non-isolated lines, configurable for either (1) 7 BCD digits plus 1 sign bit plus 3 bits for decimal point location or (2) 24-bit binary plus 1 sign bit
Status Inputs: ≤1024 electrically isolated wirepairs
Interrupt Inputs: ≤32 electrically isolated wirepairs
Counter-Totalizer Inputs: ≤32 isolated analog and ≤32 non-isolated TTL inputs
Status Outputs: ≤1024 electrically isolated wirepairs
Analog Outputs: ≤128 voltage and/or current sources in range of -10V to +10V or 0 to 20 mA
Resistance Outputs: ≤64 resistance sources with 1Ω increments to 4095Ω and/or 25Ω increments to 102,375Ω
Stepper Motor Outputs: ≤64 direct or logic level outputs

2400B Mainframe

The 2400B must have either option -001 or Option -002 installed to be operational.
Capacity: Six slots for any combination of input, output, or extender chassis interface plug-in modules. A-to-D converter module (Option -109) installed in a dedicated additional slot
Serial Outputs: EIA Standard RS-232-C, two ports, output only

Options

Serial Interface Option (-001)

Bi-directional serial interface to compatible host computer. This option is configurable as either an RS-232-C, RS-422, or 20 mA current loop via a changeable jumper. As an RS-232-C interface, Option -001 supports five protocols.

IEEE-488 Interface Option (-002)

Bi-directional IEEE-488 interface to compatible host computer or instrument controller such as Fluke 1722A.

2401A Scanner Extender Chassis

Capacity: Ten scanner modules (Option -101, -115, or -117) 100 analog input channels
System Size: Ten maximum
Maximum Distance: 75 meters (250 feet) from 2400B or 2403A. A 1-meter cable included

2402A I/O Extender Chassis

Capacity: 12 input and/or output plug-in modules. Option 2402A-501 required, installed in 2400B
System Size: 16 maximum
Maximum Distance: 15 meters (50 feet) from 2400B. A 2-meter cable included

2403A Remote A/D Extender Chassis

Capacity: Eight slots for signal conditioners, scanner modules (Option -101, -115 or -117) plus two slots for Interface Options (-401) for up to ten 2401As. One A/D module required (Option -109). Option 2403A-601 also required
Maximum Distance: 1220 meters (4000 feet) from 2400B. Order cable by length (Opt -602) plus installed connectors (Opt -603)

High Performance A/D Converter Option (-109)

Required for all analog measurement inputs. Only one allowed for each 2400B System.
Input Resistance: >200 MΩ in 0.1V, 0.8V, and 6.4V range; 10 MΩ in 100V range
Input Capacitance: 0.005 μF at 25 readings per second; 0.5 μF at 3 readings per second
Zero Stability: Automatically zeroed before each measurement

Voltage, Current, Thermocouple Inputs

High Performance Scanner Option (-101)

Ten 3-wire dry reed relays (Hi, Lo, shield).
Thermal Offset: <1 μV per channel
Maximum Voltage: 350V dc or peak ac between any input terminal and system ground or other terminal
Temperature Resolution: 0.1 degree (one count)

Thermocouple and DC Voltage Input Connector Option (-102)

Ten 3-wire sets of screw terminals on isothermal block enclosed in a safety housing. Integral reference junction correction for 0°C. Plugs into Scanner Module (Option -101).

DC Voltage Input Connector Option (-108)

Ten 3-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into scanner module (Option -101).
Range: ±1 μV to ±100V
Maximum Voltage: 350V dc or peak ac. See Option -101

Temperature Measurement Accuracy

Measurement may be performed in Celsius, Fahrenheit, Kelvin, or Rankine (w/Option -101, -102)

Thermocouple Type	Range °C	24 hours 21°C to 25C°		90 Days 18°C to 28°C		1 Year 13°C to 33°C	
		Low Reading Rate	High Reading Rate	Low Reading Rate	High Reading Rate	Low Reading Rate	High Reading Rate
JNBS	-200 to -160	0.40	0.55	0.50	0.60	0.70	0.75
	-160 to 0	0.30	0.40	0.35	0.45	0.50	0.55
	0 to 760	0.20	0.25	0.25	0.30	0.35	0.35
KNBS	-225 to -210	0.70	1.00	0.85	1.10	1.30	1.40
	-210 to -160	0.55	0.80	0.65	0.90	1.00	1.10
	-160 to -80	0.35	0.50	0.40	0.55	0.60	0.70
	-80 to +1350	0.25	0.35	0.30	0.40	0.45	0.50
TNBS	-230 to -210	0.70	0.95	0.80	1.05	1.20	1.35
	-210 to -150	0.50	0.75	0.60	0.80	0.95	1.05
	-150 to -50	0.35	0.50	0.40	0.55	0.60	0.70
	-50 to +400	0.25	0.35	0.30	0.40	0.45	0.50
ENBS	-250 to -230	1.00	1.25	1.15	1.40	1.65	1.80
	-230 to -180	0.60	0.75	0.70	0.85	0.95	1.05
	-180 to 0	0.35	0.45	0.40	0.50	0.55	0.60
	0 to +1000	0.20	0.25	0.25	0.30	0.30	0.35
RNBS	0 to 60	0.80	1.55	1.00	1.75	1.95	2.35
	60 to 200	0.65	1.25	0.80	1.40	1.55	1.85
	200 to 600	0.50	0.95	0.65	1.10	1.20	1.40
	600 to 1767	0.40	0.75	0.50	0.85	0.95	1.10
SNBS	0 to 60	0.80	1.55	1.00	1.75	1.90	2.30
	60 to 200	0.65	1.25	0.80	1.40	1.55	1.85
	200 to 600	0.55	1.00	0.65	1.10	1.25	1.50
	600 to 1767	0.45	0.85	0.55	0.95	1.05	1.25
BNBS	200 to 420	2.00	4.05	2.55	4.60	5.10	6.10
	420 to 750	1.00	1.95	1.25	2.15	2.40	2.85
	750 to 1150	0.60	1.15	0.75	1.30	1.45	1.70
	1150 to 1850	0.45	0.85	0.55	0.95	1.05	1.25
NNBS**	-200 to -170	0.60	0.95	0.70	1.05	1.20	1.35
	-170 to 0	0.45	0.70	0.55	0.80	0.85	1.00
	0 to 1300	0.25	0.40	0.30	0.45	0.50	0.55
CHOS***	0 to 1200	0.40	0.65	0.45	0.75	0.80	0.95
	1200 to 2315	0.55	0.95	0.70	1.10	1.25	1.45
JDIN	-200 to -100	0.35	0.40	0.40	0.45	0.50	0.55
	-100 to 200	0.25	0.30	0.30	0.35	0.40	0.45
	200 to 900	0.20	0.25	0.20	0.25	0.30	0.30

Includes all but sensor error: connector gradient, reference junction, linearization conformity, A-to-D conversion, temperature coefficient, time drift, scanner offset.

** *Nicrosil/Nisil*

*** *Hoskins Mfg. Co. Tungsten - 5% Rhenium vs Tungsten - 26% Rhenium*

DC Voltage Measurement Accuracy:

±(% Rdg + Counts + μV)*

Scan Rate	24 Hours 21°C to 25°C	90 Days 18°C to 28°C	1 Year 13°C to 33°C
0.1V, 0.8V, 6.4V Ranges			
3CH/S	±(0.002%+2+2)	±(0.005%+3+2)	±(0.015%+4+6)
25CH/S	±(0.002%+4+4)	±(0.005%+5+4)	±(0.015%+6+6)
100V Range			
3CH/S	±(0.008%+2+0)	±(0.01%+3+0)	±(0.02%+4+0)
25 CH/S	±(0.008%+4+0)	±(0.01%+5+0)	±(0.02%+6+0)

* *After 45 minute warm-up. With Option -109, -101, and -108 (or -102)*

AC Voltage Input Connector Option (-119)

Ten sets of 2-wire screw terminals for input wires enclosed in a safety housing. Plugs into scanner module (Option -101).
Voltage Range: 5V rms to 250V rms
Frequency Range: 45 Hz to 450 Hz
Conversion Method: 1/2-wave, average-responding, calibrated to indicate rms value of sinewave
Maximum Voltage: 250V rms or 250V dc
Accuracy: ±(1.0% of input +0.1V)

Current Input Connector Option (-106)

Specifications are the same as for Option -101 but with a precision 15Ω, 0.25 watt resistor in each channel to convert current to voltage. For 4 to 20 mA sources; 129 mA maximum. Plugs into Scanner Module (Option -101). Some other current values available on request.

RTDs, Ohms, 1/4-Bridge Strain Inputs

Ohms Mode Specifications

Max Resistance	Resolution	Excitation Current
64,000Ω	1.0Ω	100 μA
8000Ω	0.1Ω	100 μA
800Ω	0.01Ω	1 mA
100Ω	0.001Ω	1 mA
10Ω	0.0001Ω	10 mA

Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second
Four-Wire: ±(0.021% of reading + 0.01% range)
Three-Wire: ±(0.021% of reading + 0.02% range + 0.21Ω)

RTD Mode Specifications

Resolution: 0.03°C
Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second, 4-wire
100Ω Pt RTD with alpha = 0.00385: ±0.2°C at 0°C, ±0.3°C at 600°C

1/4-Bridge Strain Mode Specifications

Total System Accuracy*
350Ω Gage: ±(0.042% of reading + 14 microstrain)
Resolution: 0.2 microstrain
120Ω Gage: ±(0.042% of reading + 16 microstrain)
Resolution: 0.5 microstrain

** For 90 days, 18°C to 28°C, 25 readings per second, 350Ω gage, 4V excitation*

Signal Conditioner Option (-701)

For Ohms, RTD, 1/4-bridge strain measurements.
Configuration: 3- or 4-wire, switch-selectable
Excitation Currents: 100 μA, 1 mA, 10 mA, switch-selectable
Accuracy: ±0.005% at calibration, 21°C to 25°C

Four-Wire Scanner Option (-115)

Capacity: Ten 4-wire channels (reed relays)
Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB
Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel
Connector Option: Use 2400A-116

Note: This scanner may not be used for voltage measurements.

Four-Wire Input Connector Option (-116)

Ten 4-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into Scanner Module Option (-115)
Maximum Voltage: Same as for Option -115

1/2-and Full-Bridge Strain Measurements

Total System Accuracy*

1/2-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with both gages principally active
Full-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with two gages principally active
Resolution: 0.5 microstrain

**For 90 days, 18°C to 28°C, 25 readings per second, 350Ω gage, 4V excitation*

Signal Conditioner Option (-702)

For 1/2- and full-bridge strain measurements
Excitation Voltage: 4,5,8,10,12,15, or 20V dc, software-selectable

Six-Wire Scanner Option (-117)

Capacity: Five 6-wire channels (reed relays)
Conductors: Excitation source (2); remote sense (2); analog input (2)
Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB
Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel.
Connector Option: Use 2400A-118

Six-Wire Input Connector Option (-118)

Five 6-wire sets of screw terminals for input wires enclosed in safety housing. Plugs into six-wire scanner module Option -117

Other Input Specifications

Counter/Totalizer Signal Input Option (-113)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.
Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Analog Input Voltage Range: 50 mV to 30V rms
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)

Period Range
TTL Input: 1.1 µs to 6.7s
Analog Input: 5 µs to 0.1s
Period Resolution: 400 ns

Time Interval Range
TTL Input: 1 µs to 3.82 hr
Analog Input: 2 µs to 50 ms
Time Interval Resolution: 819 µs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: DC to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 screw terminals supplied with option

4 Channel Counter/Totalizer Option (-113/AA)

Measures period, frequency, time interval, and totalizes
Inputs: Four channels, non-isolated
Frequency Range: 0-500 kHz
Period Range: 10 µs to 50,000s
Totalizer Capacity: 999,999
Input Voltage Range: 175 mV to 70V rms
Connector: 12 screw terminals supplied with option

Digital Input Module Option (-103)

BCD Mode: 7 BCD digits +1 sign +3 decimal position bits
Binary Mode: 24 bits +1 sign bit
Logic Level: TTL, 0 to +0.75V low, +2.5 to +8V high
Rate: ≤250 words per second
Connector Options: Use 2400A-110 or -111

Status Input Module Option (-104)

Bits Per Module: 32, isolatable from system ground or other modules by up to 30V dc or peak ac
Format: Individually readable
Input: Contact closures or TTL level
Connector Option: Use 2400A-110 or -111

Sequence of Events Recorder Option (-104/AA)

Number of Inputs: 32 channels
Channels Per System: 1024 max
Resolution: 0.1 ms to 100 ms, selectable
Connector Option: Use 2400A-110 or -111

Interrupt Signal Input Option (-114)

Number of Inputs: 16
Input Logic: Contact closures or TTL level, switch-selectable
Connector Option: Use 2400A-110 or -111

Screw Terminal Connector Option (-110)

Terminals: 50, for wire sizes up to #14 AWG

Solder Pin Cable Connector Option (-111)

Terminals: 50, for wire sizes up to #22 AWG

Control Output Specifications

Analog Control Output Option (-302)

Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Isolation: ≤30V dc or peak ac, channel to channel
90-Day Accuracy: ±20 mV in voltage mode and ±20 µA in current mode for ambient temperature of 18°C to 28°C
Connector Option: Use 2400A-110 or -111

Status Output Control Option (-301)

Outputs: 32, open collector, diode clamped
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Connector Option: Use 2400A-110 or -111

Relay Output Card Option (-301/AA)

Number of Contacts: 16
Contact Rating: 250V ac at 3A with non-inductive load and 28V dc at 3A
Contact Arrangement: Form "C" (N.O. or N.C.)
Connector: Terminals supplied with option

Resistance Output Control Option (-305)

Outputs: Two
Isolation: ≤30V dc or peak ac channel to channel or channel to ground
Values: 0 to 4095Ω in 1Ω increments
Connector: Four screw terminals supplied with option

Resistance Output Control Option (-306)

Outputs: Two
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Values: 0 to 102,375Ω in 25Ω increments
Connector: Four screw terminals supplied with option

Stepper Motor Control Output Option (-307)

Number of Outputs: One, non-isolated
Input Signals: External Enable, Closed-Loop Feedback
Direct Output Signals: Four-Phase Unipolar Drive, Flyback Protected
Logic Output Signals: CW/CCW direction and Step Clock, or CW and CCW Clock Outputs; Busy/Done
Acceleration and Deceleration Rates: 114 Hz/second to 97656 Hz/second. Software-selectable
Connector: 12 screw terminals, supplied with option
Note: Option -307 may be configured as a frequency source. Ask about Option -307/ABK

General Specifications

Shock and Vibration: Meets MIL-T-28800, Class 5, Type III requirements
Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤80% to 40°C and ≤70% to 50°C, operating, non-condensing
Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 or 60 Hz ±2 Hz, 130 watts maximum
Size: 22 cm H x 43 cm W x 38 cm D (8.66 in H x 16.9 in W x 14.96 in D) for 2400B, 2401A, 2402A, and 2403A. Fit standard 19-inch rack
Weight*
2400B: 11.4 kg (25 lb)
2401A: 6.4 kg (14 lb)
2402A: 11 kg (24 lb)
2403A: 8.2 kg (18 lb)
**Approximate, fully loaded*

Included with Instrument: Manual Set, Getting Started Guide and power cord

Ordering Information

Models

2400B* Intelligent Computer Front End
2401A Scanner Extender Chassis
2402A I/O Extender Chassis
2403A Remote A/D Extender Chassis
**Option -001 or -002 is required*

Options

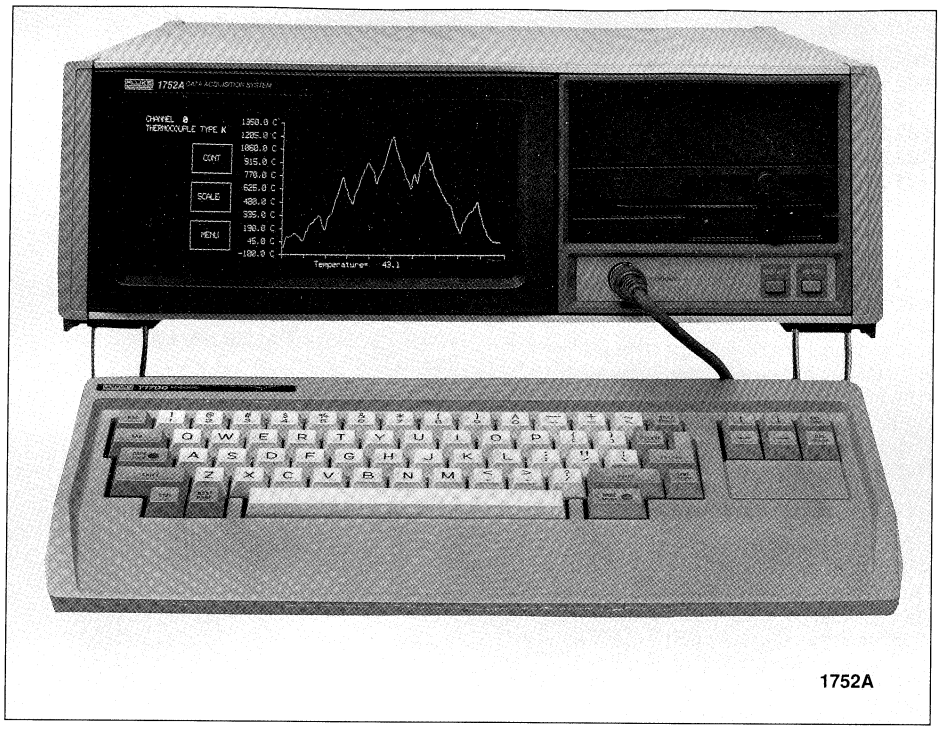
-001 Serial Interface
-002 IEEE-488 Interface
-101 High Performance Scanner
-102 Thermocouple Input Connector
-103 Digital Signal Input
-104 Status Signal Input
-104/AA Sequence of Events Recorder
-106 Current Input Connector
-108 DC Voltage Input Connector
-109** High Performance A/D Converter
-110 Screw Terminal I/O Connector
-111 Solder Pin I/O Connector
-113 Counter/Totalizer Signal Input
-113/AA 4 Channel Counter/Totalizer
-114 Interrupt-Signal Input
-115 Four-Wire Scanner
-116 Four-Wire Input Connector
-117 Six-Wire Scanner
-118 Six-Wire Input Connector
-119 AC Voltage Input Connector
-301 Status Output
-301/AA Relay Output
-302 Current/Voltage Analog Output
-305 Resistance Output (1Ω-4 kΩ)
-306 Resistance Output (25Ω-100 kΩ)
-307 Stepper Motor Control Output
-401 Scanner Extender Interface
-402 Scanner Extender Cable
-403 Connectors for 2401A-402 Cable
-501 I/O Extender Interface
-502 I/O Cable (with connectors, 9m)
-601 Remote A/D Extender Interface
-602 Remote A/D Extender Cable
-603 Connectors for 2403A-602 Cable
-701 RTD, Ohms, 1/4- & 1/2-Bridge Strain Signal Conditioner Measurements
-702 1/2- & Full-Bridge Strain Signal Conditioner
***Required for analog measurements*

Accessories (Also see Section 20)

Y1707 Cable for RS-232-C, 2m
Y1705 Null Modem Cable, RS-232-C
Y8022 IEEE-488 Shielded Interface Cable, 2m
Y2053 Rack Adapter w/24" slides
Y2054 19" Rack Adapter w/o slides
Y2055 Multi-connector, RS-422

1752A

GPIB
IEEE-488



1752A

1752A Data Acquisition System

- New high speed measurement & control processor option
- Analog measurements to 1,000 per second, accuracy of 0.02%
- Touch sense graphics display
- High performance processor with Macrostore™ floating point processing
- 136K bytes of RAM; expandable to 3.0M bytes
- 400K byte floppy disk, optional 40M byte fixed disk
- BASIC programmable with real time and measurement and control extensions
- GPIB/IEEE-488, RS-232/422, current loop and parallel interfaces
- Rackmountable with removable keyboard
- Analog control option (voltage or current)
- Status input/output option
- Counter/totalizer option
- Signal conditioning options for dc/ac volts, thermocouples, RTD, strain

The Fluke 1752A Data Acquisition System is a powerful microcomputer-based system for measurement and control applications. The data acquisition functions are integrated into the same chassis as the computer to minimize desktop or rack space, simplify programming, and increase system performance. The 1752A's BASIC offerings provide a structured programming environment tailored for high speed data acquisition and instrument control. Single-word commands simplify the task of writing programs for both data acquisition and GPIB/IEEE-488* compatible instrument control.

The touch screen replaces a keyboard or switch panel, making system control as simple as touching the screen.

High Performance Microcomputer

The 1752A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1752A's high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory workspace, functions as an independent graphics display terminal for the central processor. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

Soft-loaded Operating System

The 1752A is easily configured to automatically start running your application software. On power-up the 1752A loads operating software from its internal floppy disk then executes a command file which instructs it to perform any desired task sequence. Alternatively, the 1752A may be operated as a diskless system when equipped with optional internal hard disk or nonvolatile RAM. Since the operating software is soft-loaded, updating is as easy as inserting a new disk and restarting.

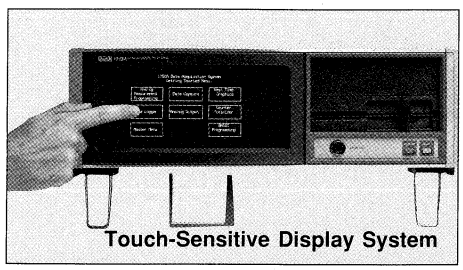
RAM memory in the 1752A can be partially allocated as a file-structured electronic disk for high speed task overlays and large, fast-access virtual data arrays.

The 1752A includes four slots for additional memory and interface options. The standard 136K RAM memory is expandable to over 3 megabytes.

Mass Storage

The 400K byte internal floppy disk drive capacity can be expanded through the 17XXA-440 40M byte internal hard disk. This option is a rugged drive designed to meet demanding industrial and portable applications. Reliable performance is guaranteed even at ambient temperatures of 40°C. Self-parking heads prevent disk crash if the unit is transported.

Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of nonvolatile memory may be installed.



Touch-Sensitive Display System

Touch-Sensitive Display System

With its touch-sensitive display, the 1752A is particularly well suited for applications where personnel need to operate complex systems.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. Systems based on this concept are easily updated for new tasks: the cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touch-sensitive display overlay goes back to 1979. It has proven to be a rugged, reliable component.

Characters Plus Graphics

The graphics display capability of the 1752A is independent of its character display, and of the 1752A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1752A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1752A character display is an independent function that can overlay graphics data displays for labels, or be used alone for text and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1752A includes an industry standard composite video output that will display whatever is on the 1752A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Data Acquisition and Control

The 1752A-010 Analog Measurement Processor allows the 1752A to connect to 16 differential or 32 single-ended inputs, and acquire data at up to 1,000 readings per second. Multiple 1752A-010's may be installed to increase system throughput to 4,000 channels per second. (Any single input, however, can be sampled at a maximum rate of 1,000 per second.) Normal mode rejection may be added through either internal line synchronization, or external synchronization, using the Y1752A Line Synchronization Transformer. The Analog Measurement Processor interfaces to the 1752A bus without isolation. Inputs are protected against damage to 50V dc, and fused input resistors decrease the risk of dangerous higher voltages reaching system operators. An external signal conditioning subsystem is available which provides isolation as well as signal conditioning for inputs such as ac voltages, thermocouples, RTDs and strain.

For analog control, use the 1752A-011. This option allows the 1752A to control devices which accept a 0 to 20 mA or a ±10V dc control signal. Each of the four outputs can be individually configured for either current or voltage.

For frequency, time, and totalizing measurements, the 1752A-012 option offers a single input. To sense switch closures or logic levels, as well as perform on-off control, use the 17XXA-002 Parallel Interface. This option offers 32 bits configurable for either input or output. To switch higher levels, an optional digital isolation subsystem is available. To expand your system, use the 1702A Extender Chassis. This increases the number of slots available for measurement and control options by 11. More 1702As may be added for larger systems.

Interfacing

The 1752A includes an IEEE-488 bus interface and an RS-232C serial data port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1752A programming language. The 1752A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1752A can pass control to another controller and take it back when offered. As system controller, the 1752A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an IEEE-488 interface and an additional RS-232C serial data port. The 1752A can accomodate up to four IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial-data port with its own buffer memory. It is supplied configured for RS-232C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either high true or low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Memory Expansion Modules (-006, -007, -016, -017)

Internal program and data space may be expanded to over 3M bytes with RAM expansion options. Memory may be added in the following increments:

17XXA-006 256K bytes
17XXA-007 512K bytes
17XXA-016 1M bytes
17XXA-017 2M bytes

Application programs can assign any part of this memory to function as an "Electronic Disk." Programs and data may be loaded to this E-Disk, allowing faster transfer rates and no disk wear.

Non-volatile RAM Options (-018, -019, -020)

These options provide either 256K bytes (-018), 512K bytes (-019) or 1M bytes (-020) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM – over 1M bytes per second. Up to 4M bytes non-volatile RAM may be installed in the 1752A.

Non-volatile RAM is a solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Non-volatile RAM is battery backed up for up to five years to retain its file contents through a power loss. Since non-volatile RAM has a much greater tolerance to temperature extremes than other media, the 1722A can operate from 0°C to 40°C when non-volatile RAM is the primary file storage medium. Non-volatile RAM provides a write protection switch to protect its file contents.

High Speed Data Acquisition and Control

A new 1752A option providing sampling of analog/digital inputs at up to 60 Hz is now available. Full details on the high speed measurement and control processor are found on page 429

Software

The 1752A offers an environment specifically suited to the development of real time control programs. Interpreted BASIC, Compiled BASIC, FORTRAN, Assembly, C and several utility softwares are available. For more information on 1752A software systems, consult the 1700 Series Software section, following this section. A data acquisition library provides routines directly accessible from BASIC, greatly simplifying data acquisition and control tasks. The "Getting Started" software provides the user with a number of useful programs, allowing the user to access many of the 1752A's capabilities through the touch screen.

1752A

Module-Level Diagnostics

The 1752A's diagnostic software allows operators to identify failures to the module level. Spare-module kits are available for time-critical applications. Fluke also maintains an inventory of 1752A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not usually in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1752A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Sales Engineer or Representative to let you evaluate the 1752A through its manuals. You will be pleasantly surprised.

Specifications

Option Specifications*

Analog Measurement Processor (-010)

Number of Channels: 16 differential or 32 single-ended (single and differential channels may be mixed)
System Capacity: 4 processors, 128 single-ended channels
Ranges: (full scale, each channel) ±1.0158V; ±10.158V; ±65 mA; 4 to 20 mA displayed as 0 to 100% of scale
Resolution: (16 bits) 10V range, 310 µV; 1V range, 31 µV; 65 mA range, 2.07 µA, (15 ohm, 0.04%, 20 ppm TC sense resistor)
Reading Rate: Synchronized Modes-400 channels/s @50 Hz, 480 channels/s @60 Hz, 400 channels/s @400 Hz; Asynchronous Mode 1000 channels/s
Accuracy (90 days): (10°C to 40°C operating) 10V range, ±(0.02% of reading + 1.24 mV); 1V range, ±(0.02% of reading + 248 µV); 65 mA range, ±(0.05% of reading + 16.5 µA)
Common Mode Rejection: dc -77 dB; 50/60 Hz, 60 dB
Normal Mode Rejection: Asynchronous mode, 0 dB; internally synchronized, 20 dB; Externally synchronized, 45 dB
Input Protection: To 50V rms without side effects, fuse protected to 240V rms
Connector: Requires two Y1750s

Analog Control Output (-011)

Outputs: Isolated. Four per module; voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Resolution: 2 mV (13 bits) or 5 µA (12 bits)
Isolation: ≤30V dc or peak ac, channel to channel
Max Load: ±5 mA in voltage mode; ≤750Ω in current mode
90-Day Accuracy: ±20 mV in voltage mode and ±20 µA in current mode for ambient temperature of 18°C to 28°C
Rate: 1000 changes/sec
Connector Option: Use 2400A-110 or -111

Counter/Totalizer Signal Input (-012)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.
Inputs: TTL, gate 1, gate 2, trigger, count up, count down, up/down, count, non-isolated common, isolated common, isolated analog input
Isolation: Both analog input and isolated common are isolated from the 1752A and/or ground up to 30V and up to 1.0 V/µs maximum slew rate
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)
Period Range
TTL Input: 1.1 µs to 6.7s
Analog Input: 5 µs to 0.1s
Period Resolution: 400 ns
Time Interval Range
TTL Input: 1 µs to 3.82 hr
Analog Input: 2 µs to 50 ms
Time Interval Resolution: 819 µs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 conductors, supplied with option (screw terminals)

Parallel Interface (-002)

Data I/O lines terminated with 2400Ω to +5V, 5000Ω to ground, with diode input protection. Schematics provided with documentation.
Update Rate: 3000/s (status output)

General Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating
Relative Humidity: 20% to 80%, non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating
Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum
Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet
Weight: 15.9 kg (35 lb); keyboard 1.4 kg (3 lb)
Included with Instrument: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, Data Acquisition and Control Guide, and a pad of 50 display worksheets

Ordering Information

Models

1752A Data Acquisition System (w/one 1752A-010 Analog Measurement Processor)
1752A-1 Data Acquisition System (w/o 1752A-010 Analog Meas Processor)

Options (for above Models)

-002 Parallel Interface
-006 256K Byte RAM Memory Expansion
-007 512K Byte RAM Memory Expansion
-008 IEEE-488/RS-232C Interface
-009 Dual Serial Interface
-010 Analog Measurement Processor
-011 4 Channel Analog Output
-012 Counter/Totalizer
-016 1M Byte RAM Memory Expansion
-017 2M Byte RAM Memory Expansion
-018 256K Byte Non-Volatile RAM
-019 512K Byte Non-Volatile RAM
-020 1M Byte Non-Volatile RAM
-440 40M Byte Hard Disk

Language Systems

-201 Assembly Language Development System
-202 FORTRAN Development System
-203 Compiled BASIC Development System
-205 Extended BASIC Development System
-912 Non-ANSI C Development System
-913 Non-ANSI C Compiler

Software Options

-900 Binder
-901 Gabby
-902 Touchscreen Toolbox
-903 Compiled MenuBASIC
-905 Extended MenuBASIC
-907 Transport->PC
S1703 Compiled MenuBASIC Development Package
S1705 Extended MenuBASIC Development Package

* *Specifications for options common to 1752A & 1722A Mainframes are found in the 1722A section.*

Peripherals

1020 Touch Control Screen (includes a desk-top enclosure)
1021 Touch Control Screen
1780A InfoTouch Display

Accessories (Also see Section 20)

Y1700 Programmer Keyboard
Y1702 RS-232C Null Modem Cable, 2m
Y1703 RS-232C Null Modem Cable, 4m
Y1705 RS-232C Null Modem Cable, 0.3m
Y1706 Certified Blank Disks Unformatted (pkg of 10)
Y1707 RS-232C Interface Cable, 2m
Y1708 RS-232C Interface Cable, 10m
Y1709 Printer Cable, 2m
Y1717 Parallel Interface Cable
Y1750 Input Terminal Block w/Cable
Y1751 Replacement Cable Set for Y1750
Y1752 Line Frequency Sync Transformer
Y1790 Rackmount Kit w/24" Slides
Y1795 Portable Carry Handle
M00-260-610 18" Rack Slides
M00-280-610 24" Rack Slides
Y8021 Shielded IEEE-488 Interface Cable, 1m
Y8022 Shielded IEEE-488 Interface Cable, 2m
Y8023 Shielded IEEE-488 Interface Cable, 4m
2400A-110 Screw Terminal I/O Connector
2400A-111 Solder Pin I/O Connector

Multifunction Board

The Fluke Multifunction Board by Virtech is a high speed measurement control processor for the Fluke 1752A. The Multifunction Board provides a broad complement of features ideal for high-speed data acquisition and control. High speed Analog Inputs/Outputs, Digital I/O and Multitasking commands provide the power for complex data acquisition applications.

Standard Features Include:

- Multitasking commands for "stand-alone" processing power, allows the Fluke 1752A to concentrate on supervisory tasks, report generation and operator interface.
- 20 kHz sampling of 8 differential analog inputs to characterize or react to rapid events.
- Store 27,000 readings so the Multifunction Board can scan at high speed without constant attention of the user program.
- Continuous control with 4 analog output channels, allows you to "close the loop" without adding options.
- 16 digital outputs for parallel output, "On-Off" control or device actuation.
- 32 digital inputs for status sensing or parallel input.

Optional Features Include:

- 40 kHz or 60 kHz conversion rate
- Analog expansion multiplexer system expandable to 400 differential/800 single ended channels
- RAM expansion up to 516,000 readings
- Industrial Software Package
  - High speed multichannel PID loop control independent of host
  - Ramp/Soak generation
  - mX + b scaling of analog inputs
  - Digital sequence generation
  - Enhanced analog input polling

Multitasking Operating System

The multitasking operating system resident on the board makes this much more than just a measurement card. It is a measurement system with the ability to prioritize, schedule and perform complex data acquisition tasks. This means the Multifunction Board can act intelligently to ensure that high priority tasks will not be missed. Language extensions to Interpreted BASIC, Compiled BASIC, FORTRAN, C, and Assembly Language environments are provided.

An example is AIPOLL which defines an analog input polling process in the multifunction board. The command looks like this:
AIPOLL (channel_number%, low_limit, hi_limit, priority%, interrupt%, task_id%)

This task compares CHANNEL_NUMBER% against LO_LIMIT AND HI_LIMIT. The task itself is identified by its unique TASK_ID%. This task will continue automatically until the task is explicitly stopped. If no higher priority tasks are active, this routine will preempt any lower priority tasks as determined by PRIORITY%. If either limit is exceeded then the user program is interrupted as specified by the INTERRUPT% variable.

On board data storage ensures that high speed measurement tasks act independently. This means that the host CPU doesn't have to continually monitor the Multifunction Board for data buffer overflow. The Multifunction Board can store data for later retrieval by the host CPU.

Specifications

Technical Specifications

System Capacity: Four cards in the 1752A
Software Support: Fluke Interpreted BASIC, Fluke Compiled BASIC, Fluke FORTRAN, 99000 Assembly Language, and C

Analog Inputs

Input Channels: 8 differential – 0-100 mV, 0-1V, 0-10V; ±50 mV, ±100 mV, ±500 mV, ±1V, ±5V, ±10V
Accuracy: 0.05% of full scale all ranges except 0.10% on 0-100 mV and ± 50 mV ranges
Conversion Rate: 20 kHz standard

Analog Outputs

Output Channels: 4 standard
Ranges: 0-5V, 0-10V; ±2.5V, ±5V, ±10V, 0-25 mA (4-20 mA)
Linearity: 0.02% of full scale

Accuracy
Full Scale: 0.2% of full scale
Zero: 0.05% of full scale
Resolution: 12 bits
Settling Time: <5 uSec to 0.02% of final value
Voltage Mode Output Current: 5 mA

Digital Inputs

Input Lines: 32 + 2 handshake output lines
Configuration: Each line may be configured individually as a Status Input or Interrupt Input. Interrupt Inputs may respond to input level or input transition in either direction. Alternatively, all lines may be grouped as 2 16-bit binary words.
Input Range: -0.2V to +5.5V to common
Input Levels: LS TTL load with 10K pullup to +5V
Isolation: All digital inputs and outputs share a common isolated return that can vary 50V dc from system ground

Digital Outputs

Output Lines: 16 + 1 handshake line
Configuration: Each line may be configured as an individual status output or as one 16 bit binary word

Output Levels
Maximum Voltage On Output: 40V
Output Drive (with 1.1V drop): 100 mA
Maximum Output Drive: 200 mA

Environmental

Operating Temperature: 0 to 40°C
Storage Temperature: -20°C to 60°C
Operating Humidity: 5 to 95% non-condensing

Ordering Information

Models

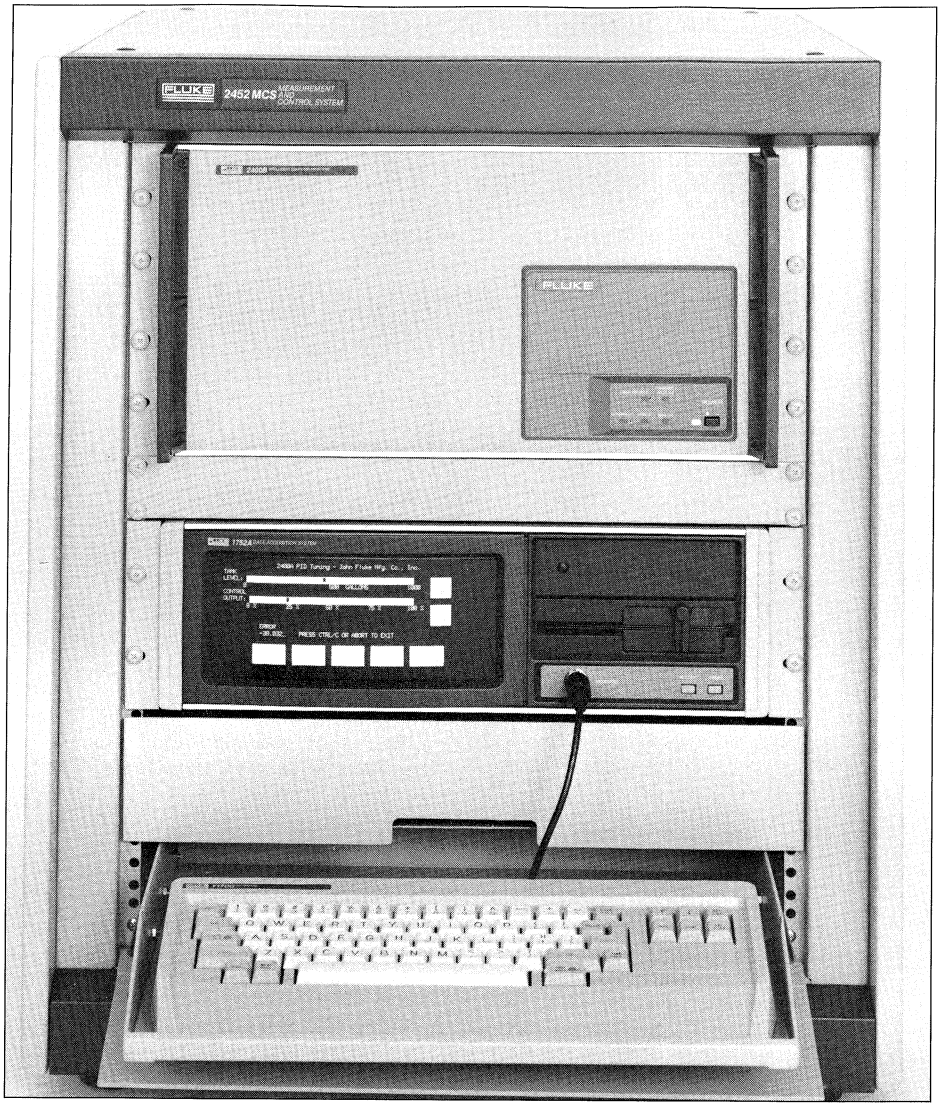
V7800 Multifunction Board

This is the basic model. An extensive option list and configuration information is available from your local Fluke Account Manager or Representative.

Measurement & Control System

2452MCS

GPIB
IEEE-488



2452MCS Measurement & Control System

- Complete system – combines 2400B Intelligent Computer Front End, 1752A Data Acquisition System, and software
- Extensive selection of I/O options – expandable to over 1000 channels with 2401A and 2402A extender chassis
- Up to 60 kHz data acquisition with 1752A option
- Touch Screen – friendly operator interface with graphics
- "Multi-computing" – 2400B handles scanning, linearizations, limit checking and direct control of test or process. 1752A downloads and modifies 2400B program, retrieves scanned data, formats and outputs reports, and provides operator interface
- Available with or without 28 inch high cabinet
- Choice of GPIB/IEEE-488 or Serial (RS-232-C, RS-422) Interfaces

The 2452MCS is a fully integrated measurement and control system which combines the power of two intelligent Fluke instruments – the 1752A Data Acquisition System and the 2400B Intelligent Computer Front End. The system is housed in a locking cabinet that fits on either a work bench or separate stand and includes all the hardware, cables, drawers, etc., necessary to combine the 2400B and 1752A into a complete measurement and control system. Alternatively, the 2452MCS may be ordered without a cabinet to be mounted in your own rack or panel.

The 2400B provides digital and analog measurement, signal conditioning, control outputs, and intelligent decision making, while the 1752A provides tremendous computing power, high speed data acquisition, a CRT display with a touch-sensitive overlay, advanced graphics capabilities, and mass storage via 40M byte hard disk and non-volatile RAM options. Both instruments work together, sometimes independently, sometimes cooperatively, providing a multi-computing system with the power and flexibility to expand as your application requirements increase.

The programmer's keyboard is placed on a convenient sliding rack drawer that may be locked to prevent unauthorized program modification. The system can be programmed to allow the touch-sensitive CRT display to be the operator's interface. This reduces operator errors and training time because the operator interacts with a friendly CRT display customized for the application and written in familiar words.

The 2452MCS, when equipped with the 2400B's Serial interface, permits the 2400B to be located up to 1220 meters (4000 feet) away from the 1752A. A distributed data acquisition system may be constructed in this manner using a single 1722A or 1752A and multiple 2400Bs, in either star or "daisy chain" configurations.

The basic 2452MCS System includes the software tools, and hardware necessary to make it operate as a ten-channel data acquisition system. The system is expandable to sixty channels in the basic 2400B mainframe and to over 1000 channels by adding 2401A and/or 2402A Extender Chassis and input/output options.

Input/Output Capabilities

The measurement of analog inputs such as thermocouples, RTDs, strain gages, dc and ac voltages, and currents can be performed by a 17-bit A/D converter in the 2400B. Capable of resolving 1 μV, the highly accurate A/D conversion preserves data integrity through a sophisticated noise rejection technique that synchronizes its measurement period with the power line frequency. For high speed measurements, analog inputs can be brought directly into an optional analog measurement processor in the 1752A at up to 60,000 readings per second.

Digital inputs accommodated by the 2452MCS incude status, contact closure, interrupt, BCD, pulse, frequency, totalizing and sequence of events.

Controlling outputs sourced by the 2452MCS consist of voltage, 4-20 mA current, resistance, stepper motor control, TTL outputs, and relay closures. A complete description of input/output capabilities is found in the pages describing the 2400B.

Software Options Included

Software supplied with the system includes a program development package (ProLink II), an enhanced BASIC interpreter with extended graphics capabilities, an advanced Editor, and a File Utility Program. The 2452MCS-03 and -04 also include the ProComm software package. (ProLink II and ProComm are both described in a section immediately following the 2452MCS description.) This complete package provides the tools necessary for a programmer to create a custom tailored data acquisition program.

If you want to "come up to speed" and write your application program in a hurry, consider the ProGen Application Software (S2452) package described on the following page.

Turnkey Systems

Fluke Customer Support Services System Integration group and Fluke Cooperative Services (FCS) are available to write custom application software and combine with Fluke hardware for a complete system. In fact, if a turnkey system is what you require, Fluke has a list of Fluke Cooperative Service partners that are experienced with Fluke equipment and capable of fulfilling your needs in several unique industry segments.

Information on training classes, Customer Support Service and FCS is available from your Fluke Sales Representative.

Specifications

For complete specifications please refer to the pages in this section describing the 1752A and 2400B.

CRT Display: High contrast green phosphor, high resolution, 5x9 inch display screen. Sixteen lines of eighty characters or eight lines of forty characters, selectable by program control.

Transparent Touch-Sensitive Overlay: Positioned directly over the display screen. Provides a 6x10 array of touch-sense areas for dynamic operator interface.

Graphics Display: 640 by 224 dots, hardware sector generator

Memory, 1752A: 136K bytes of RAM (expandable to over 3.0M bytes)

Memory, 2400B: 28K bytes of RAM for program storage

Mass Storage

- Double-sided 5¼-inch floppy disk stores 400K bytes
- Up to 4M bytes of non-volatile RAM (optional)
- 40M bytes with internal hard disk (optional)

1752A Communications Interfaces: One GPIB/IEEE-488* port and one RS-232-C port is standard. May be expanded to include six additional RS-232-C, RS-422, 20 mA serial ports and a second IEEE-488 port

2400B Interfaces: Three. One IEEE-488 port or one serial (RS-232-C, RS-422, or 20 mA) port, and two RS-232-C output-only ports

Temperature: 10°C to 30°C, operating; -10°C to 60°C, non-operating (except floppy disks limited to 10°C to 52°C)

Relative Humidity: 5% to 80% operating, non-condensing; 5% to 95%, non-operating and non-condensing (except floppy disks limited to 8% to 90%)

Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 Hz to 60 Hz, ±2 Hz

Size: 70.6 cm H x 61.0 cm W x 70.5 cm D (27.8 in H x 24 in W x 27.8 in D)

Weight: 84 kg (185 lb) approximately, not including options

2452MCS System Components:

- 1752A-1 with Keyboard
- Fluke enhanced BASIC Interpreter, Advanced Editor, File Utility Program
- ProLink II application software package (see following page for description)
- ProComm application software package (-03, -04 only) (see following page for description)
- 2400B with one each of Option -101, -102, -109, and -002 (or -001)
- Integral power strip and power cord
- Full set of Operator and Service Manuals
- 90-day on-site service

Model & Version	Rack Cabinet 71 cm (28") High	2400B Interface & 2 Meter Cable
2452MCS-01	Yes	IEEE-488 (Opt -002)
2452MCS-02	No	IEEE-488 (Opt -002)
2452MCS-03	Yes	Serial (Opt -001)
2452MCS-04	No	Serial (Opt -001)

The rack cabinet has a lockable storage drawer and keyboard drawer, a rear door, and associated hardware.

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Ordering Information

Models

2452MCS-01
2452MCS-02
2452MCS-03
2452MCS-04

Options

See 2400B and 1752A in this section.

Accessories (Also see Section 20)

A24-89 71 cm Instrument Rack (28")
A24-75 183 cm Instrument Rack (6')
A24-90 Wheeled base, for A24-89 or A24-75
A24-123 Serial Impact Printer w/RS-232-C I/F
Y2055 15-Pin Multi-Connector for Multi-Drop RS-422 Hook-up ("Y" Connector)

Measurement & Control Software

ProLink II Application Software (S2400)

Supplied with all 2452MCS Systems
For use with Fluke 1722A/1752A and 2400B
Simplifies development of 2400B application program
Menu-driven user interface

Measurement & Control Software

Fluke offers a wide range of application software to help you develop your 2400B program.

Three of these software packages are designed to be used with the 2452MCS. They are Fluke ProLink II™ Application Software, ProComm™ Serial Communications Utility Package, and ProGen™ Application Software Package.

A fourth software development tool, ProLink PC,™ runs on your IBM XT,™ PC AT,™ or IBM compatible.

Fluke ProLink II Application Software comes standard with all 2452MCS systems. It is a tool which makes developing 2452MCS application program easier.

The 2452MCS consists of two independent computers: the Fluke 2400B and the 1752A Data Acquisition System. These two computers must talk to each other in order to do the job. Fluke ProLink II handles a lot of the system housekeeping tasks you would otherwise have to do. It presents you with a single user interface to both the 1752A and 2400B.

ProLink II presents the user with a menu of choices. You simply move the cursor to the proper selection and press the carriage return. This "one-touch" approach lets you do the following:

1. Automatically run Fluke BASIC; the File Utility Program which allows you to copy, move, delete or otherwise manipulate files; and SET, which allows you to set the RS-232C characteristics of the 1722A/1752A output ports. After exiting any of these three programs, you will automatically be returned to ProLink II.
2. Sends bus commands to the 2400B and displays responses to those commands.
3. Displays English language error messages if an error occurs.
4. Select, edit, download or retrieve user written 2400B programs.
5. Monitor selected variables during program execution. This function is very useful during the program debugging stage. You can download and run your 2400B program, and then monitor certain key variables. In this way you can ensure that variables are changing as you expect them to.
6. Print a hard copy of any file on an external printer.

ProLink PC Application Software (S2401)

For use with IBM PC and Fluke 2400B Intelligent Computer Front End (serial communication)
Simplifies development of 2400B measurement and control program
Menu-driven user interface

ProLink PC is a menu-driven tool for developing 2400B programs with an IBM PC, PC XT, or IBM compatible. Similar in scope and function to ProLink II software, ProLink PC software will handle the communications between the two computers.

Your IBM PC must have a serial interface installed. MS-DOS™ version 2.1 or higher is required.

The operator interface operates similar to ProLink II. The user is presented with a menu of choices. These choices allow you to do the following:

1. Set the RS-232C characteristics of the IBM communications ports.
2. Select, download, or retrieve 2400B programs.
3. Sends bus commands to the 2400B and display responses to those commands.
4. Displays English language error messages if an error occurs.
5. Monitor selected variables during program execution for program debugging.
6. Print a hard copy of a file on an external printer.
7. Exit ProLink PC to the IBM's operating system. The user can then use the editor EDLIN to edit his 2400B program.
8. Automatically set the date and time in the 2400B.

ProLogger 24 Application Software (S2402)

For use with IBM-PC and Fluke 2400B Intelligent Computer Front End
A program development tool and a data acquisition program

ProLogger 24 is a communications utility and a data acquisition program for the IBM Personal Computer and the Fluke 2400B.

As a communications utility this tool assists in the development of a 2400B program. It includes error decoding, downloading and retrieval of the program, a line editor for program modification, bus command interaction and real time block graphic display of a 2400B channel or variable.

As a data acquisition program it provides the ability to print and record to the IBM disk 2400B data. The data can be recorded as sent from the 2400B or in LOTUS 1-2-3™ format.

The key to the power of ProLogger 24 is the user defined macro. Macros are a series of 2400B bus commands that are executed on interval or on demand. ProLogger 24 can receive, display, record or print 2400B data. Data may be checked against limits. If a limit is exceeded the macro can execute another bus command, branch within the macro or trigger another macro. An alarm indicator flashes for unacknowledged alarms. An alarm transition log and an alarm status report is available to the operator.

The IBM-PC, XT, AT or compatable must have a serial interface and MS-DOS 2.1 or higher. A color monitor is not necessary, but will enhance the appearance of ProLogger 24. The IBM-PC needs 128K of memory, however, LOTUS 1-2-3 will require additional memory. The 2400B needs option -001 and a serial cable.

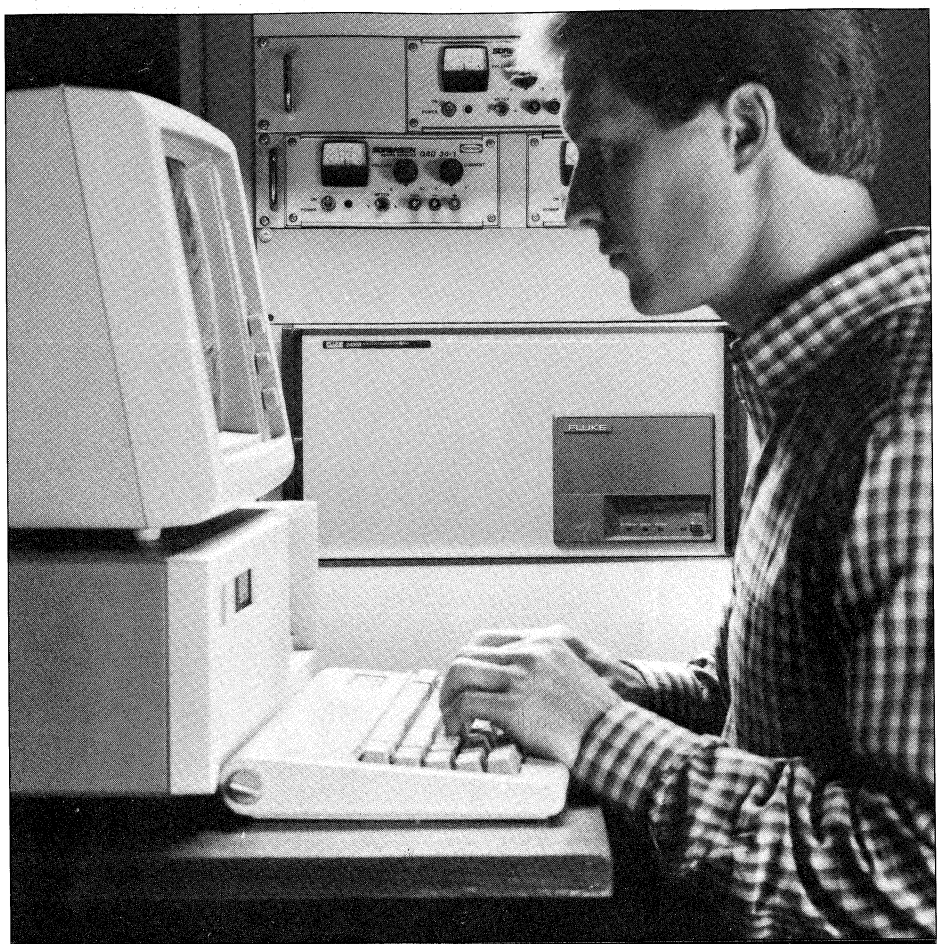
ProLogger 24 allows full use of the 2400B stored program capability.

Ordering Information

Software Package

S2400* ProLink II Application Software for 1722A/1752A
S2401 ProLink PC Application Software for MS-DOS
S2402 ProLogger 24 Application Software for MS-DOS

**Included with all 2452MCS Systems*



ProComm Serial Communications Utility (S2417)

- Supplied with 2452MCS-03 and -04
- For use with 1722A/1752A and 2400B equipped with 2400B-001 serial I/F
- Implements serial communications between 1722A/1752A and 2400B, or multiple 2400Bs to single 1722A/1752A
- Provides built-in error detection and recovery capability
- Supports communications via modems as well as "hard-wired"

ProComm Serial Communications Utility Package comes standard with both serial versions of the 2452MCS, -03 and -04.

ProComm software is a utility package which implements serial communications between the 1722A/1752A and the 2400B Front End. The subroutines are callable from BASIC.

There are three functions which ProComm software can provide for you. If you are using an RS-422 or current loop transmission line, you can have more than one 2400B connected to your 1722A/1752A. This is called a multipoint system. ProComm software allows you to address and unaddress (terminate communications with) each 2400B in your system.

Second, ProComm software implements the highest level message transfer protocol supported by the 2400B, blocked format with acknowledgements and check character. This message transmission protocol provides your communications link with built-in error detection and recovery capability. It is especially useful in electrically noisy applications, or where you must guarantee the integrity of your data.

Third, if you are using a 2400B with an auto-answer modem across an RS-232C interface, ProComm software will automatically hang up the phone line on demand.

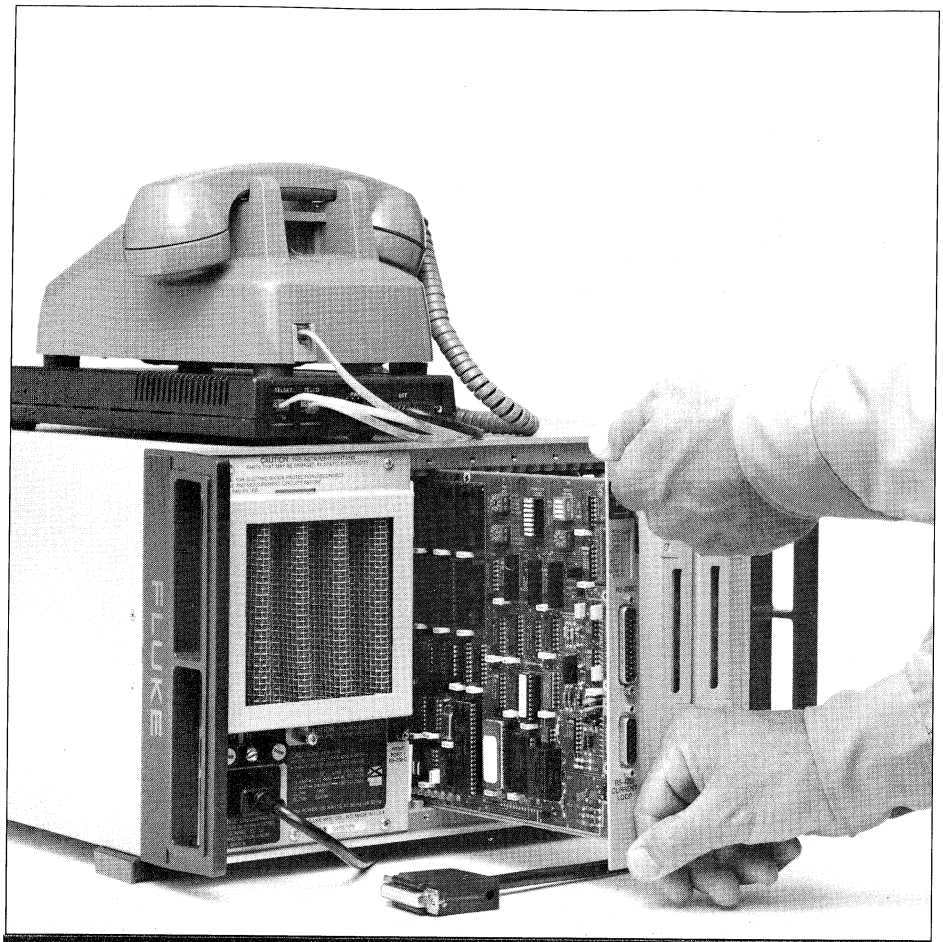
Ordering Information

Software Package

S2417** ProComm Serial Communications Package for 1722A/1752A

***Included with 2452MCS-03 and -04*

Measurement & Control Software



ProGen Application Software (S2452)

For use with 2452MCS Systems

Menu-prompted monitoring/controlling/logging program

Requires no language programming knowledge to operate

Supports up to 500 channels of input/output

ProGen Application Software allows the user to get up and running quickly with the 2452MCS. It is a menu-prompted tool which actually programs the 2452MCS for you. Your 2452MCS can be monitoring and controlling your process or test in a short time.

ProGen software is compatible with all versions of 2452MCS, serial or GPIB/IEEE-488*. At least 512K byte of RAM expansion option must be installed.

Fluke realizes that there may be one person who programs the application, and another who operates it. Accordingly, ProGen software has two separate disks: Programmer and Operator.

The person responsible for configuring the 2452MCS to meet the application uses the Programmer disk. This disk, in turn, creates the Operator disk.

The programmer is prompted to either "fill-in-the-blanks" or use the cursor control keys to move the cursor to the proper choice. Up to 500 channels can be monitored and controlled. In addition, you may select one of up to 100 user-defined limits lists of four limits each to apply to each channel.

The operator can change only those limits and setpoints which the programmer allows. The opdata, some data, or alarms only. Alarm data is automatically recorded.

ProGen software is the easy way to get your 2452MCS up and running.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Ordering Information

Software Package

S2452 ProGen Application Software for 1722A/1752A

2400-Series Option Compatibility

Option	Description	2400B	2401A	2402A	2403A	Note
2400B-001	RS-232/RS-422 Interface	•	—	—	—	1
2400B-002	IEEE-488 Host I/F	•	—	—	—	1
2400A-101	Thermocouple/DC Scanner Card	•	•	—	•	2
2400A-102	Thermocouple Connector	•	•	—	•	—
2400A-103	Digital Input Scanner Card	•	—	•	—	3
2400A-104	Status Input Scanner Card	•	—	•	—	3
2400A-104/AA	Seq-of-Events Input Card	•	—	•	—	3
2400A-106	DC Current Connector	•	•	—	•	—
2400A-108	DC Voltage Connector	•	•	—	•	—
2400A-109	A-to-D Converter Card	•	—	—	•	4
2400A-110	I/O Connector	•	—	•	—	—
2400A-111	I/O Connector	•	—	•	—	—
2400A-113	Counter Input Card	•	—	•	—	5
2400A-113/AA	Counter Input Card	•	—	•	—	5
2400A-114	Interrupt Input	•	—	•	—	3
2400A-115	4-Wire Scanner Card	•	•	—	•	6
2400A-116	4-Wire Connector	•	•	—	•	—
2400A-117	6-Wire Scanner Card	•	•	—	•	7
2400A-118	6-Wire Connector	•	•	—	•	—
2400A-119	AC Voltage Connector	•	•	—	•	—
2400A-201	8K-Byte RAM	*	—	—	—	—
2400A-301	Status Output Card	•	—	•	—	3
2400A-301/AA	Relay Output Card	•	—	•	—	5
2400A-302	Analog Output Card	•	—	•	—	3
2400A-305	Low Ohms Output Card	•	—	•	—	5
2400A-306	High Ohms Output Card	•	—	•	—	5
2400A-307	Stepper Motor Output Card	•	—	•	—	5
2401A-401	Extender Interface for 2401A	8	•	—	—	—
2401A-402	Custom-Length Cable	—	•	—	—	9
2401A-403	Cable Connectors	—	•	—	—	9
2402A-501	Extender Interface for 2402A	8	—	•	—	—
2402A-502	9-M Cable w/Connectors	—	—	•	—	10
2403A-601	Extender Interface for 2403A	8	—	—	•	—
2403A-602	Custom-Length Cable	—	—	—	•	11
2403A-603	Cable Connector Kit	—	—	—	•	11
2400A-701	Signal Conditioner	•	—	—	•	5
2400A-702	Signal Conditioner	•	—	—	•	5
2400A-901	Software Upgrade Kit	*	—	—	—	—
Other Items						
S2400	ProLink II Software Package	•	—	—	—	12
S2401	ProLink PC Software Package	•	—	—	—	13
S2402	Prologger 24 Software Package	•	—	—	—	13
S2417	ProComm Software Package	•	—	—	—	12
S2452	ProGen Software Package	•	—	—	—	12
Y2053	Rack Adapter w/24" slides	•	•	•	•	—
Y2054	Rack Adapter w/o slides	•	•	•	•	—

Notes: All options are customer-installable except where noted

• Compatible option

** For 2400A, not 2400B*

1 Option -001 or -002 required. RS-232 or IEEE-488 cable not included.

2 One Option -102, -106, -108, or -119 required with each Option -101.

3 One Option -110 or -111 required with each of these options.

4 Only one Option -109 per system. Required with Options -101, -115, or -117.

5 No connector option needed.

6 Option -116 required with each -115, plus one -701 per system.

7 Option -118 required with each -117, plus one -702 per system.

8 Installed in 2400B. One -401 or -501 good for 1 or 2 extender cables.

9 Maximum 75 meters. 1-Meter cable w/connectors included with each 2401A.

10 Maximum 15 meters. 2-Meter cable w/ connectors included with each 2402A.

11 Maximum cable length is 1220 meters. Required with 2403A.

12 Primarily for use with 1722A or 1752A.

13 Primarily for use with IBM PCs or compatibles.

Option Compatibility

2280-Series Option Compatibility

Option	Description	2281A	2285B	2286A	2287A	2289A	22810A	22811A	Note
228XX-160	ACV & DCV Input Connector	•	•	•	•	•	•	•	1
228XX-161	A-to-D Converter Card	•	•	•	•	•	#	•	2
228XX-162	Thermocouple/DCV Scanner	•	•	•	•	•	#	•	3
228XX-163	RTD/Ohms Scanner/Excitation	•	•	•	•	•	•	•	4
228XX-164	RTD/Ohms/Strain Excitation	•	•	•	•	•	•	•	5
228XX-167	Counter/Totalizer	•	—	•	•	•	•	•	6
2280A-167/AA	Counter/Totalizer	•	•	•	•	•	•	•	7
228XX-168	Digital/Status Input/Output	•	•	•	•	•	•	•	8
228XX-169	Status Output Connector	•	•	•	•	•	•	•	9
228XX-170	Analog Output Card/Connector	•	—	•	•	•	•	•	6
228XX-171	Current Input Connector	•	•	•	•	•	•	•	1
228XX-174	Transducer Excitation Connector	•	•	•	•	•	•	•	10
228XX-175	Thermocouple/DCV Connector	•	•	•	•	•	#	#	1
228XX-176	DC Voltage Input Connector	•	•	•	•	•	•	•	1
228XX-177	RTD/Ohms Connector	•	•	•	•	•	•	•	11
228XX-179	Digital/Status Connector	•	•	•	•	•	•	•	12
2286A-211	Advanced Math	—	—	13	—	—	—	—	—
228XX-341	RS-232 Interface	—	•	•	14	14	14	14	—
228XX-342	IEEE-488 Interface	—	•	•	—	—	—	—	—
2281A-402	Connecting Cable	15	—	—	—	—	—	—	—
2281A-403	Connector-Pair for -402	15	—	—	—	—	—	—	—
2281A-431	Power Supply for 2281A(s)	16	—	—	—	—	—	—	—
2287A-165					•	—		#	
2287A-265					18	—		18	
2289A-901	Helios Toolbox PC Software	—	—	—	•	•	•	•	17
2289A-902					•	•		•	
Other Items									
S2280	ProLogger, PC Software	—	•	•	—	—	—	—	17
S2289	ProLogger HCL, PC Software	—	—	—	—	•	•	—	17
S2290	LabTech Notebook, PC Software	—	—	—	•	•	•	•	17
Y2044	Rackmount Kit w/slides	•	•	•	•	•	•	•	—
Y2045	Rackmount Kit w/o slides	•	•	•	•	•	•	•	—
Y2047	Y Connector for two -402s	•	—	—	—	—	—	—	—

Notes: All options are customer-installable except where noted.

- *• Compatible.*
- *# One included.*
- *1 Scanner Option -162 required.*
- *2 One required if Option -162, -163, or -164 is in that mainframe.*
- *3 Connector Option -160, -171, -175, or -176 is required.*
- *4 Connector Option -177 is required.*
- *5 Connector Option -174 and Option -162 with -175 (or -176) also required.*
- *6 Includes connector.*
- *7 Connector Option -179 is required.*
- *8 Option -179 required for inputs. Option -169 required for outputs.*
- *9 Used with Option -168 only.*
- *10 Used with Option -164 only.*
- *11 Used with Option -163 only.*
- *12 Used with Option -168 or -167/AA only.*
- *13 Factory or Service Center installation only.*
- *14 RS-232 Interface is included with the 2287A, 2289A, 22810A and 22811A.*
- *15 A one-meter cable with connectors is included. Order only when longer cable is needed. Connectors come assembled on cable when both ordered.*
- *16 Only needed for very large systems or very remote 2281As.*
- *17 Software not compatible with IEEE-488 Interface.*
- *18 Only one -265 Option per -165 Option is allowed.*

Operator Interfaces



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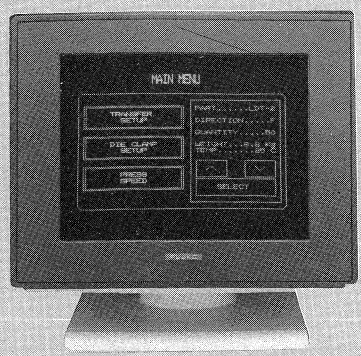

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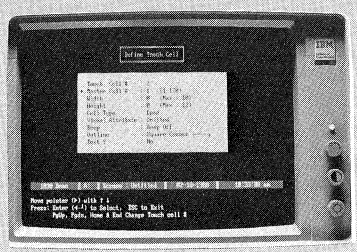
NEW



1034 Page 438



1050 Page 440



Software Page 442

Fluke Touch Control Screens (TCS) are sophisticated operator interfaces for computer-based machinery or systems. With a minimum of training, operators can accurately and efficiently control even the most complex systems simply by touching the screen.

Our Touch Control Screens are used as the primary operator interface in applications such as production test systems, machinery control, and with bar code readers in data collection systems. In addition, many original equipment manufacturers of semiconductor fabrication machines, automated test equipment, and heavy industrial metal stamping presses use Fluke Touch Control Screens.

High reliability, rugged packaging, and ease-of-integration are just a few of the reasons manufacturers are choosing Fluke Touch Control Screens as their operator interface in harsh industrial environments.

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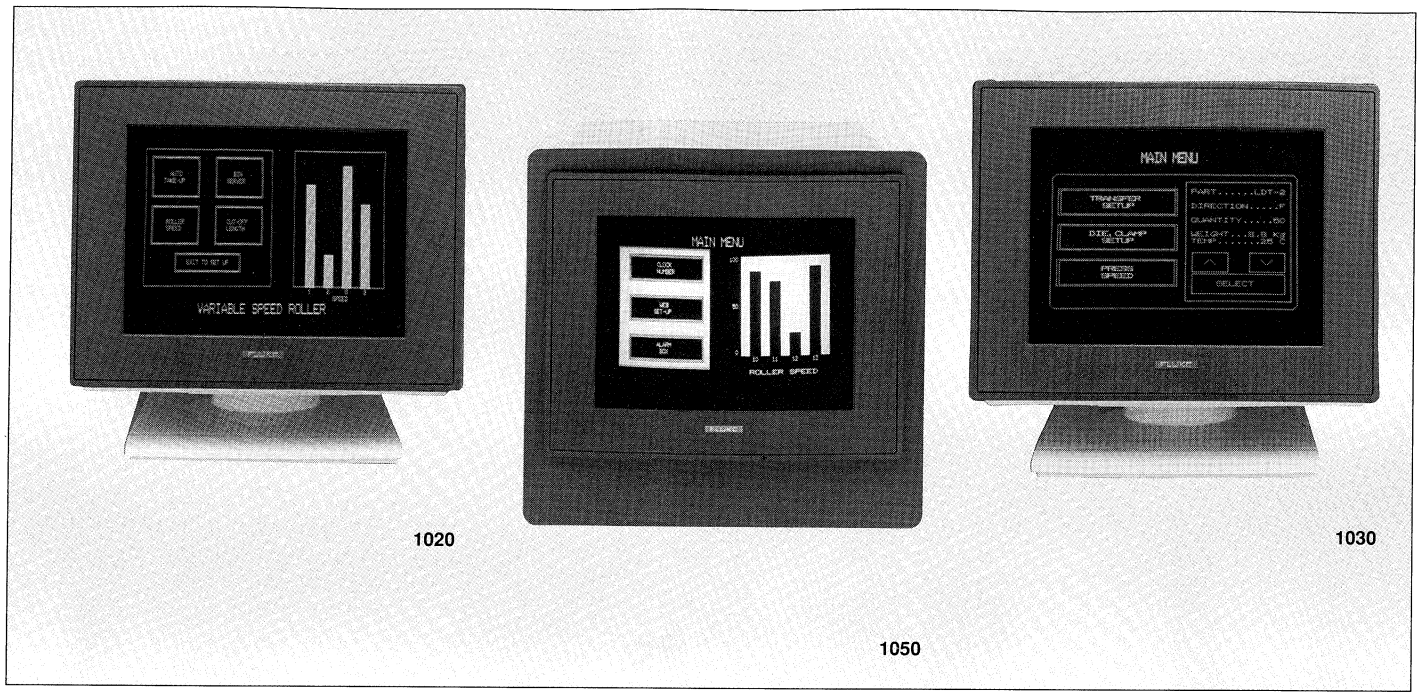
Touch Control Screens



Touch Control Screens eliminate confusing sequences and memorization required by traditional control panels and terminals. Instead, they present a list of options to save training time and cost. Powerful built-in firmware makes these units simple to integrate into any computer-based machine or system.

The Fluke Touch Control Screen (TCS) offering is composed of three product series: The 1020 Series, the 1030 Series, and the 1050 Series. In addition, three software development packages are also available, ScreenBuilder™, IconBuilder™ and Touch Control Screen Toolbox™. The 1020 Series is a fully-integrated subsystem providing the benefits of touch control at a low price. The 1030 Series is a more advanced TCS offering Total Display Memory™ and the ability to multidrop 32 units on a single host serial port. Lastly, the 1050 Series provides all the high level functionality of the monochrome 1030 in a 12" color display.

Each series of products has a durable touch sensitive front panel, CRT, logic board, power supply, and mounting hardware. They are resistant to vibration and shock and sealed against moisture and dirt so they perform reliably in rugged environments. Based on over a decade of touch control experience, these screens bring the latest in technology to OEM applications and inhouse turnkey projects.

High Reliability, Low Cost, Operator Interfaces

- Touch panel consists of 120 touch cells (12 x 10)
- Advanced programming commands
- Rackmountable
- Optional NEMA 12 panel mounting kit
- Selectable character attributes-highlight, blinking, reverse video, underline, conceal (or any combination of these)
- High contrast 12" CRT
- Full one year warranty
- OEM and quantity discounts

Touch Panel

The touch panel consists of transparent, conductive polyester sheets that form a switch matrix of 120 touch cells, each 2 lines high by 8 characters wide.

For increased resistance to chemical attack and abrasion, the touch panel is coated with a hardened anti-glare surface. The touch panel has been successfully tested to over 1 million touches.

Mechanical Integration

Mounting the TCS is as simple as cutting a hole, tightening mounting clips, and attaching the cables. For applications that require a drip-proof, dust-tight seal, a NEMA 12 Panel Mounting Kit is available. For easy installation in a standard 19" instrument rack, rackmount kits are also available.

Safety & EMI Standards

The Touch Control Screen is designed to comply with the following safety standards:

- ANSI/UL 478
- IEC 348
- IEC 435
- CSA 556B

The TCS has been verified to comply with the following EMI standards:

- FCC Part 15 Subpart J Class B
- VDE 0871

Diagnostics

Extensive diagnostic and self-test routines ensure the reliability of TCS operations. Whenever the TCS is powered-up or reset, an automatic self-test of ROM, RAM, non-volatile memory and touch panel ensures the integrity of its components.

1020 Series

The Fluke 1020 Series Touch Control Screens (TCS) are low price, menu-based operator interfaces for industrial applications. The Fluke 1020 and 1021 are both fully integrated subsystems. The Model 1020 includes a desk-top enclosure, a complete manual set, and an optional tilt-swivel base and amber display. The 1021, mountable into a panel or rack, can be installed with a NEMA 12 seal for use in harsh environments. The 1021 can include a fan for extending its operating temperature range.

Software Integration

The enhanced command set of the 1020 Series yields flexibility and programming ease. Region commands allow the programmer to create rectangular "touch targets" in a single command. Other commands allow the host to erase an entire region or modify the attributes within it. Characters can be displayed in reverse video, highlighted, blinking, underlined, or any combination of these. Touch panel commands allow the programmer to modify the way the 1020 or 1021 reports to the host that a touch has been made.

Communications

The 1020 and 1021 have an RS-232C/RS-422-A serial interface that supports full-duplex communication and allows connection to the host computer directly or through a modem. Baud rates are selectable in standard increments up to 19,200. The TCS uses ANSI standard display codes (ANSI x3.64-1979) and is powered from standard ac line voltage.

1020 Options

Amber Phosphor Display (1020-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 phosphor display is standard.

Tilt/Swivel Base (1020-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

1021 Options

Amber Phosphor Display (1021-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 phosphor display is standard.

Fan (1021-20)

An optional fan, including filter and filter cover, is available to increase the operating temperature range by 10°C.



1020

Enclosure (1021-30)

An attractive plastic enclosure is available for operating the Touch Control Screen on a desktop.

Tilt/Swivel Base (1021-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

Custom Connector Extender Cable (1021-60)

A set of connectors that allows access to internal digital and video signals.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the Touch Control Screen.

TCS Null Modem Cable (Y1062)

The TCS Null Modem Cable allows the TCS to be connected to most host computer RS-232 interfaces without the need for custom cabling.

NEMA 12 Panel Mounting Kit (Y1070)

This kit provides the gasketing and mounting hardware necessary to give the Touch Control Screen a NEMA Type 12 rating (drip-proof, dust-tight) when panel mounted in a suitable enclosure.

19" Rackmount Kit (Y1080)

The Y1080 is the front panel to use when mounting the Touch Control Screen into a 482.6 mm (19 in) wide instrumentation rack.

19" Rackmount Kit with 18" Slides (Y1081)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rackmount Kit with 24" Slides (Y1082)

The Y1082 is identical to the Y1081 except that it provides 24" slides.

Keyboard Extender Cable (Y1085)

The Y1085 is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rackmounting accessories.

Contrast Enhancement Overlay (Y1090)

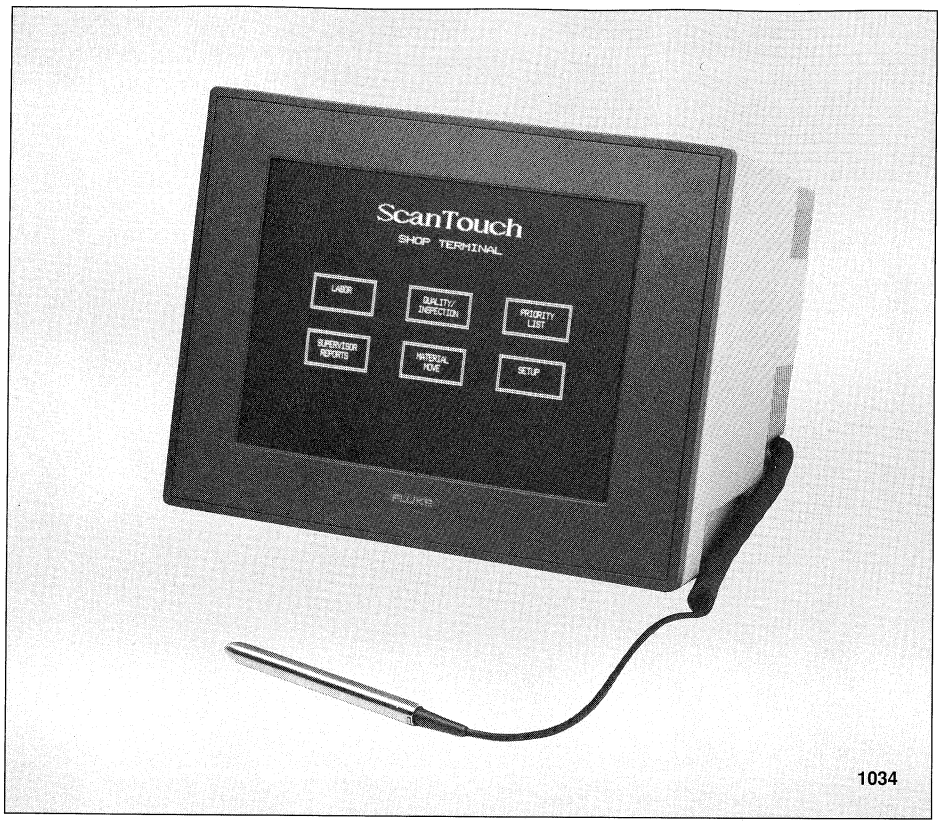
The Y1090 is a gray overlay that enhances visual contrast between the display background and characters on the Touch Control Screen.

Touch Control Screens

1030 Series

RS 232

NEW



1030 Series

The 1030 Series Touch Control Screens are advanced operator interfaces. A great amount of functionality is built-in to these units to reduce host computer requirements and simplify programming. The 1030 Series has three models: the Model 1030, 1031 and the 1034. The 1030 is a fully integrated TCS with bench-top enclosure, a complete manual set, and one Expansion Memory Module for Total Display Memory™ capability. Optional tilt-swivel base and amber display are available.

The Model 1031 is mountable in a panel or rack. Optional NEMA 12 panel mount kit for use in harsh environments is available, as well as 19" rackmount kits. A fan may also be added to the 1031 to extend the operating temperature range. Up to 3 Expansion Memory Modules can be ordered with the 1031 for Total Display Memory capability.

The Model 1034 is a shop terminal designed for use in production transaction systems. The 1034 is a 1031 with integrated bar code reader. The auto-discriminating bar code reader reads all common bar code symbologies in use today. An optional high grade stainless steel wand is also available (1034-70). All other standard 1031 options are used with the 1034.

Total Display Memory

Total Display Memory is a unique capability that not only stores the visual characteristics of each application screen, but also all "Touchkey" programming and screen attributes. This screen storage capability preserves complete screen functionality and allows stored screens to be edited without disrupting the currently displayed screen. Because the 1030 Series employs an efficient data compression algorithm, less complex screens require proportionately less memory. Also, the transition from one stored screen to the next is virtually instantaneous.

Total Display Memory is added to the 1030 Series by inserting up to three Expansion Memory Modules. Two memory types are available: EEPROM and Non-Volatile RAM. Only one memory type can be used in any single TCS.

Software Integration

The 1030 Series provides a set of commands to easily create "Touchkeys," which are a group of touch cells configured to function as a single button. Touchkeys are also easily outlined on the display for a target, plus they can be created to automatically provide visual/audible feedback to the operator when any one of their touch cells has been activated. Other commands create bar charts, set scrolling regions, and modify character attributes. The 1030 Series also has the ability for the programmer to create custom characters and download them into the TCS's system memory.

Communications

The 1030 Series and the host computer communicate via serial interface supporting full-duplex RS-232C, RS-422-A, and RS-485. RS-232C is used most in normal environments. In noisy environments, or for distances of up to 1200m (4000') RS-422-A is recommended. RS-485 is used in multidrop configurations supporting up to 32 TCSs on one host serial port.

1030 Options

Amber Phosphor Display (1030-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 is standard.

Tilt/Swivel Base (1030-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

1031/1034 Options

Amber Phosphor Display (1031, 1034-10)

The amber monochrome PC194 phosphor display is available as a factory configured option. The green P31 is standard.

Fan (1031, 1034-20)

An optional fan, including filter and filter cover, is available to increase the operating temperature by 10°C.

Enclosure (1031, 1034-30)

An attractive plastic enclosure is available for operating the TCS on a pedestal or bench-top.

Tilt/Swivel Base (1031, 1034-31)

The Tilt/Swivel Base can be attached to the enclosure for easy up-down and left-right movement of the unit.

Expansion Memory Module - Non-Volatile RAM (1031, 1034-40)

Expansion Memory Modules allow the 1031 to store all application screens, touchkey programming, and screen attributes. Up to three 1031-40s may be installed in a single 1031.

Expansion Memory Module EEPROM (1031, 1034-50)

Expansion Memory Modules allow the 1031 to store all application screens, touchkey programming, and screen attributes. Up to three 1031-50s may be installed in a single 1031.

Custom Connector Extender Cable (1031-60, 1034-60)

A set of connectors that allows access to internal digital and video signals.

Bar Code Wand (1034-70)*

The high grade, stainless steel wand connects easily to the bar code port at the rear of the terminal.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the Touch Control Screen.

RS-485 Multidrop Adapter Cable (Y1060)

This accessory provides easy daisy-chaining when using the 1030 Series TCS in a multidrop configuration.

TCS Null Modem Cable (Y1062)

The TCS Null Modem Cable allows the TCS to be connected to most host computer RS-232 interfaces without the need for custom cabling.

NEMA 12 Panel Mounting Kit (Y1070)

This kit provides the gasketing and mounting hardware necessary to give the Touch Control Screen a NEMA 12 rating (drip-proof, dust-tight) when panel mounted in a suitable enclosure.

19" Rackmount Kit (Y1080)

The Y1080 is the front panel to use when mounting the Touch Control Screen into a 482.6mm (19 in) wide instrumentation rack.

19" Rackmount Kit with 18" Slides (Y1081)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rackmount Kit with 24" Slides (Y1082)

The Y1082 is identical to the Y1081 except that it provides 24" slides.

Keyboard Extender Cable (Y1085)

The Y1085 is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rackmounting accessories.

Bar Code Wand Extender Cable (Y1086)

The Y1086 is used to extend the bar code wand interface to the front panel of the Y1080, Y1081, and Y1082 rack mounting accessories. The Y1086 can also be used in most custom panel mount applications.

Contrast Enhancement Overlay (Y1090)

The Y1090 is a gray overlay that enhances visual contrast between the display background and characters on the Touch Control Screen.

Only available with model 1034

Specifications

1020 and 1030 Series

Temperature: 0 to 50°C without plastic enclosure; 0 to 60°C without plastic enclosure, with optional fan; 0 to 40°C with plastic enclosure; 0 to 50°C with plastic enclosure,with optional fan
Voltage: 90V to 132V ac, 180V to 264V ac, 47 Hz to 440 Hz
Touch Panel: 120 Touch Cells, 12 rows x 10 columns; with hardened scratch resistant surface
CRT: 305 mm (12.0 in) diagonal, Monochrome P31 Phosphor (green); PC194 Phosphor (amber), option
Size: 335.3 mm W x 260.9 mm H x 330 mm D (13.2 in W x 10.3 in H x 13.0 in D), with enclosure; 318 mm D (12.5 in D) without enclosure
Weight: 8.44 kg (18.6 lb) without plastic enclosure

Ordering Information

1020 Series

1020 Touch Control Screen Package (includes 1021, enclosure, manual set)
1021 Touch Control Screen

Options (1020)

1020-10 Amber Phosphor Display
1020-31* Tilt/Swivel Base
** Customer installable*

Options (1021)

1021-10 Amber Phosphor Display
1021-20* Fan with cover and filter
1021-30* Enclosure
1021-31* Tilt/Swivel Base (used on 1021-30)
1021-60 Custom Connector Extender Cable
1021-90 1020 Series Manual Set
** Customer installable*

1030 Series

1030 Touch Control Screen Package (includes 1031, enclosure, manual set, 1 Expansion Memory Module NVRAM)
1031 Touch Control Screen
1034 ScanTouch Shop Terminal

Options (1030)

1030-10 Amber Phosphor Display
1030-31* Tilt/Swivel Base
** Customer installable*

Options (1031, 1034)

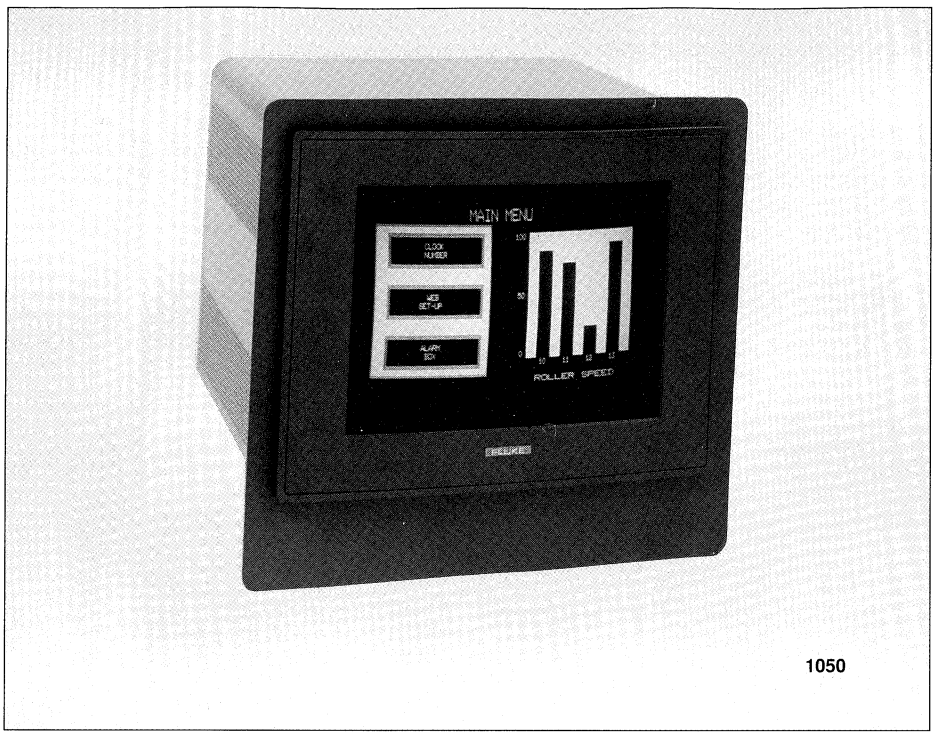
103X-10 Amber Phosphor Display
103X-20* Fan with cover and filter
103X-30* Enclosure
103X-31* Tilt/Swivel Base
103X-40** Expansion Memory Module NV RAM
103X-50** Expansion Memory Module EEPROM
103X-60 Custom Connector Extender Cable
103X-70 Bar Code Wand
103X-90 1030 Series Manual Set
** Customer installable*
*** Only one type of Expansion Memory can be ordered per 103X. Up to three (3) of the chosen options may be installed per 1031*

Accessories (1020 and 1030 Series)

Y1000 Alphanumeric Keyboard
Y1060*RS-485 Multidrop Adapter Cable
Y1062 TCS Null Modem Cable
Y1070 NEMA 12 Panel Mounting Kit
Y1080 19" Rackmount Kit
Y1081 19" Rackmount Kit w/18" Slides
Y1082 19" Rackmount Kit w/24" Slides
Y1085 Keyboard Extender Cable
Y1086 Bar Code Wand Extender Cable
Y1090 Contrast Enhancement Overlay
Y1707 2m RS-232C Cable
Y1708 10m RS-232C Cable
** For 1030 Series only*

1050 Series

RS-232



1050

1050 Series

The 1050 Series Color Touch Control Screen (CTCS) provides full color capability along with the same high level functionality of the 1030 Series. Up to 32 different colors can be displayed on any single 1050 screen. The 1050 Series has three models: the 1050 Color Touch Control Screen Package, the 1051 Color Touch Control Screen (panel mount), and the 1052 Color Touch Control Screen (rack mount).

The 1050 Series also has Total Display Memory™ capability, powerful firmware for ease of software integration, and multidrop capability of up to 32 CTCSs on a single host serial port. The 1050 Series meets NEMA 12 when panel mounted.

Specifications

1050 Series

Temperature: 0°C to 40°C without optional fan, 0°C to 50°C with optional fan
Voltage: 90V to 132V ac, 180V to 264V ac, 50/60 Hz
Touch Panel: 120 Touch Cells, 12 rows x 10 columns; with hardened scratch resistant surface
CRT: 305 mm (12 in) diagonal, 16 normal colors plus 16 highlight colors
Size: 1050/1051: 373.4 mm W x 345 mm H x 367.4 D. (14.7 in W x 13.6 in H x14.5 in D). 1052: 482.6 mm W x 355.6 mm eight rack units H x 370.8 mm D (19.0 in W x 14.0 in eight rack units high x 14.6 in D)
Weight: 15.6 kg (34 lbs)

Ordering Information

Models

1050 Color Touch Control Screen Pkg (Includes 1051, manual set, 1 Expansion Memory Module NVRAM)
1051 Color Touch Control Screen (panel mount)
1052 Color Touch Control Screen (rack mount)

Refer to 1030 Series section for descriptions of Options and Accessories.

Options (1051)

1051-20 Fan (with filter)
1051-40* Expansion Memory Module (Non-Volatile RAM)
1051-50* Expansion Memory Module (EEPROM)
1051-60 Custom Connector Extender Cable (Factory Configured)
1051-90 1050 Series Manual Set

Options (1052)

1052-20 Fan (with filter)
1052-40* Expansion Memory Module (Non-Volatile RAM)
1052-50* Expansion Memory Module (EEPROM)
1052-60 Custom Connector Extender Cable (Factory Configured)
1052-81 18" Rack Slide Kit
1052-82 24" Rack Slide Kit
1052-90 1050 Series Manual Set

** Only one type of Expansion Memory option can be ordered per 1051 or 1052. Up to quantity three (3) of the chosen option may be installed per 1051 or 1052*

Accessories (1050 Series)

Y1000 Alphanumeric Keyboard
Y1060 RS-485 Multidrop Adapter Cable
Y1062 TCS Null Modem Cable, 2m
Y1085 Keyboard Extender Cable
Y1707 RS-232-C Cable, 2m
Y1708 RS-232-C Cable, 10m



(NSN 7025-01-212-2063) **1780A**

1780A InfoTouch® Display

- Compact, rugged packaging
- Operates with any computer via RS-232-C
- 60 fingertip-sized touch sensitive areas
- Crisp, alphanumeric and character graphic display

The 1780A provides a simple yet sophisticated means of interfacing an operator to a complex control process.

Whether the operator is highly skilled in a particular manufacturing or test process, or is a first-time or occasional user of an on-line information system, the 1780A is the ideal link between the user and the computer at the heart of your system. The 1780A's display screen is used to present choices to the operator, and the transparent, touch-sensitive switch matrix over-laying the display receives the operator's response to those choices. Complicated processes can be performed in a series of steps, each involving a small number of choices.

The InfoTouch Display eliminates the complexity of remembering and correctly entering system commands at a conventional keyboard. And since the operator can only act upon the choices presented to him on the display, the possibilities of error are greatly reduced. Information can be presented to the operator in numbers, letters, graphic messages, or custom symbols or alphabets. The touch-sensitive overlay covers most of the screen, and provides 60 fingertip sized touch areas.

Customizing the InfoTouch Display panel is a simple programming task of writing and storing sequences of ASCII characters and display control codes. Since the ASCII sequences are not dependent upon software language, the InfoTouch Display can be used with virtually any host computer. And since the displays are stored in your computer's software or firmware, changes can be easily made as you update the capabilities of your system.

The standard InfoTouch Display allows display of the full ASCII character set plus eleven standard graphics characters for creating simple line drawings or outlining touch-sense areas. Expanded graphics capabilities are optionally available via the 1780A-201 Expanded Graphics Character Set. This option provides 128 more graphics characters to let you generate complex process diagrams or other graphic displays.Or, if you like, you can customize the character sets for your particular system needs.

Optional Keyboard Interface

The Keyboard Interface Option (-001) gives the 1780A another input and output mode in addition to the touch sensitive screen. It may be used with a customized keypad, test fixture, or with the Y1720 Programmer Keyboard for operation as a standard terminal. There are also five TTL output lines on the interface which can be controlled through remote commands from the host.

Accessory Descriptions

Y1791 is a rack mount adapter with a blank filler panel. It allows the 1780A to be mounted to either the right or left side of standard 19-inch rack enclosures. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1792 is a rack mount adapter with a keyboard extension cable. It is similar to Y1791 but includes an extension cable mounted to the filler panel which will extend the function of the 1780A-001 Keyboard Interface to the front panel. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1793 is a carry handle that can be easily installed in place of the trim on either side of the 1780A.

Y1720 Full ASCII keyboard.

Specifications

Signal Emissions: Meets FCC Part 15, Subpart J, Class A
Temperature: 0°C to 50°C, operating; -40°C to +65°C, non-operating
Relative Humidity: To 95% from 0°C to 25°C, 75% to 40°C, and 45% to 50°C, non-condensing
Power: 90V to 132V ac, or 198V to 264V ac, 47 to 63 Hz, 55W maximum
Safety: Protection Class II per IEC 348
Size: 13.3 cm H x 28.8 cm W x 34.4 cm D (5.23 in H x 11.35 in WS x 13.55 in D). Standard $5^{1}/_{4}$ in rack height
Weight: 9.7 kg (22 lb)

Ordering Information

Models

1780A InfoTouch® Display

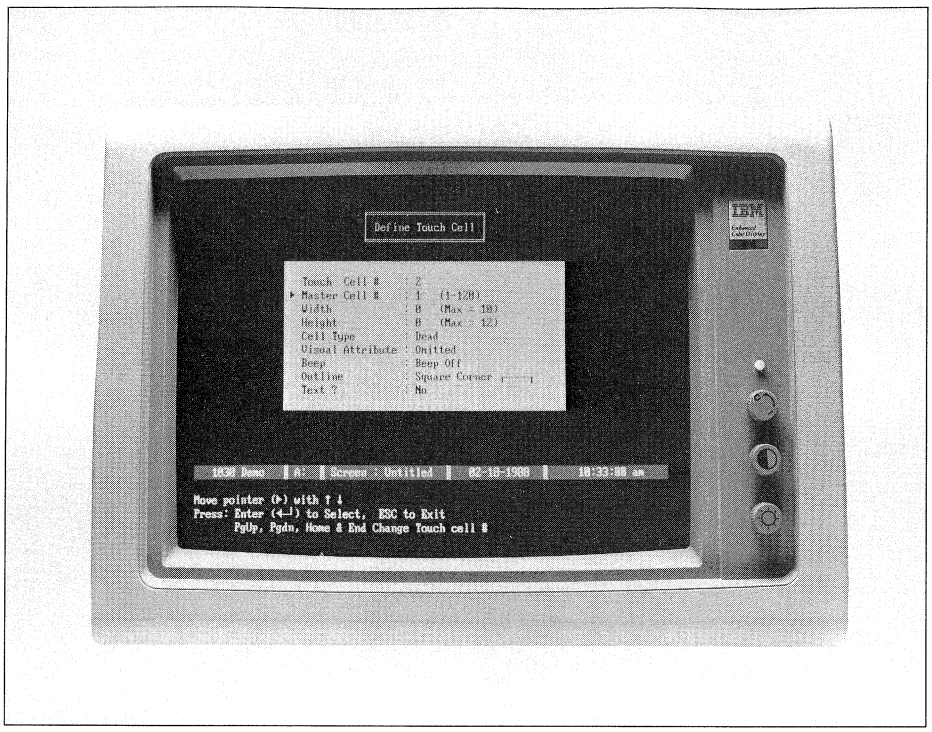
Options

-001* Keyboard Interface
-002* Keyboard Interface w/Y1720 Keyboard
1780A-201 Expanded Graphics Character Set
**Customer installable*

Accessories (Also see Section 20)

Y1062 TCS Null Modem Cable, 2m
Y1707 RS-232-C Cable, 2m
Y1708 RS-232-C Cable, 10m
Y1720 Keyboard
Y1791* Rack Mount Kit
Y1792* Rack Mount Kit and Keyboard Cable
Y1793 Carry Handle
M00-260-610 18" Rack Slide Kit
M00-270-610 20" Rack Slide Kit
M00-280-610 24" Rack Slide Kit
**Separately order rack slides M00-260-610,M00-270-610, or M00-280-610*

Software Development Tools



Software Development Tools

Fast software integration is accomplished by three application development tools. All three run on the IBM family of Personal Computers (PCs) and compatibles.

- ScreenBuilder™
- IconBuilder™
- TCS Toolbox™

ScreenBuilder

ScreenBuilder is a development tool that allows the user to completely develop 1030 or 1050 stored screens simply by "filling in the blanks" on the PC. ScreenBuilder can be used as an "off-line" tool apart from the target system of the TCS application. In fact much of the screen development may be done without a TCS by viewing a representation of the screen on the PC monitor.

ScreenBuilder stores screens on a PC disk or in the TCS's optional memory.

ScreenBuilder features:

- Full support for all elements of stored screens. No additional programming is required to complete stored screens.
- Moving and editing of touchkeys, regions, and text.
- Complete control over characters attributes and colors* of touchkeys, regions, and text in any combination.
- Double-size, double-width, and normal size text.
- Hardcopy documentation for reference during host software development.

IconBuilder

IconBuilder allows the user to create character fonts and icons for custom displays on the 1030 and 1050 Series TCSs. Much like ScreenBuilder, IconBuilder gives the designer the flexibility of creating and downloading apart from the target system. In use, TCS characters are enlarged on the PC screen so that each pixel can be edited. Once developed, these custom fonts and icons are stored on the PC disk or downloaded to the Touch Control Screen.

IconBuilder features:

- Juxtaposed character editing for creating icons.
- Character block moves for rearranging characters within a font.
- Easy character copying and replicating.
- Actual-size and enlarged character viewing on the PC monitor.
- Storage of all or part of the character font in the TCS or in "download files."
- Hardcopy documentation.

** Color is only available on the 1050 Series of Touch Control Screens.*

TCS Toolbox

The TCS Toolbox provides twelve unique functions that facilitate the development of a 1020 Series application program. Each individual function is called from QuickBASIC in a single program statement. Among the various routines are ones to place touchkeys, center and format text, automate numeric and alphanumeric data entry, and several to simplify touch report decoding. For fast debugging, complete error checking and reporting are performed. For customization, all source code is included.

The TCS Toolbox is best suited for 1020 Series Touch Control Screens. It uses only the low level functions supported by the 1020 Series, and works without screen memory.

Compatibility and Features

	TCS Toolbox	Icon Builder	Screen Builder
For Use w/1020	X	•	•
For Use w/1030	•	X	X
For Use w/1050	•	X	X
Creates Stored Screens	•	•	X
Creates Custom Fonts	•	X	•
DecodesTouch Reports	X	•	•

System Requirements

ScreenBuilder and IconBuilder

- Fluke 1030 or 1050 Series TCS.
- IBM PC, PC/XT, PC/AT or equivalent.
  - 512K Bytes of memory (or more).
  - 5¼ inch floppy disk drive.
  - Serial port (optional but recommended).
  - Parallel printer port (optional).
  - Printer (optional).
- PC-DOS or equivalent, version 2.12 or later.
- Fluke Y1062 TCS Null Modem Cable or equivalent (a wiring diagram is included in the ScreenBuilder manual).
- VGA, EGA, CGA, MDA, Hercules or equivalent graphics card.

TCS Toolbox

Same as ScreenBuilder/IconBuilder except for:

- Fluke 1020 Series TCS.
- 320K Bytes of memory (or more) in the PC.
- Microsoft QuickBASIC version 2.0 or later.

Ordering Information

Models

S1005 ScreenBuilder™
S1008 IconBuilder™
102X-902 TCS Toolbox™

Digital Thermometers



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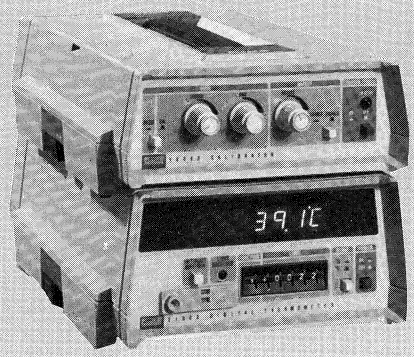


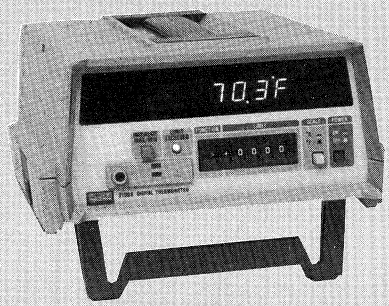
2190A/Y2003 Page 453



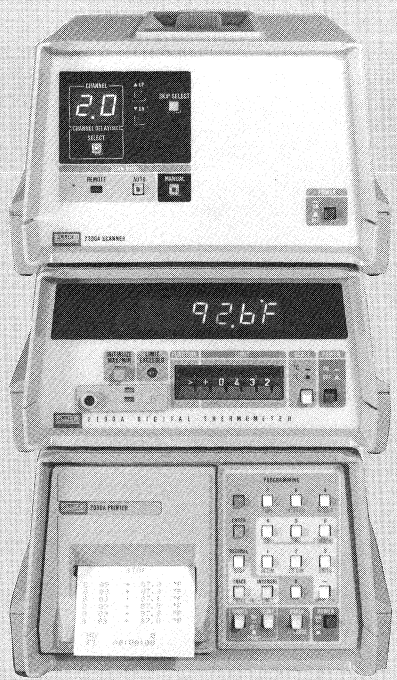
2170A Page 447



2175A Page 448



2190A Page 452



2383A & 2393A Page 460

Fluke specializes in two basic kinds of digital thermometers: those that measure temperature using thermocouples and those that measure temperature using resistance temperature devices (RTDs). Fluke RTD thermometers are used when the greatest accuracy is required.

Fluke thermocouple thermometers range in style and purpose from handheld battery operated models (50 Series) used frequently by service technicians, to the more precise and versatile 2190A. The 2190A can be used with a printer and automatic scanner to record the temperature from many sensing points.

NOTE: Fluke data loggers should not be overlooked as temperature measurement instruments. They measure temperature using either thermocouples or RTDs from multiple points. Also, Fluke makes accessories for digital multimeters which allow temperature measurements.

Selection Guide Page 444
Handheld Thermometers Page 445
Panel Mount Thermometers Page 447
Portable & Rackmountable Page 447

Selection Guide

	Panel Mount		Portable or Rackmountable									
Models	**2160A**	**2170A**	**2165A**	**2166A**	**2168A**	**2175A**	**2176A**	**2190A**	**2180A**	**2189A**	**51**	**52**
Page	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**452**	**452**	**452**	**445**	**445**
Pt, Ni, Cu Type RTDs	—	—	—	—	—	—	—	—	All	Pt	—	—
NBS Type B, E, J, K, R, S, T, C T/Cs *	All	E,J,K,T	All	All	All	E,J,K,T	E,J,K,T	All	—	—	J,K	J,K
DIN Type J, T, T/Cs	No	No	No	No	No	No	No	Both	—	—	—	—
Measurement Resolution C	1°	0.1°	1°	1°	1°	0.1°	0.1°	0.1°	0.01°	0.01°	0.1°	0.1°
Number of Digits	4	4	4	4	4	4	4	5	5	5	5	5
Single Alarm Limits	—	—	—	—	—	—	—	-006	-006	-006	—	—
Selectable Input Points	1	1	1	10	1	1	10	1	1	1	1	2
Multipoint Selector, Manual	2161A	2161A	**	—	**	**	**	Y2001	Y2000	Y2000	—	—
Points Per Selector	10	10	**	—	**	**	**	10	10	10	—	—
Maximum Points	30[2]	30	**	—	**	**	**	100	100[3]	100[3]	1	2
Batteries	—	—	-01	Y2004	Y2004	-01	Y2004	Y2009	Y2009	Y2009	Inc	Inc
External 12V DC Operation	—	—	—	Yes	Yes	—	Yes	Yes	Yes	Yes	—	—
Analog Output Option	-04	-04	-04	-04	-04	-04	-04	-002	-002	-002	—	—
Digital Output Option	-02	-02	-02	-02	-02	-02	-02	-002	-002	-002	—	—

** Type "C" is not an ANSI/ISA approved designation. It is used to designate Tungsten-5% Rhenium vs. Tungsten-26% Rhenium.*
*** Works with 2161A Multipoint Selector except case style is different.*
[1] Also see 8520A/PRT Precision Thermometry Systems.
[2] With the use of the 2161A Multipont Selector.
[3] With the use of the 2300A and 2301A.

Thermometry Product Summary

2160 and 2170 Series: Low-cost, high-accuracy digital thermocouple thermometers in either bench/portable or panel mount styles for applications requiring 1° or 0.1° resolution.

8520A/PRT: Best accuracy from -200°C to +350°C. A Rosemount Special 162N Platinum Resistance Thermometer Probe (PRT) and a Fluke 8520A 5 1/2-Digit Precision Multimeter having a built-in, customized linearization curve to match the specific PRT.

2180A, 2189A, and 2190A: Fluke's most accurate and versatile general purpose digital thermometers for RTDs or thermocouples. You may stack and latch each thermometer to a wide range of accessories, including manual multipoints, a battery pack, and a thermocouple calibrator. Also designed for use with the 2300A Automatic Scanner, and the 2020A and 2030A Printers.

50 Series: The 50 Series combine Fluke's technical expertise in low-cost handheld test instruments and laboratory-grade benchtop temperature instruments to create one of the most advanced, yet affordable, handheld thermometer lines in the industry.

2300A Scanner: Designed to be used with a 2180A or 2190A Digital Thermometer. The 2300A will automatically scan up to 100 points of temperature, using either a 2180A and RTDs or a 2190A and thermocouples. The unit can also run under computer control.

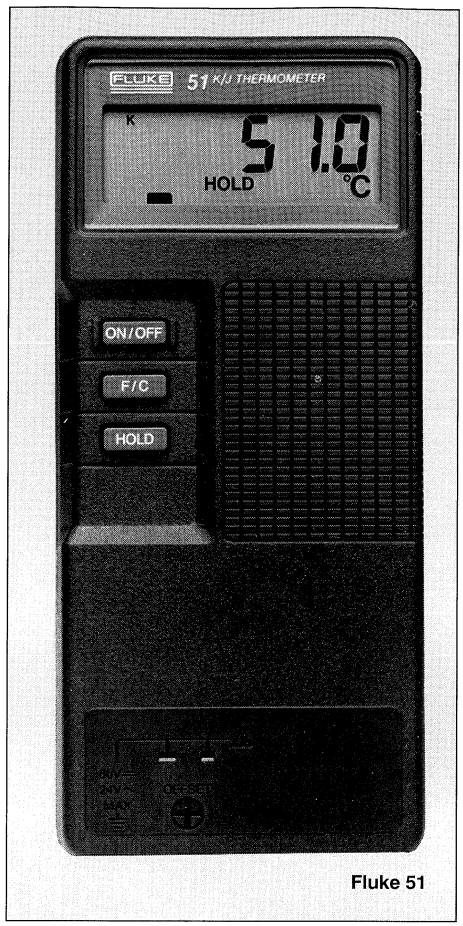
Temperature Logging Systems: Choose from two models — one for RTDs and one for thermocouples. These factory-tested systems include a thermometer, scanner, and printer for precision temperature logging that is also portable.

2020A and 2030A Printers: Allow you to log data from a thermometer or a scanner and thermometer. The 2030A permits mX+b math scaling and trend plotting.

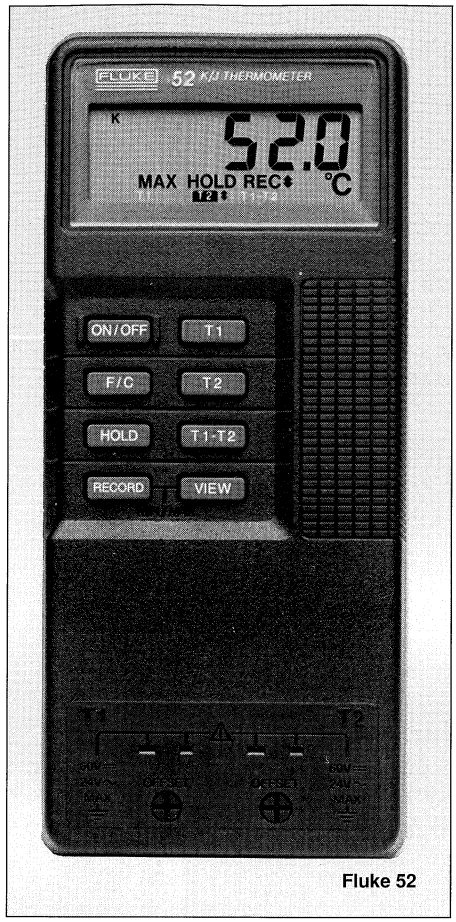
Note: All products with a PM prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

Fluke 51 & 52

T&M EXPRESS LINE



Fluke 51



Fluke 52

Fluke 50 Series Thermometer
Self-test
J or K-type thermocouples
°C or °F display
Reading hold function
Single thermocouple input
1°C or 0.1°C (1°F or 0.2°F) resolution

Additional for the Fluke 52
Dual thermocouple input
Differential temperature (T_1-T_2)
Scan function (T_1, T_2, T_1-T_2,...)
Min/Max record
User-selectable resolution
1°C or 0.1°C (1°F or 0.2°F)

The Fluke 51 & 52 Digital Thermometers are designed for high accuracy and resolution with excellent repeatability. Their price/performance ratio is unmatched in the industry. Reliability, a three-year warranty, and 1200-hour battery life combine to give users the lowest possible cost of ownership.

The Fluke 51 is a high quality, high performance Digital Thermocouple Thermometer. The most demanding users will get everything they expect and more from this rugged, single-input unit.

The Fluke 52 has several additional measurement functions and high-performance features. Dual inputs (T_1 and T_2) allow two individual points to be monitored, and provide information for the differential mode (T_1-T_2). A MIN/MAX register is available for any input (T_1, T_2 or T_1-T_2). At power-up the user can select a "scan" mode, which scrolls through the three modes in a T_1, T_2, T_1-T_2 continuous sequence. Also selectable at power-up is the choice of high resolution (0.1 degrees C or 0.2 degrees F) or low resolution (1°C or 1°F) readouts.

Specifications

Technical Specifications

Temperature Scale: Celsius or Fahrenheit user-selectable

Resolution: 1°C or 1°F (or 0.1°C or 0.2°F) user-selectable

Thermocouple Types: K-type or J-type that conform to NBS and IEC 584 tables, user-selectable

Measurement Range: K-type range is -200°C to 1370°C (-328°F to 2498°F). J-type range is -200°C to 760°C (-328°F to 1400°F). Also check the rated range of the thermocouple to be used. For Fluke K-type probes see Section 5.

Meter Operating Range: For use in 0°C to 50°C environment (32°F to 122°F)

Meter Accuracy: Specified for a period of one year when meter is operated in an environment of 18°C to 28°C (64°F to 82°F). Thermocouple errors should be added to meter errors to determine measurement accuracy. See thermocouple manufacturer's data.or, for Fluke K-type probes, see Section 5.

Model	Accuracy ±(%of Rdg + °C)		Accuracy ±(%of Rdg + °F)	
	Type K	Type J	Type K	Type J
51 or 52	0.1% + 0.7°C	0.1% + 0.8°C	0.1% + 1.3°F	0.1% + 1.4°F
52* T_1-T_2	0.1% + 1.0°C	0.1% + 1.2°C	0.1% + 1.8°F	0.1% + 2.2°F

**Typical accuracy only for T_1 minus T_2 temperature*

Temperature Coefficient: Within the meter operating range, add to the meter accuracy specification 0.01% of reading +0.03 degrees for each degree below 18°C (64°F) or above 28°C (82°F)

Error Offset: Errors contributed by one particular thermocouple may be practically eliminated, over a limited measurement range, using a recessed front panel OFFSET adjustment on the meter and an accurate temperature standard when making the adjustment. Although making that adjustment may increase measurement errors made using other thermocouples, the two-input Model 52 offers a means of adjusting one input and dedicating it to making particularly accurate measurements while using the other input for all other thermocouples

Input Connectors: For standard miniature K-type or J-type polarized thermocouple plugs with flat, in-line blades spaced 7.9 mm (0.312 in) center to center

Maximum Input: 60V dc or 24V rms ac between the input pins or any input and ground. Maximum of 1V between inputs T_1 and T_2 on the Model 52

Reading Rate: 1 second per reading for one probe, 1.7 seconds per reading in the scan mode with the Model 52

Storage Temperature: -40°C to 60°C (-40°F to 140°F)

Relative Humidity: To 90% up to 35°C (95°F); to 70% up to 50°C (122°F)

Fluke 51 & 52

General Specifications

Battery: Standard 9V battery (NEDA 1604, 6F22, or 006P)
Battery Life: 1200 hours. Low battery indicator appears when less than 50 hours of battery life remain
Safety: Protection Class III as defined in IEC 348, Safety Requirements for Electronic Apparatus.
Size: 2.84 mm H x 7.49 mm W x 16.64 mm L (1.12 in H x 2.95 in W x 6.55 in L)
Weight: 280 gm (10 oz.)
Included with Instrument: Battery, 80PK-1 probe for general purpose measurements (two with the 52), and operator's manual

Ordering Information

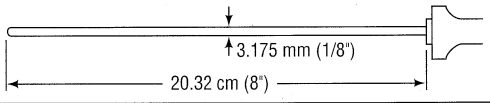
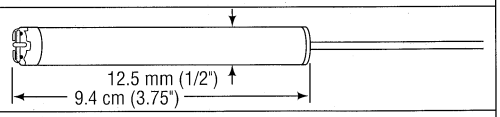
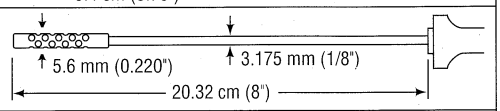
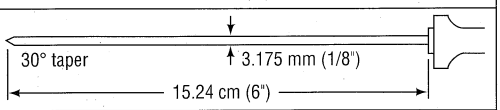
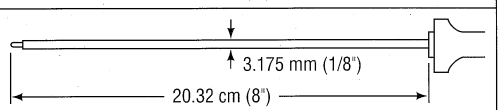
Models

51 Digital Thermometer
52 Digital Thermometer

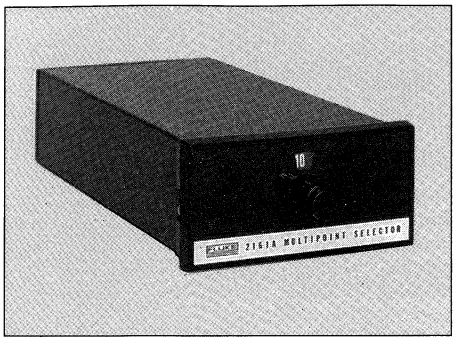
Accessories (Also see Section 20)

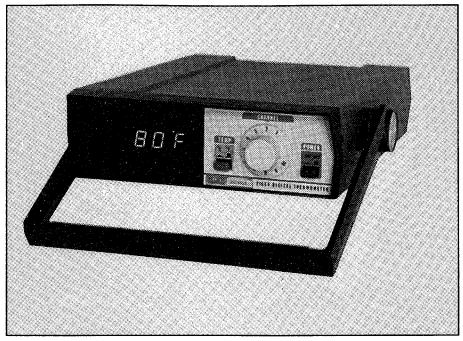
80PK-1 Bead Air Probe
80PK-2A Inconel Sheath Immersion Probe
80PK-3A Surface Probe
80PK-4A Air Probe
80PK-5A Stainless Steel Piercing Probe
80PK-6A Exposed Probe
80CJ-M Male Connector, Type J Mini (pkg. of 2)
80CK-M Male Connector, Type K Mini (pkg. of 2)
C25 Soft Carrying Case
C50 Compact Soft Case
C70 Protective Holster
C100 Universal Hard Carrying Case

K-Type, Thermocouples,
(See Section 5 for specifications)

Model	Range	Style
80PK-1 Bead Air Probe	-40°C to 260°C (-40°F to 500°F)	
80PK-2A Inconel Sheath Immersion	-196°C to 927°C (-320°F to 1700°F)	
80PK-3 Surface Probe	-28°C to 260°C (-18.4°F to 500°F)	
80PK-4A Air Probe	-196°C to 816°C (-320°F to 1500°F)	
80PK-5 Stainless Steel Piercing Probe	-196°C to 927°C (°F to 1700°F)	
80PK-6A Exposed Probe	-196°C to 927°C (-320°F to °F)	
80CK-M Male Type K Mini Connector (pkg of 2) (20 AWG Max)	N/A	
80CJ-M Male Type J Mini Connector (pkg of 2) (20 AWG Max)	N/A	









2160A & 2170A Thermometer

The 2160A and 2170A Thermometers are designed to be mounted in a panel. The panel opening required is a rectangle that is only 4.5 cm high by 9.2 cm wide, conforming to DIN Standard 43700. Both thermometers will indicate temperature in degrees Celsius or degrees Fahrenheit and an internal jumper is used to switch from one scale to the other.

The 2160A has a 1°C or 1°F resolution and uses any one of eight thermocouple types (J,K,T,E,R,S,B,or C). The 2170A has a 0.1°C or 0.1°F resolution and uses any one of four thermocouple types (J,K,T,or E). Both the 2160A and 2170 A are physically and electrically compatible with the 2161A Multipoint Selector.

2161A Multipoint Selector

The Model 2161A Multipoint Selector is a panel-mounting, manually switched selector that allows 1 to 10 thermocouple probe of the same type to function as the input of the 2160A, or 2170A or other thermocouple thermometers. Two or more 2161As can be connected in series for monitoring more than ten inputs.

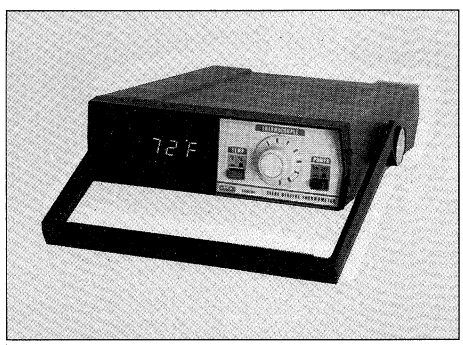


2165A Digital Thermometer

A single-point instrument in a rugged, portable case with specifications identical to the 2160A. It can be equipped with internal rechargeable batteries. Pushbutton controls include power (ON-OFF), temperature scale selection (°F/ °C), and battery charge (ON-OFF). Resolution is 1°F or 1°C.

2166A Multipoint Thermometer

The 2166A is the same basic bench-type instrument as the 2165A but with the capability for monitoring up to 10 thermocouples of the same type. Thermocouple channel selection is by a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (Y2004 Battery Pack has rechargeable batteries). Resolution is 1°F or 1°C.



2168A Multitype Thermometer

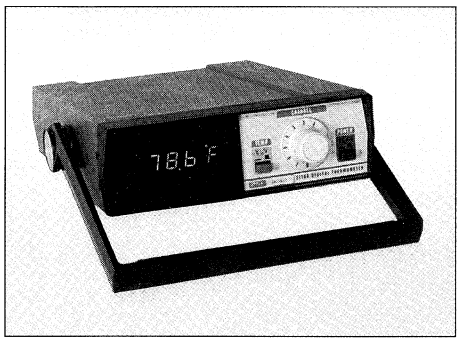
The 2168A is a portable, single-point instrument capable of accepting the output from any one of eight thermocouple types. Performance specifications are identical to the 2160A for each thermocouple type. Front panel controls include pushbutton power switch (ON-OFF) and temperature scale selection (°F or °C), plus an eight-position rotary switch for selecting thermocouple type. Power is either line voltage or external 12V dc (with Y2004 Carrying Case). Resolution is 1°F or 1°C.



(NSN 6685-01-126-6648)

2175A Digital Thermometer

The 2175A is a single-point instrument in a rugged portable bench-mount case with the same specifications as the 2170A. It can be equipped with internal rechargeable batteries. Pushbutton controls include a power switch (ON-OFF), temperature scale selection (°F/°C), and battery charge. Resolution is 0.1°F or 0.1°C.



2176A Digital Thermometer

The 2176A is the same basic bench-type instrument as the 2175A but with the additional capability of monitoring up to 10 thermocouples (of the same type). Thermocouple channel selection is by means of a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (with Y2004 Battery Pack). Resolution is 0.1°F or 0.1°C.

Specifications

Technical Specifications

Compatible Thermocouple Types:
2160A Series: J,K,T, E, R, S, B, C
2170A Series: J,K,T,E
Measurement Method: Dual-slope integration over a 100 ms period
Drift: None, automatic zero correction
Reading Rate: 2.5 readings per second
Conversion °C to °F: Jumper-selectable in panel-mount models, Switch-selectable on portable models.
Input Connections: Screw terminals on isothermal connector
Input Circuit: Two-wire, isolated
Input Impedance: 100 MΩ
Input Current: 500A
Source Impedance: 5 kΩ (5 kΩ causes <0.2°C error with K thermocouple)
Maximum Input Voltage: 400V dc or peak ac continuously, between inputs or either input and ground
Maximum Common Mode Voltage: 400V dc or peak ac
Common Mode Rejection: ≥120 dB at 50, 60, 400 Hz ±0.1% with 1 kΩ source impedance unbalance
Normal Mode Rejection: ≥60 dB at 50, 60, 400 Hz ± 0.1%
Overload: Display flashes when input voltage exceeds full-scale temperature range
Open Input: Display flashes to indicate open at input terminals
Response time: ≤2.0 second to rated accuracy

2160A Series Accuracy Specification

Thermocouple Type	Applicable Temperature Range °C	Maximum Error** (±°C)			Applicable Temperature Range °F	Maximum Error** (±°F)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 68 to 86°F	1 Year 59 to 95°F
J	-189 to 0	1	1.5	1.5	-328 to 32	1.5	2	2.5
	0 to 778	1	1	1.5	32 to 1432	1	1.5	2
K	-189 to 0	1	1.5	2	-328 to 32	2	2.5	3
	0 to 1356	1	1.5	2	32 to 2472	1.5	2.5	3
T	-189 to 0	1	1.5	2	-328 to 32	1.5	2	3.5
	0 to 400	1	1	1	32 to 752	1	1.5	2
E	-189 to 0	1	1.5	2	-328 to 32	1.5	2	3.5
	0 to 1000	1	1	1.5	32 to 1832	1	2	2.5
R	0 to 1756	1.5	2.5	3	32 to 3232	2	4	5
S	0 to 1733	1.5	2	3	32 to 3232	2	3.5	4.5
B	533 to 1800	1.5	2	2.5	992 to 3352	2	3.5	4.5
C*	0 to 2284	2	3	3	32 to 3999	3	5	5.5

**C designates Tungsten-5% Rhenium vs. Tungsten-26% Rhenium*

***Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1° C or 0.2° F for Model 2166A.*

2170A Series Accuracy Specification

Thermocouple Type	Applicable Temperature Range °C	Maximum Error * (±°C)			Applicable Temperature Range °F	Maximum Error* (±°F)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 68 to 86°F	1 Year 59 to 95°F
J	-99.9 to 0	0.5	1	1.2	-99.9 to 32	0.9	1.6	2.1
	0 to 777.9	0.4	0.7	1.1	32 to 999.9	0.7	1.2	1.6
K	-99.9 to 0	0.7	1.2	1.5	-99.9 to 32	1.1	2.0	2.6
	0 to 999.9	0.5	1.1	1.4	32 to 999.9	1	1.4	1.8
T	-99.9 to 0	0.6	1	1.6	-99.9 to 32	0.9	1.7	2.9
	0 to 400	0.4	0.6	0.9	32 to 752	0.6	1	1.5
E	-99.9 to 0	0.6	1	1.7	-99.9 to 32	0.9	1.7	3.0
	0 to 999.9	0.5	1	1.4	32 to 999.9	0.8	1.3	1.8

**Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1°C and 0.2° F for Model 2176A.*

Option Specifications

Rechargeable Batteries (-01)

Used in Models 2165A and 2175A for portable-operations, and provides a continuous operating time of 8 hours. The internal batteries are rechargeable from line power in either trickle or full charge mode. They are field-installable at a later date.

Digital Output Unit (-02)

A field-installable option that provides a parallel BCD digital output equivalent to the displayed measurement date. Output data is solicited by and External Trigger and valid data is insured by Busy and Not Busy outputs. Output is fully buffered TTL/DTL compatible, isolated to 300V. A 6-foot ribbon cable and connector are included. Operates only when powered by AC line.

Analog Output Unit (-04)

A field-installable assembly which provides an output voltage of 1 mV per degree (Celsius or Fahrenheit) up to 4,000V (4000 degrees). Automatic polarity sensing is provided so that the polarity of the output voltage agrees with the displayed temperature. The output voltage is isolated from the input and referenced to the low terminal of the external voltmeter, strip-chart recorder, etc. A 6-foot pair of wires and connector are included. Accuracy is ± 0.5% of reading ±1 mV. Operates only when powered by AC line.

General Specifications

Type of Display: LED
Shock and Vibration: Meets requirements of MIL-Std-810
Ambient Temperature: 0°C to 50°C, operating; -40°C to 60°C with batteries, -40°C to 75°C without batteries, non-operating
Relative Humidity: ≤90% from 0°C to 35°C, ≤80% to 50°C, non-condensing
Line Operation: 115V ac ± 10%, 50 to 440 Hz, 8W (Bench), 4W (panel). 100V ac and 230V ac versions are also available
Battery Operation: Option -01 for the 2165A and 2175A operates eight hours on a full charge. Y2004 Battery Pack for 2166A, 2168A, and 2176A operates six hours on a full charge, typically
External DC Source: (2166A, 2168A, and 2176A) 11 to 15V dc at 400 mA. Y2004 recommended
Size: (2165A, 2166A, 2168A, 2175A and 2176A) 6.4 cm H x 21.7 cm W x 25.2 cm D (2.52 in H x 8.55 in W x 9.9 in D)
Size: (2160A and 2170A) conforms to DIN standard 43700. 4.8 cm H x 9.6 cm W x 20.5 cm D (1.88 in H x 3.78 in W x 8.05 in D). Panel cutout is 9.2 cm x 4.5 cm (3.62 in x 1.77 in)
Weight
- **2165 and 2175A:** 1.19 kg (2.63 lb) without batteries, 1.79 kg (3.95 lb) with batteries
- **2166A, 2168A, 2176A:** 1.35 kg (3 lb)
- **2160A, 2170A:** 0.74 kg (1.63 lb)

Warranty Period: One year

Included with Instrument: Instruction manual, power cord. Thermocouple or thermocouple probe not included.

Ordering Information

Models

2160A Digital Thermometer (panel-mount)
2161A Digital Multipoint Selector (panel-mount)
2165A Digital Thermometer
2166A Multipoint Thermometer
2168A Multipoint Thermometer
2170A Digital Thermometer (panel mount)
2175A Digital Thermometer
2176A Digital Thermometer
Thermocouples or probes not included. Specify thermocouple type to be used.

Options (for 2165A or 2175A only)

-01 Rechargeable Batteries

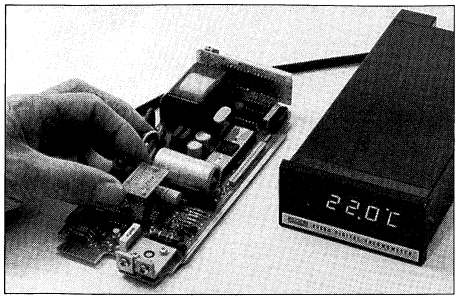
Options (for all above Models)

-02* Digital Output (w/ cable)
-04* Analog Output (w/ cable)
** Mutually exclusive in one instrument*

Accessories (Also see Section 20)

See next page for Digital Thermometers Accessories

2160A & 2170A Series Accessories

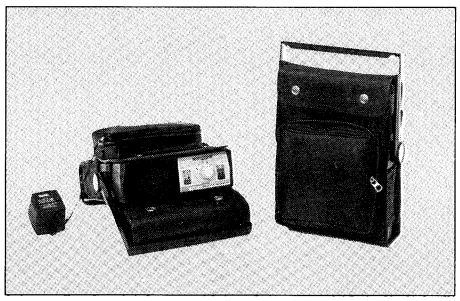


Thermocouple Type Conversion Kits

Your 2160-or 2170-Series Digital Thermometer may be equipped to work with only one type of thermocouple at a time. But it is very simple to convert it to be used with a different type thermocouple with an inexpensive conversion kit. Section II of your instruction manual tells how.

A conversion kit for a J, K, T, or E type thermocouple may be installed in any 2160 or 2170 Series Thermometer. In addition, a kit for a type R, S, B, or C may be installed in 2160 Series (but not the 2170 Series)

NBS Type	Conversion Kit No.	NBS Type	Conversion Kit No.
J	2160A-7016	R	2160A-7012
K	2160A-7017	S	2160A-7013
T	2160A-7018	B	2160A-7014
E	2160A-7019	C	2160A-7015

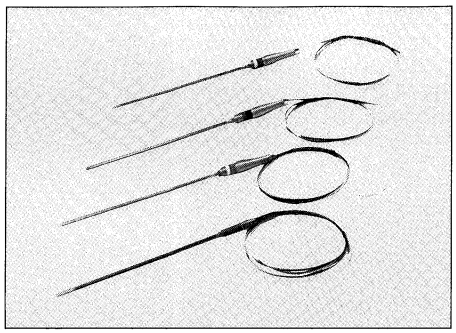


Y2004 Case and Battery Pack

The Y2004 consists of a case, 12-volt battery pack, and charger for use with the 2166A, 2168A, and 2176A. The Y8205 is a case only for any bench model 2160 or 2170 Series Thermometer. The Y2004 is especially recommended for the 2166A, 2168A, and 2176A Digital Thermometers because those models are not available with a self-contained rechargeable battery pack but have external 12-volt power connectors.

Typical operating time with batteries having a full charge is six hours. Recharge time at 25°C is approximately 15 hours.

P20 Series Thermocouple Probes

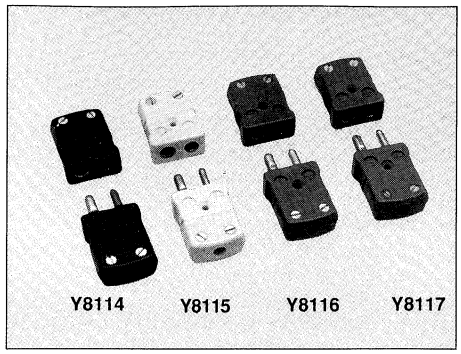


These probes are ANSI Standard accuracy general purpose immersion type probes. They have sheaths 6-inches long by 1/8-inch diameter made of INCONEL.

The thermocouple lead wire is three feet long and its insulation will withstand temperatures up to 480°C continually. Inside the sheath, the wires are insulated with magnesium oxide but are grounded to the sheath at the junction. They are particularly intended for use with Fluke 2190A Digital Thermometers and the 2160-Series, 2170 Series Digital Thermometers.

The 80PK, Type K Series Probes shown in Section 5 can also be used with the 2160 Series, 2170 Series, and 2190A Digital Thermometers by simply cutting off the attached thermocouple plug and attaching the bare end of the wires to the thermometer inputs.

Type	Useful Range
P20J	-150° to 760°C
P20K	-150° to 1260°C
P20T	-150° to 400°C
P20E	-270° to 1000°C



Thermocouple Probe Extender Connectors

Matching thermocouple connectors should be used to extend length of leads when using thermocouple probes. Connectors and 100-foot lengths of #20 AWG thermocouple wire are available. Connectors are made of thermocouple material and should match the type of thermocouple wire.

NBS Type	Probe Type	Mating Connectors	Thermocouple Wire (100 ft.)
J	P20J	Y8114	Y8110
K	P20K	Y8115	Y8111
T	P20T	Y8116	Y8112
E	P20E	Y8117	Y8113

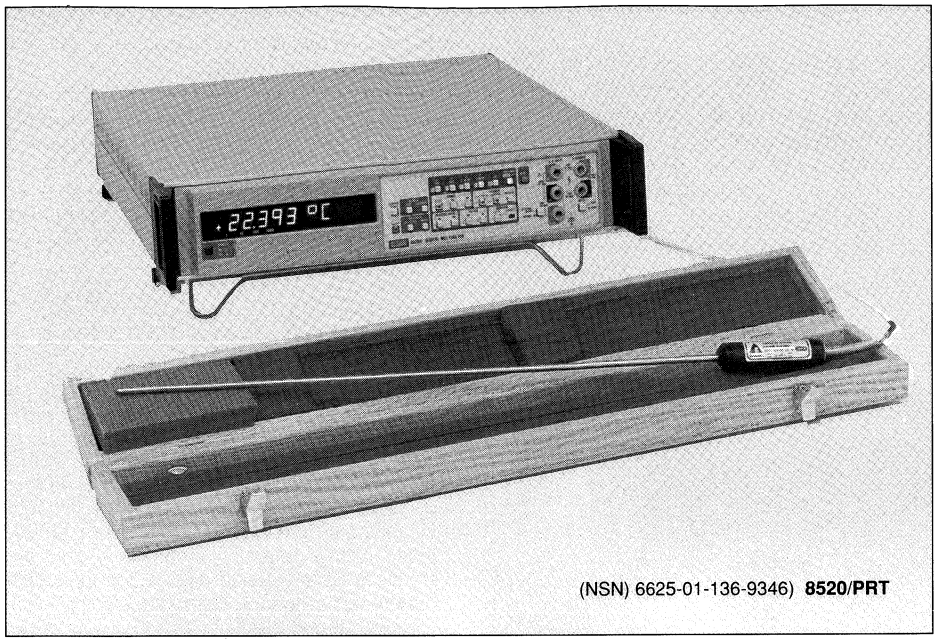
Ordering Information

Models

2160A-7012 Conversion Kit, R type
2160A-7013 Conversion Kit, S type
2160A-7014 Conversion Kit, B type
2160A-7015 Conversion Kit, C type
2160A-7016 Conversion Kit, J type
2160A-7017 Conversion Kit, K type
2160A-7018 Conversion Kit, T type
2160A-7019 Conversion Kit, E type
Y2004 Battery Pack & Case
Y8205 Carrying Case
P20J Thermocouple Probe, J type
P20K Thermocouple Probe, K type
P20T Thermocouple Probe, T type
P20E Thermocouple Probe, E type
Y8110 Thermocouple Wire, 100' type J
Y8111 Thermocouple Wire, 100' type K
Y8112 Thermocouple Wire, 100' type T
Y8113 Thermocouple Wire, 100' type E
Y8114 Extension Plug, type J
Y8115 Extension Plug, type K
Y8116 Extension Plug, type T
Y8117 Extension Plug, type E

8520A/PRT

GPIB
IEEE-488



(NSN) 6625-01-136-9346) **8520/PRT**

8520A/PRT Temperature Measurement System

- -183°C to +350°C (IPTS 68) range
- ±0.010°C accuracy -100°C to +100°C
- 0.001°C resolution
- Reading storage memory
- GPIB/IEEE-488 interface
- Onboard computational programs
- Full DMM capability

The 8520A/PRT is a temperature measurement system consisting of a special Rosemount* 162N Platinum Resistance Thermometer (PRT) and a Fluke 8520A 5½ Digit Precision Digital Multimeter. The 8520A contains a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001° resolution.

The system provides a fast, low-cost way of making extremely accurate temperature measurements, or calibrating temperature measurement instruments, in the range of -183°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

**Rosemount® is a trademark of Rosemount, Inc.*

162N PRT Characteristics

All PRTs exhibit hysteresis during temperature cycling, as with going from room temperature to boiling and back. The special 162N has a hysteresis of less than 0.001% of the temperature span. That is less than 1 mK (0.001°C) for a 100°C span, less than 6 mK for the entire thermometer range. This quality is not achievable in any industrial PRT.

Errors due to a change in ice-point resistance can be detected using a standard 100-ohm resistor (supplied), and the change can be compensated easily by changing the gain factor in a memory register of the 8520A. Such compensation is completely effective near 0°C, least effective near -110°C and +240°C, but predictable as a worst-case error at all temperatures within the range of -183°C to +350°C.

8520A Characteristics

The 8520A Digital Multimeter is compatible with GPIB/IEEE-488* instrument systems and has both built in and optional math power for a wide range of R&D and ATE applications other than temperature measurement and calibration. See Section 3 for more information.

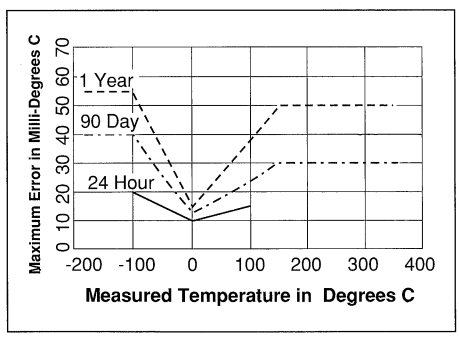
Accuracy

The temperature measurement accuracy of the 8520A/PRT system is shown graphically in the accompanying chart. Because accuracy depends on the stability characteristics of the 8520A as a function of both ambient temperature and time, 24-hour, 90-day, and 1-year accuracy curves are shown. The kind of accuracy you need will determine how often the 8520A should be calibrated.

The stability characteristics of the PRT are also very important and are influenced by time, how carefully it is used, and the kind of use it gets.

The 162N Probe is calibrated in liquid baths. No significant error due to self-heating will occur when measuring the temperature of liquids. A +12 mK error should be expected when measuring the temperature of gases.

Specifications



Probe Sheath: INCONEL-X750, 5.6 mm (0.219 in) diameter, 48 cm (19 in) length
Connector: Mates with 8520A/PRT
Power: 100, 120, 220, or 240V ac, ± 10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 47.7 cm L x 43.2 cm W (3½ in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)

Ordering Information

Model

8520A/PRT Temperature Measurement System w/Probe

Option

8520A-010 Extended Software Pkg

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Digital Thermometers

2180A, 2189A & 2190A

T&M EXPRESS LINE

GPIB IEEE-488

RS-232



2189A Thermometry System

2180A, 2189A & 2190A TemPak Series
0.01° resolution for the 2180A and 2189A and 0.1° resolution for the 2190A
Capable of running off of 12V dc or ac line power
Designed to be integrated with a wide variety of instruments and accessories
°C of °F is selectable via a front panel switch
A full five digit LED display
Analog and digital (RS-232-C or GPIB/IEEE-488) output options are available
The limits option allows peak and valley memory, alarms and delta
The 2189A consists of a 2180A and plantinum RTD probe for greater accuracy
6 different RTD types are switch selectable. 4 platinum, 1 nickel, 1 copper (2180A)
15 different thermocouple linearizations including 2 DIN and 3 JIS standards (2190A)

Fluke's most accurate and versatile general purpose digital thermometers are the 2180A and 2189A for RTDs and the 2190A for thermocouples. State-of-the-art accuracy teams with a large family of options and accessories to let you make precision temperature measurements in the lab or out in the field.

The 2180A RTD Digital Thermometer lets you switch-select one of six different types of RTDs, four platimum, one nickel, and one copper. Resolution is 0.01 degrees.

The 2189A Thermometry System consists of a 2180A that is factory-matched to a precision Y2039 Platinum RTD Probe.

The 2190A Thermocouple Digital Thermometer supports ten different thermocouple types, including two that comply to European DIN standards and three to Japanese standards. Resolution is 0.1 degrees. Take your choice from three different standard combinations of thermocouple types.

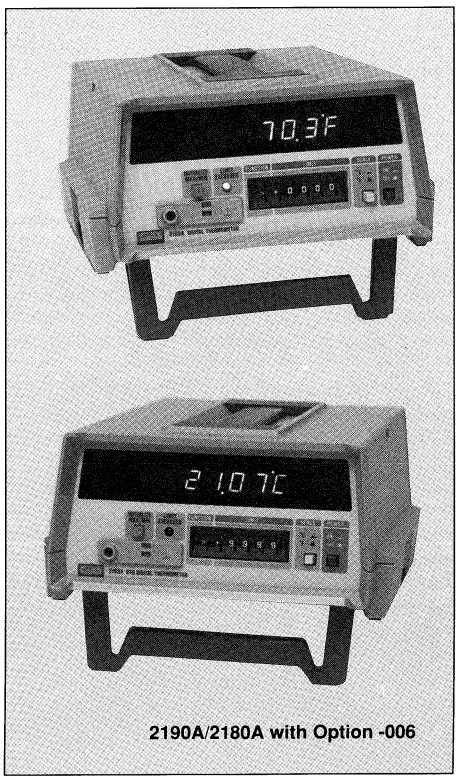
Each thermometer features a bright, high resolution LED display with pushbutton selection of Fahrenheit or Celsius readings. Each is capable of being run from either ac line power or external 12V dc, for field portability.



2180A without Option -006
(NSN 6685-01-136-3630)

Output Option -002, -004 and Limits Option -006 are usable with any of the three thermometers. Other accessory items electronically connect and stack and latch to the 2180A or 2190A. These include manual multipoints, multiple alarms, a battery pack, and a thermocouple thermometer calibrator. Some are also practical to use with the 2189A.

For automatic scanning, see the section on the 2300A Scanner. A 2020A or 2030A Printer allows you to permanently store data when used with a 2180A or 2190A configured with an output option. Portable temperature logging is available with the factory-tested Temperature Logging Systems — 2383A or 2393A.



2190A/2180A with Option -006

Limits Option (-006)

This option adds three powerful functions to the 2180A and 2190A Thermometers: Alarms, Peak Memory, and Delta. The Alarms function lights an indicator and closes a relay to activate external devices whenever a single preset maximum or minimum set-point is exceeded. Peak Memory stores the highest and lowest temperature reading for later recall. And Delta automatically subtracts a thumbwheel setting from the actual measurement and displays the difference.

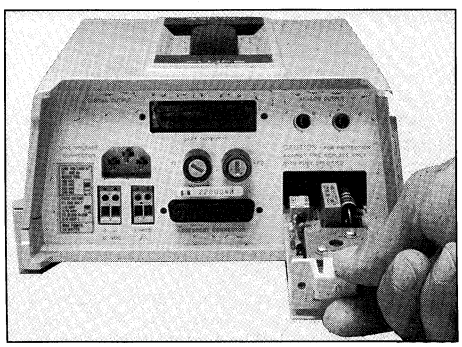
IEEE-488 Option (-004)

The 21X0-004 is an GPIB/IEEE-488* output option for the 2180A, 2189A and 2190A thermometers. This option mounts within the thermometer in the same location as the 21X0A-002. Readings are taken in response to an SRQ from the option by an IEEE-488 controller. This interface option does not include analog output capability. For applications requiring analog output and IEEE-488, use Option -002, 2XXXA-522, 1120A and Y7203. Not for use in a 2300A Scanner System.

Output Option (-002)

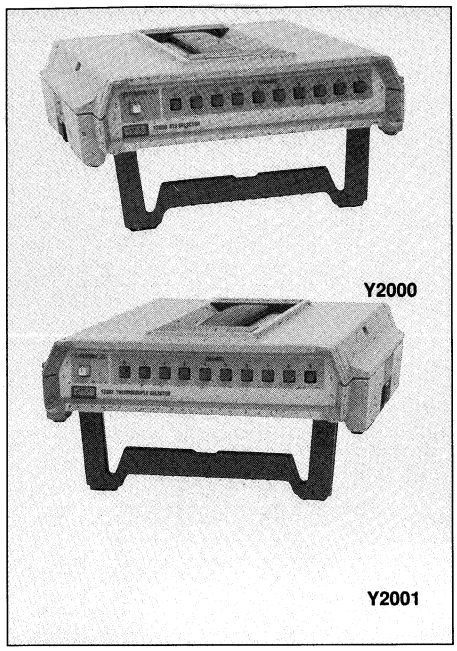
For recording temperature measurements with a 2180A, 2189A, or 2190A, you can use Output Option -002. It provides both an analog output for chart recorders and a digital output for printers or computers, and may be installed in the field. The digital output is available in four forms, depending on connector pins and cabling used: Parallel ASCII, RS-232-C, TTY current loop, and IEEE-488 (using the Fluke 1120A Translator). The Y2026B RS-232-C Cable Adapter is available to convert the 36-pin PTI connector on the option to a standard 25-pin RS-232-C connector, or the user can wire his own cable to the connector provided.

Option -002 is required when the thermometer is being used with a Fluke 2020A-004 or 2030A Printer unless a 2300A Scanner is used.



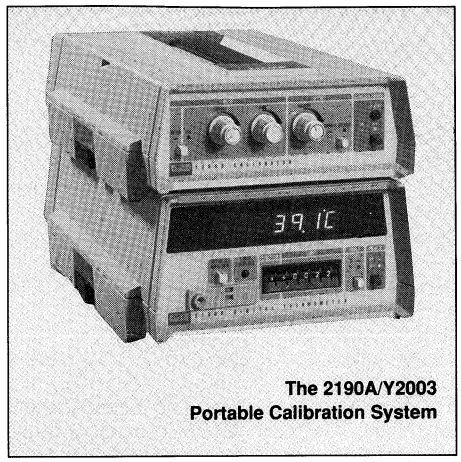
Rear view of 2190A showing the (A) Output Option -002 Connector, (B) Y2030 Thermocouple Input Module, and (C) Limits Option -006 Relay Output.

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*



Multipoint Selector (Y2000 & Y2001)

The Y2000 RTD Multipoint Selector (for the 2180A) and the Y2001 Thermocouple Multipoint Selector (for the 2190A) increase the number of points your thermometer can monitor. Connect up to ten sensors to each multipoint selector. Cascade up to ten multipoint selectors for up to 100 measuring points—all using a single 2180A or 2190A Thermometer. Both units have ten pushbuttons to easily access a specific measurement point. To measure or monitor more than one type of RTD or thermocouple, take advantage of internal switching. This allows you to monitor five sensors of one type, five of another. With Output Option -002 or -004 installed, the channel number is sent to your printer or computer, too. For automatic scanning applications see the 2300A, 2383A and 2393A.

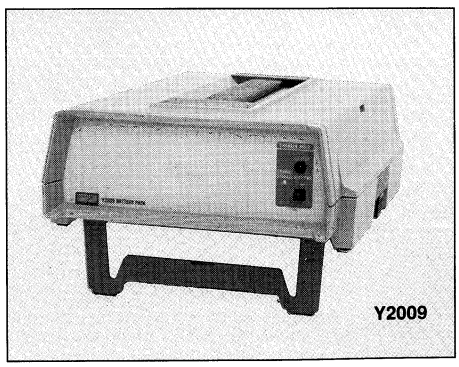


The 2190A/Y2003 Portable Calibration System

Thermometer Calibration (Y2003)

The Y2003 Thermometer Calibrator and 2190A Digital Thermocouple Thermometer can be used together to check the accuracy of a thermocouple or millivolt-measuring or recording instrument.

Accurate and completely portable, the Y2003-2190A combination provides a variable voltage output from -10 mV to +90 mV. The output voltage simulates a thermocouple output, so that the reading on the 2190A Thermometer can be compared with a corresponding reading on any other thermocouple thermometer, either analog or digital. In addition, the Y2003 and 2190A can be used to calibrate millivolt chart recorders and digital or analog indicators measuring to 90 mV. Besides being used as a portable calibration system, the Y2003 can be used as a battery pack for the 2190A. See Y2009 below for battery usage details. For more information ask for Bulletin B0059.



Battery Pack (Y2009)

The Y2009 Battery Pack is a rechargeable, self-contained 12V dc nickel-cadmium supply for up to five hours of continuous operation. An indicator light tells you when batteries are low, while an automatic cut-off prevents damage to the cells from excessive discharge.

Specifications

2180A & 2190A Specifications

2180A RTD Thermometer

RTD Types: 100Ω Pt, 385 (DIN), 390, 3916, or 392; 100Ω Ni (DIN); 10Ω Cu; 0 to 999Ω resistance — switch-selectable
Resolution: 100Ω Pt RTDs: 0.01°, autoranging to 0.1° above 204°C; 100Ω Ni RTDs: 0.01°, autoranging to 0.1° above 93°C; 10Ω Cu RTDs 0.1°.
Input Connection: 4-wire screw terminals. Terminals accept 3-wire and 2-wire RTDs at reduced accuracy
RTD Matching: User-performed potentiometer adjustment matches the 2180A to user's RTD to compensate for variations in lead length and resistance at 0°C
Lead Resistance: 4-wire: 200Ω max per lead for both 100Ω and 10Ω RTDs; 3-wire: 2Ω max per lead for 100Ω RTDs, 0.18Ω max per lead for 10Ω RTDs; 2-wire; 0.9Ω max per lead for 100Ω RTDs, 0.09Ω max per lead for 10Ω RTDs
Lead Resistance Error: 4-wire; no error, 3-wire 100Ω RTDs: 0.012° per degree per ohm; 3-wire 10Ω RTDs: 0.12° per degree per ohm; 2-wire 100Ω RTDs: 0.025° per degree per ohm; 2-wire 10Ω RTDs 0.25° per degree per ohm

2180A Linearizations (Type 2)*

RTD Type	Linearization Coefficients		
100Ω 385 Pt	DIN**43760 Table		
100Ω 390 Pt	ALPHA* DELTA* A4* C4*	= = = =	0.0038994 1.494 -0.265668×10^{-4} $-0.205984 \times 10^{-11}$
100Ω 3916 Pt	ALPHA* DELTA* A4* C4*	= = = =	0.003916 1.505 -0.099668×10^{-5} $-0.271142 \times 10^{-12}$
100Ω 392 Pt	ALPHA* DELTA* A4* C4*	= = = =	0.0039221 1.493 -0.38668×10^{-5} $+0.192912 \times 10^{-13}$
100Ω 617 Ni	DIN** 43760 Table		
10Ω*** Cu	RO R25 ALPHA	= = =	9.042 Ohms 10.005 Ohms 0.004260

**See IPTS 68 equations in NBS Monograph 126. Type 1 no longer available.*
***European Standard.*
****Contact factory for information on the 2180A/AT for 10Ω, 3 wire applications.*

2180A Accuracy (Type 2)* (Celsius)

RTDs		Maximum Error* ±Degrees C		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C
100Ω	-190 to 0	0.043	0.089	0.112
	0 to 204	0.043	0.132	0.173
385 Pt	-190 to 0	0.11	0.12	0.14
	0 to 750	0.11	0.26	0.37
100Ω	-200 to 0	0.009	0.055	0.078
	0 to 204	0.009	0.098	0.139
390 Pt	-200 to 0	0.08	0.10	0.11
	0 to 750	0.08	0.23	0.32
100Ω	-200 to 0	0.040	0.086	0.109
	0 to 204	0.040	0.13	0.171
3916 Pt	-200 to 0	0.11	0.12	0.14
	0 to 750	0.10	0.26	0.34
100Ω	-200 to 0	0.008	0.055	0.078
	0 to 204	0.009	0.098	0.139
392 Pt	-200 to 0	0.08	0.10	0.11
	0 to 750	0.08	0.23	0.32
100Ω	-60 to 0	0.129	0.157	0.172
	0 to 93	0.129	0.176	0.199
617 Ni	-60 to 0	0.19	0.20	0.21
	0 to 177	0.19	0.22	0.25
10Ω Cu	-75 to 0	0.16	0.18	0.19
	0 to 150	0.16	0.20	0.23
Ohms	0 to 196.99	0.005	0.042	0.059
	0 to 999.99	0.05	0.22	0.31

2180A Accuracy (Type 2)* (Fahrenheit)

RTDs		Maximum Error* ±Degrees F		
Type	Applicable Portion of Temperature Range °F	At Cal	90 Days 68°C to 86°C	1 Year 59°C to 95°C
100Ω	-309.9 to 32	0.076	0.161	0.203
	32 to 399.2	0.076	0.239	0.314
385 Pt	-309.9 to 32	0.18	0.21	0.24
	32 to 1382.0	0.18	0.46	0.62
100Ω	-327.9 to 32	0.015	0.100	0.142
	32 to 399.2	0.015	0.177	0.252
390 Pt	-327.9 to 32	0.13	0.16	0.19
	32 to 1382.2	0.13	0.41	0.57
100Ω	-327.9 to 32	0.071	0.156	0.198
	32 to399.2	0.071	0.234	0.309
3916 Pt	-327.9* to 32	0.17	0.21	0.24
	32 to 1382.2	0.17	0.46	0.62
100Ω	-327.9 to 32	0.014	0.099	0.141
	32 to 399.2	0.014	0.177	0.252
392 Pt	-327.9 to 32	0.12	0.16	0.19
	32 to 1382.2	0.12	0.41	0.57
100Ω	-76 to 32	0.230	0.282	0.308
	32 to 199.4	0.231	0.317	0.359
617 Ni	-76 to 32	0.33	0.39	0.35
	32 to 350.6	0.33	0.39	0.44
10Ω Cu	-103 to 32	0.27	0.31	0.34
	-103 to 302	0.27	0.35	0.41
Ohms	.005	All units In Ohms		
	.05			

Note: Shaded area is 0.01° resolution; unshaded area is 0.1° resolution.
**Total instrument accuracy. Does not include RTD probe errors. Valid for 4-wire RTDs only. Microcomputer Type 1 no longer available.*

2189A Thermometry System

Includes Platinum RTD Probe Y2039 and a 2180A RTD Thermometer.

Maximum System error (±°C)

Temp. °C	At Calibration	90 Days 18°C-28°C Ambient	1 Year 18°C-28°C° Ambient
Low Temperature Range...			
-183	(1)	(1)	(1)
-50	0.04	0.08	0.11
0	0.03	0.07	0.09
50	0.05	0.10	0.13
100	0.07	0.12	0.16
150	0.08	0.15	0.20
200	0.09	0.17	0.23
High Temperature Range...Periodic probe exposure*			
204	0.14	0.25	0.27
300	0.18	0.32	0.33
400	0.21	0.39	0.40
480	0.29	0.48	0.50

(1) The system operates down to -183°C but the probe calibration is not verified below -50°C. It is estimated that the accuracy below -50°C is the same as the accuracy at an equal temperature in the positive range. Low temperature calibrations are available as a special.
**Accuracy above 200°C is based on the user performing an Ice Point adjustment in accordance with the following schedule:*

Probe Exposure Temperature Range	Total Exposure Time Before Adjustment
200°C to 350°C	500 hours
350°C to 480°C	250 hours

Exposure of the Y2039 at high temperatures for long periods of time may cause the probe to change its characteristics and require the accuracy specifications to be degraded. For example, there is a 20% probability that exposure at 480°C for 500 hours will require degrading. It is easy for the user to determine if degrading is necessary by measuring the Ice Point resistance of the probe. The 2189A Instruction Manual explains this degrading procedure.

2190A Specifications

Thermocouple Types: Five, switch-selectable. Which thermocouple types depends on your choice of microcomputer type. See Accuracy chart below.

2190A Accuracy* (Celsius)

Thermocouples		Maximum Error* ±Degrees C		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C
Type 1				
J	-128 to 0	0.18	0.19	0.21
	0 to 900	0.18	0.31	0.36
K	-132 to 0	0.18	0.19	0.21
	0 to 1350	0.18	0.39	0.47
T	-243 to 0	0.18	0.20	0.22
	0 to 400	0.18	0.22	0.25
R	0 to 1708	0.31	0.59	0.70
C**	0 to 2471	0.18	0.60	0.75
Type 2				
J	-128 to 0	0.18	0.19	0.21
	0 to 900	0.18	0.31	0.36
K	-132 to 0	0.18	0.19	0.21
	0 to 1350	0.18	0.39	0.47
E	-252 to 0	0.18	0.20	0.22
	0 to1000	0.18	0.33	0.39
R	0 to 1708	0.31	0.59	0.70
S	0 to 1685	0.22	0.50	0.60
Type 3				
J DIN***	-100 to 0	0.18	0.19	0.20
	0 to 760	0.18	0.28	0.33
K	-50 to 0	0.18	0.18	0.20
	0 to 1372	0.18	0.39	0.48
T DIN***	-200 to 0	0.18	0.20	0.21
	0 to 400	0.18	0.22	0.25
B	420 to 1815	0.21	0.52	0.62
R	140 to 1700	0.18	0.46	0.46

2190A Accuracy* (Fahrenheit)

Thermocouples		Maximum Error* ±Degrees F		
Type	Applicable Portion of Temperature Range °F	At Cal	90 Days 68°F to 86°F	1 Year 59°F to 95°F
Type 1				
J	-198 to 32	0.20	0.23	0.26
	32 to 1652	0.20	0.47	0.58
K	-206 to 32	0.30	0.33	0.37
	32 to 2462	0.30	0.72	0.87
T	-405 to 32	0.30	0.35	0.39
	32 to 752	0.30	0.41	0.46
R	32 to 3106	0.47	1.01	1.20
C**	32 to 4480	0.30	1.11	1.37
Type 2				
J	-198 to 32	0.20	0.23	0.26
	32 to 1652	0.20	0.47	0.58
K	-206 to 32	0.30	0.33	0.37
	32 to 2462	0.30	0.72	0.87
E	-422 to 32	0.30	0.33	0.40
	32 to 1832	0.30	0.61	0.72
R	32 to 3106	0.47	1.01	1.20
S	32 to 3065	0.38	0.92	1.10
Type 3				
J DIN***	-148 to 32	0.30	0.32	0.36
	32 to 1400	0.30	0.52	0.61
K	-58 to 32	0.20	0.22	0.25
	32 to 2502	0.20	0.63	0.78
T DIN***	-328 to 32	0.30	0.34	0.38
	32 to 752	0.30	0.41	0.46
B	788 to 3299	0.37	0.95	1.15
R	284 to 3092	0.20	0.74	0.93

** Total instrument accuracy. Does not include Thermocouple errors*
*** C designates Tungsten-5% Rhenium vs. Tungsten 26% Rhenium*
**** DIN 43710, a European Standard until 1984*

Resolution: 0.1°C, °F
Input Connection: 2 wires on screw terminal isothermal block
Max Source Impedance: 2 kΩ
Overrange Detection: Flashing display
Open Circuit Detection: Source impedance of 3 kΩ or more causes of flashing "0C"
Repertoire: SH1, AH1, T6, LO, SR1, RLO, PPO, DC0, DT0, C0, E2
Service Request Usable: Yes
Power: Operates only when powered by AC line

14

2190A/AM Thermocouple Thermometer

The 2190A/AM is a modified 2190A thermometer with fifteen thermocouple linearizations instead of the standard five. The user can select any of the 15 thermocouple types by adjusting the configuration of a multiswitch. The Model 2190A/AM provides all of the benefits of the standard 2190A in accuracy and system capability. The 2190A/AMK is a kit for retrofitting existing 2190As. The 2190A/AM offers the Japanese (JIS) series and European (DIN) of linearizations as well as the U.S. N and D linearizations.

Specifications are equivalent to those of the standard 2190A. Thermocouple Types Supported: NBS types (J,K,T,C,R,E,S,B,N,D), DIN types (J,T), JIS Types (J,K,R)

Option Specifications

Output Option (-002)

Analog Output
Type: Linearized and isolated
Voltage: 1.0 mV/°C or °F to 5 mA max
Temperature Coefficient: 200 ppm/°C from 25°C
Noise: ≤100 μV at 100 Hz bandwidth
Accuracy: ±0.1% of reading ±1 mV
Drift: 200 μV/°C from 25°C
Overload or Open Circuit: Zero volts via banana jacks

Digital Output
Types: Four, E.I.A. Standard RS-232-C, TTY current loop, parallel ASCII, and Fluke PTI
Connector: 36-pin AMP "Champ"
Serial Baud Rates: 110, 150, 300, 600, 1200, 2400, 4800, or 9600, switch-selectable
RS-232-C Signals: Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Signal Common
Parallel ASCII Signals: Data: 8 lines; Instrument Address; 4 lines; Address Valid; Data Valid; Acknowledge: Ground; +5V
TTY Current Loop Signals: Source and controlled sink, 20 mA
Out-of Limit Signals: Exclamation point transmitted with Option -006 only

Limits Option (-006)

Limits Function: Lights LED and activates form A (SPST) reed relay when thumbwheel setpoint is exceeded. Reed relay rated 10 VA, 184V dc or 130V ac rms max, 0.5A max, resistive, Selectable either low (≤) or high (≥)
Min/Max Function: Continuously stores Min and Max temperature
Delta Function: Displays difference between thumbwheel setpoint and actual temperature
Thumbwheels: 6, for function, sign, and setpoint (±9999). Setpoint resolution is 1 degree.

Accessory Specifications

Y2000 RTD Multipoint Selector

Channels: Ten per Y2000, up to ten Y2000s per 2180A. Channel number sent to printer or computer when Output Option -002 or -004 are used
RTD Types: Same as 2180A. Two types per Y2000
Power: Supplied by 2180A
Interfacing: Attached 46-cm cable plugs into rear of 2180A or Y2002. Receptacle accepts cable chained from other Y2000s
Size and Weight: Style A PTI case, 1.4 kg (3.09 lb)

Y2001 Thermocouple Multipoint Selector

Channels: Ten per Y2001, up to ten Y2001s per 2190A. Channel number sent to printer or computer when Output Option -002 or -004 are used
Thermocouple Types: Same as 2190A. Two types per Y2001
Maximum Voltage Between Channels: 125V ac rms
Power: Supplied by 2190A
Interfacing: Attached 46-cm cable plugs into rear of 2190A or Y2002. Receptacle accepts cable chained from other Y2001s
Size and Weight: Style A PTI case, 1.6 kg (3.53 lb)

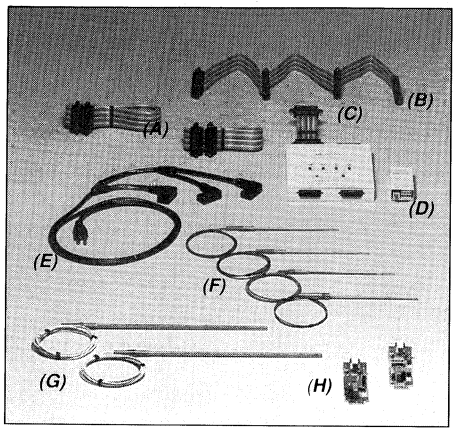
Y2003 Thermocouple Calibrator and Battery Pack

Thermocouple Types: Same as 2190A
Output Voltage: -10 mV to +90 mV, adjustable. Applied at input terminals of 2190A and thermocouple thermometer of less accuracy to be calibrated
Adjustments: Coarse, fine and offset
Battery Pack: Same specifications as Y2009
Interfacing: Attached 46-cm cable plugs into rear of 2190A
Size and Weight: Style B PTI case, 2.6 kg, (5.74 lb)

Y2009 Rechargeable Battery Pack

Output: 12V dc, 750 mA max
Battery: Ten ½-D size cells in drip-proof case
Operating Time: 5-6 hours typical at 25°C on full charge when connected to 2180A, 2190A
Recharge Time: 16 hours typical at 25°C
Charger: Built-in-on-off-switch, low-battery automatic discharge cut-off
Output Connectors: Rear panel screw terminal block
Operating and Storage Temperature: 0°C to 40°C
Power: 100, 120, 220, or 240V ac ±10% selectable, 50 to 400 Hz; 10W, typical
Size and Weight: Style B PTI case, 2.5 kg (5.52 lb), typical

A Family of Accessories



Small accessories shown are: ***(A)*** *Y7203 and Y7204 PTI Polling Cables,* ***(B)*** *Y2036 3-Module PTI Polling Cable,* ***(C)*** *Y2026 Cable/Adapter,* ***(D)*** *Y2022 Calibration Divider,* ***(E)*** *Y2024 3-Module Power Cord,* ***(F)*** *P20-Series Thermocouple Probes,* ***(G)*** *Y2037 and Y2039 RTD Probes,* ***(H)*** *Y2030 and Y2031 Plug-In Modules.*

Y2022 Thermometer Calibration Divider (D in Picture)

Function: Either precision resistor or voltage divider (÷10 or ÷100)
Input Voltage: 0-10V dc
Output Impedence: 100Ω
Precision Resistor: 100Ω ±0.01Ω, temp coefficient 5 ppm

Y2024 3-Module Power Cord (E in Picture)

Connects three PTI-family instruments or accessories to single 120V ac power outlet

Y2026B RS-232-C Cable Adapter (C in Picture)

Function: Routes RS-232-C signals from 36-pin PTI connectors to 25-pin RS-232-C connectors
Connections: Two 36-pin PTI connectors (M and F), two 25-pin RS-232-C connectors (M and F). Y7203 cable supplied
RS-232-C Pin Selections: Slide switches. Select TD on pin 2 or 3; DTR, DSR and CTS, through or pulled up; Scanner busy, through or to CTS

Y2030 Plug-in Module (H in Picture)

Extra plug-in units for 2190A thermocouples. Leave attached to input wire-pair for easy interchange of thermocouple inputs.

Y2031 Plug-in-Module (H in Picture)

Extra plug-in unit for 2180A RTDs, leave attached to input wires for easy interchange of RTD inputs.

Y2036 PTI Polling Cable (B in Picture)

Connects up to three PTI-family measurement instruments to 2020A or 2030A Printer.

Y2037 Platinum RTD Probe (G in Picture)

Resistance: 100Ω ± 0.1Ω at 0°C
Temperature Range: -80°C to +480°C
Curve Conformity: ±0.1% of temperature using IPTS 68 with ALPHA = 0.0038994 and DELTA = 1.494
Stability: Periodic usage (20% of time) ±0.03°C if used from 0°C to 200°C and ±0.22°C if used from -80°C to +480°C
Hysteresis: Less than ± 0.08°C when using 0°C and 200°C as end points
Immersion Effects: ±0.005°C when going from 4 inches to 10 inches in an ice bath Transition End Temperature: 150°C maximum
Physical: 316 SS Sheath, 0.25 in diameter x 12 in L; four 6 ft leads #22 AWG stripped and tinned
Handling: Contains strain-free platinum coil. Must be handled with care.

Y2039 Platinum RTD Probe (G in Picture)

Probe resistance: 100Ω ± 0.1Ω at 0°C
Temperature Range: -183°C to +480°C
Performance Standard: R100° /RO° = 1.3922, nominal. Conforms to IPTS 68 within 0.03% of temperature from -50°C to 420°C using ALPHA = 0.0039221 and DELTA = 1.493
Resistance Stability: 12 mΩ/year when exposed at 200°C or 20 mΩ in 250 hours when exposed at 480°C measured with probe at 0°C. 4 mΩ = 0.01°C + 0.04% of temperature
Hysteresis: Less than 0.01°C at 200°C when using 0°C and 420°C as end points
Immersion Effects: The readings shall not vary more than 0.005°C when probe is varied from 4 to 10 inches in an ice bath
Transition End Temperature: 150°C maximum
Time Constant: 8 seconds maximum when tested in flowing water at 3 feet per second
Sheath Material: INCONEL
Size: Diameter 0.64 cm (0.25 in), length 30.5 cm (12 in)
Leads: 4 wires, 6 ft, #22 AWG, ends stripped and tinned
Calibration: Each probe is calibrated at 0°C, 200°C and 420°C. The IPTS 68 constants R0, ALPHA, DELTA and A4 are provided
Handling: Contains strain-free platinum coil. Must be handled with care

PTI Case Dimensions

Style	Height	Width	Depth
A	5.7 cm (2.25 in)	20.5 cm (8.05 in)	32.6 cm (12.85 in)
B	8.2 cm (3.23 in)		
C	10.5 cm (4.13 in)		
D	12.8 cm (5.03 in)		

General Specifications

Display: °F or °C, switch-selectable; 7 segment 1.1 cm LED
Measurement Method: Dual-slope integration, 100 ms integration time, 3.33 readings/second
Linearization Technique: Segmented 4th order curve fit
Temperature Coefficient: ±15 ppm/°C from 25°C
Stability: 175 ppm/90 days, 200 ppm/year
Common Mode Voltage: 350V dc, 250V rms ac, max
Common Mode Noise Rejection: ≥160 dB at 50, 60, and 400 Hz ± 0.1% 100Ω unbalance
Normal Mode Noise Rejection: ≥90 dB at 50, 60 and 400 Hz ± 0.1%
Drift: None, automatic zero correction
Input Impedence: 1000 MΩ at dc
Accessory Connector: 25-pin rear panel receptacle interfaces thermometer to Y2000, Y2001, Y2003, and 2300A
Shock and Vibration: Meets MIL-T-28800C, class 3 specifications
Ambient Temperature: 0°C to 50°C operating, -40°C to 75°C non-operating
Relative Humidity: ≤80% from 0°C to 50°C non-condensing
Power: 12V dc or 100, 120, 220, 240V ac ± 10% selectable, 50 to 400 Hz; 8W typical
Size: Style C PTI case, 10.5 cm H x 20.5 cm W x 32.6 cm D (4.13 in H x 8.05 in W x 12.85 in D)
Weight: 2.1 kg (4.63 lb)
Safety: (2180A and 2190A only) Factory Mutual 3820 approved, CSA 556B certified

Included with Instrument: Instruction manual, power cord. Probes are not included except with 2189A

Ordering Information

Models

RTD Thermometers
2180* Digital Thermometer
2189A Thermometry System
** Contact factory for 3-wire 10Ω copper applications*

Thermocouple Thermometers
2190A Type 1 — J,K,T,R,C
2190A Type 2 — J,K,E,R,S
2190A Type 3 — J(DIN), K,T (DIN),B,R
2190A/AM (15 types)
2190A/AMK (15 types) Upgrade Kit for 2190A
Also see 2383A and 2393A Temperature Logging Systems

Options (for 2180A, 2189A, 2190A)

-002* Analog and Digital Output
-004** IEEE-488 Output
-006 Limits

Note: Above options are customer installable
**Required for compatibility with 2020A-004 or 2030 Printer or 1120A Translator. However, the option is not required when the thermometer is used with a 2300B Scanner, unless analog output is also needed.*
***Cannot be used with Option -002*

Accessories (Also see Section 20)

Used for 2190A
P20J Thermocouple Probe, J type
P20K Thermocouple Probe, K type
P20T Thermocouple Probe, T type
P20E Thermocouple Probe, E type
Y2001 Multipoint Selector, Thermocouples
Y2003 Thermocouple Calibrator
Y2022 Thermometer Calibration Divider
Y2030 Thermocouple Input Module

Used for 2180A & 2189A
Y2000 Multipoint Selector, RTDs
Y2031 RTD Input Module
Y2037 RTD Probe, 100Ω 390PT
Y2039 RTD Probe, 100Ω 392PT

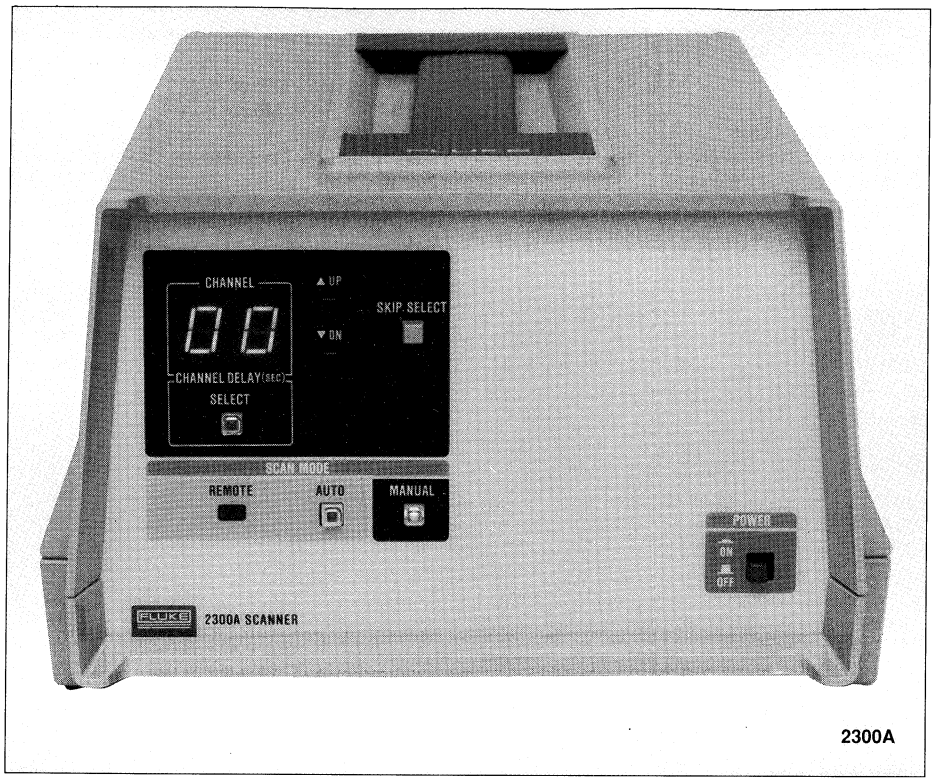
Joint Accessories
Y2009 Battery Pack, Rechargeable
Y2014 5¼" Rack Mount Kit PTI, Single, Size C, Offset
Y2015 5¼" Rack Mount Kit PTI, Double, Size C
Y2020 4.80 DIN Panel Mount Kit PTI
Y2026B Cable Adapter RS-232
Y2024 Power Cord, 3 way
Y2036 PTI Polling Cable
Y7203 Ribbon Cable PTI, 2 ft
Y7204 Ribbon Cable PTI, 5 ft

2300A (TemPak Series)

T&M EXPRESS LINE

GPIB IEEE-488

RS-232



2300A

2300A Temperature Scanner

- Can be used with either thermocouples or RTDs
- Capable of scanning 20 points
- Expandable to 100 points with the 2301A Extender Chassis
- Scanning can be either manually or automatically with a set interval time
- Unused channels can be skipped through a switch setting
- Standard interface provides remote programming capabilities
- LED display specifies the channel being monitored
- Two different types of thermocouples or RTDs can be used per input card
- Capable of running off of 12V dc or ac line power

The 2300A Temperature Scanner is designed to be used with either a Fluke 2180A or 2190A Digital Thermometer to sequentially scan and read the temperature of up to 20 RTDs or thermocouples. For even more capacity, a 2301A Scanner Extender can be added to scan an additional 30 sensors. Two 2301s may be stacked and latched together to scan up to 80 channels and a third may be added to scan up to 100 channels.

Scanning may be done one channel at a time manually, with keystrokes at the front panel, or automatically. Readings also may be printed at preselected intervals using either a Fluke 2030A Computing Printer or a 2020A Universal Interface Printer with the relevant options. All of these instruments are packaged in Fluke stack-and-latch cases that quickly and easily fit together to become an integrated, multichannel, temperature scanning and logging system. Using a 12V battery, a system may be operated in the field, away from any ac power source.

The 2300A will interface to either a 2180A or a 2190A, and provides RS-232C output for communication to external printers or computers. Remote control of the scanner is allowed via either a bi-directional RS-232C link or the GPIB/IEEE-488* bus (with the 1120A Translator). The 2301A Scanner Extender does not require a separate interface.

** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

The Y2026B RS-232C Cable Adapter is available to connect the 36-pin connector on the back of the scanner to a cable with a standard 25-pin connector. As an alternative, you can wire your own cable to the connector provided.

For preconfigured Temperature Logging System, see the 2383A and 2393A.

For applications that need mixtures of thermocouples, RTDs, dc voltages, 4 to 20 mA control loops, or contact closures, etc., see the 2280 Series Data Loggers in Section 12.

Scanner Card Options (-002 & -003)

Both the -002 Thermocouple Scanner Card option and the -003 RTD Scanner Card Option provide for 10 sensor inputs. The inputs are divided into two blocks of five, so two different thermocouple types (or two different RTD types) may be used with each card. A switch allows you to automatically skip any unused channels, or you may skip them from the front panel of the scanner.

Up to two cards (20 channels) may be housed in a 2300A Scanner, and up to three cards (30 channels) in a 2301A Scanner Extender. At least one scanner card is required for the 2300A to operate. Thermocouples and RTDs may not both be scanned at the same time by one 2300A.

Specifications

Technical Specifications

Channel Capacity: 10 or 20 channels in a 2300A; 10, 20, or 30 channels in each 2301A Extender Chassis; 100 channels per system, maximum. Each system to scan only RTDs (2180A) or only thermocouples (2190A)
Front Panel Programming: Automatic or Manual Scanning, Channel Skips, Channel Delay Time, Fast Forward, Fast Reverse
Display: Two digits, 00 through 99; either channel number or channel delay time
Channel Delay Time: Time interval between scanner relay contact closure and scanner trigger signal that initiates measurement instrument reading. Programmable from 0.0 to 8.0 seconds, 2 seconds or greater required for rated accuracy
Printer Control of Scan Interval: Either the 2020A Printer (with Option -004 and -006) or the 2030A Printer can be programmed to control the time between each scan cycle when connected to the 2300A
Scan Speed: Dependent on measurement instrument and application
Required Options: At least one Scanner Card Option (-002 or -003). Also, one to three scanner card options per 2301A Extender Chassis (if used).
IEEE-488 System: Requires 1120A Translator with Option 2XXXA-522 installed and Y7203 PTI cable
RS-232-C Compatibility: Y2026B Cable/Adapter recommended

Interface & Remote Control Specifications

I/O Connections: Interface includes an attached accessory cable with a 25-pin male connector that plugs into the back of a 2180A or 2190A Digital Thermometer. Also provides a rear panel 36-pin connector for outputs to printers and computers.
36-Pin Connector: the Portable Test Instrument (PTI) connector is used to transfer information from a 2300A Scanner and 2180A or 2109A Thermometer to a printer, RS-232-C device, or IEEE-488 bus via the Fluke 1120A translator. The output information is: Channel number, temperature value, termperature scale (°C or °F), open circuit symbol, overrange symbol, limit-exceeded symbol (if 2180A or 2190A has Option -006), carriage return (CR), and line feed (LF). A Y7203 Accessory cable is required for connecting a printer or 1120A Translator. A Y2026B Cable/Adapter is strongly recommended for transmitting RS-232-C signals.
Signals: RS-232-C Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Data Terminal Ready, Received Data, Received Line Signal Detector, Scanner Busy Ground, Source and Controlled Sink of 20 mA for TTY current loop operation (not used for programming commands). Baud rates are 110, 150, 300, 600. 1200, 2400, 4800, or 9600, switch-selectable.
IEEE-488 Signals: All IEEE Std 488-1978 signals when used with 1120A Translator with Option 2XXXA-522 installed. Interface functions SH1, AH1, T6, L4, SR1 can be implemented.
Remote Programming: The 2300A accepts commands for programming channel delay time, channel skips, monitor channel, first and last channel single scans, and first and last channel continuous scanning. Programming is activated by sending command character codes on data line of IEEE-488 bus via the 1120A Translator or on the Received Data line via an RS-232-C device

Command	Characters & Meanings
ESC	Toggle Interface Direction
R	Place Scanner in Remote Control
L	Place scanner in Local Control
D mm	Set channel delay time to m.m seconds
S mm-nn	Skip channels mm to nn
U mm-nn	Unskip channels mm to nn
M mm	Monitor channel mm
A mm-nn	Continuously scan from channel mm to nn
X mm-nn	Make a single scan from channel mm to nn
RP	Print Scan Mode
MP	Print current channel
AP	Print first and last channels
XP	Print first and last channels
DP	Print channel delay

Option Specifications

Thermocouple Scanner Card Option (-002)

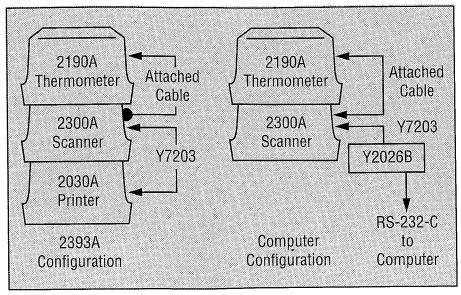
Input Channels: 10
Input Connections: Two wires per channel on screw terminal isothermal block
Thermal Offset Error: 1 microvolt, max
Channel Switches: 2-pole reed relays
Max Input Voltage: 170V dc or peak ac
Max Common Mode Voltage: 350V dc or peak ac between any two channels or between the chassis and a channel
Thermocouple Types: See 2190A Thermometer Specifications
Switch-selectable Types: Two; five channels per thermocouple type
Reference Junction Compensation: Temperature-sense transistor on scan card isothermal block is used to send isothermal block temperature to 2190A for automatic ice point compensation

RTD Scanner Card Option (-003)

Input Channels: 10
Input Connections: 4-wire screw terminal
Thermal Offset Error: 10 microvolts max
Channel Switches: 3-pole reed relays
Max Input Voltage: 30V dc or peak ac
RTD Types: See 2180A Specifications
RTD Types Selectable: Two; five channels per RTD type

General Specifications

Ambient Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤75% to 50°C, operating; -20°C to +70°C, non-operating
Safety: IEC 348 Protection Class I, solely as it relates to insulation or grounding properties
Power
2300A: 100 to 130V ac or 200 to 260V ac, switch-selectable, 50 to 60 Hz, or 12V dc, 8 Watts
2301A: Supplied by the 2300B Scanner mainframe
Size: Style D PTI case, 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in H x 8.05 in W x 12.85 in L) both 2300A and 2301A
Weight
2300A: Approximately 3.6 kg (8 lb) depending on the options
2301A: Approximately 2.7 kg (6 lb) depending on the scanner cards installed
Included with Instrument
2300A: Instruction manual, power cord, attached cable for 2180A or 2190A
2301A: Instruction manual, attached cable for 2300A or another 2301A



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Ordering Information

Models

2300A Scanner
2301A Scanner Extender Chassis

Interfacing a 2300A Scanner/2180A/2190A Thermometer combination to the IEEE-488 Bus requires a Y7203 or Y7204 Cable, the 1120A Translator and the 2XXXA-522 Personality Card. The 21X0A-002 or 21X0A-004 thermometer options are not required.

Required Options (2300A and 2301A)

-002 Thermocouple Scanner Card
-003 RTD Scanner Card

Accessories (Also see Section 20)

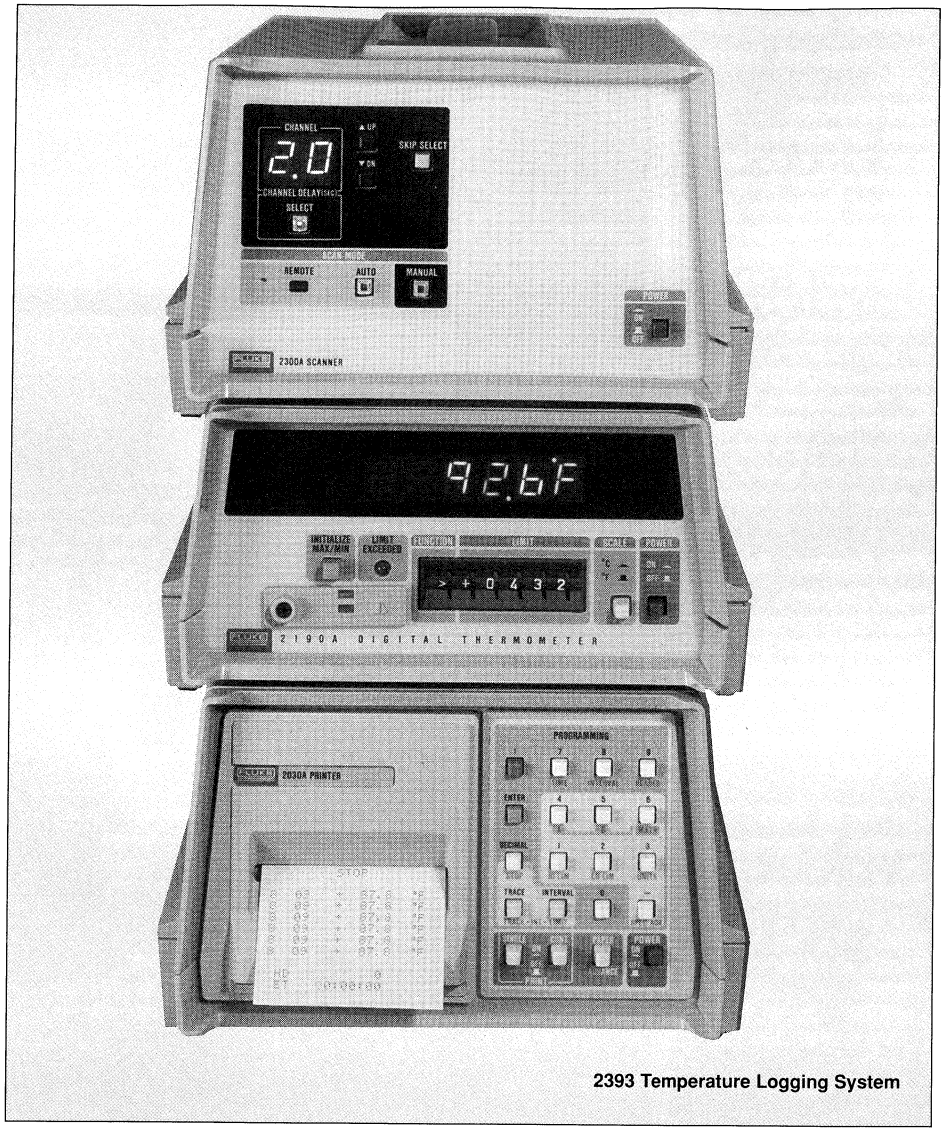
1120A IEEE-488 Translator
2XXXA-522* Personality Card for 1120A
Y2016 7" Rack Mount Kit PTI, Single
Y2017 7" Rack Mount Kit PTI, Double
Y2021 5.7" DIN Panel Mount Kit PTI
Y7203 Ribbon Cable, 2ft, PTI
Y7204 Ribbon Cable, 5ft, PTI
Y2026B RS-232-C Cable Adapter

** Required with 1120A Translator for IEEE-488 compatibility. Y7203 or Y7204 Cable also required.*

2383A & 2393A (TemPak Series)

T&M EXPRESS LINE

GPIB IEEE-488



2393 Temperature Logging System

2383A & 2393A Temperature Logging System

- Completely configured and tested temperature logging systems
- Capable of running off of 12V dc
- Capable of scanning 20 points, and expandable to 100 points with the 2301A Extender Chassis
- Scan either manually or automatically with a set interval time
- The 2300A Scanner with your choice of either RTD or thermocouple capability
- Six different RTD types are switch-selectable. Four platinum, one nickel, one copper, (2383A only)
- Ten different thermocouple linearizations are supported including two DIN standards, (2393A only)

Two portable, factory-integrated and tested temperature logging systems are available. They offer a choice of thermocouple or RTD measurements and a 2030A Printer. Temperature information from up to 10 sources may be logged using either of the two systems, or up to 20 by ordering one additional scanner option (-003 for RTDs or -002 for thermocouples). And each system may be expanded to monitor up to 100 points. Although the component parts may be ordered separately and assembled by the user, choosing the right combination of instruments, options, cables, etc., for your application is simplified by purchasing one of the systems. There is even a modest price advantage in purchasing a factory-tested system. Each offers the most accurate temperature logging capability that Fluke manufactures.

For applications that need mixtures of thermocouples, RTDs, dc voltages, 4 to 20 mA control loops, or contact closures, etc., see the 2280B Series Data Loggers in Section 12.

The following chart shows the component parts of the two systems.

System Components

Items Included	RTDs	Thermocouples
	2383A	2393A
2180A Thermometer	1	–
2190A Thermometer	–	1
2300A Scanner	1	1
Option -003*	1	–
Option -002*	–	1
2030A Printer	1	1
Y7203 Cable	1	1
Y2024 Power Cord	1	1

** Ten channels per option. One additional option may be installed in the 2300B. Up to 3 additional options may be plugged into each additional 2301A Scanner Extender. Maximum number of channels is 100.*

Specifications

Please refer to the pages in this section for the specifications and performance characteristics of the instruments and options comprising each system.

Ordering Information

Models

2383A Temperature Logging System, RTD
2393A Temperature Logging System, T/C

Note: When ordering 2393A state whether for Type 1, 2, or 3 thermocouple linearizations.

Note: When using the limits function it should be applied at a single channel.

2020A (TemPak Series)

IEEE-488

RS-232



2020A with Option -006

2020A Universal Printer

- 20-column thermal printer for recording data from a variety of instruments
- 3 interface options are available: RS-232-C, GPIB/IEEE-488, or Fluke PTI Polling
- Designed to be integrated with a wide variety of Fluke instruments and accessories through an integral latching system
- Time interval print capability with the -006 option
- Capable of running off of 12V dc or ac line power
- Single or continuous print cycles can be triggered either from the front panel or using the remote trigger connector on the rear of the instrument
- Graphic plotting available when using the -003 interface (IEEE-488)

Both the 2020A and 2030A Printers have 20-column thermal print heads for recording measurement data from a variety of Fluke instruments. Especially recommended are those instruments packaged in Fluke's Portable Test Instrument (PTI) cases. They will stack and latch to a 2020A or 2030A Printer and to one another. Connecting cables attach to the rear panels.

Because the 2300A Scanner is designed to let you measure the temperature of numerous points with just one Fluke 2180A or 2190A Thermometer, the 2020A and 2030A Printers are particularly recommended for temperature scanning and logging. Thermometer, scanner, and printer are stacked and latched together and used as an integrated temperature measuring system.

2020A Universal Printer

The Fluke 2020A is a 20 column thermal printer with three interchangeable data interface options. Whether you need GPIB/IEEE-488,* RS-232-C, or Fluke's own Portable Test Instrument (PTI) polling interface, the 2020A has the option to match. The 2020A operates from either the ac power line or a nominal 12-volt dc source.

Graphic Printing

The 2020A with an IEEE-488 interface is capable of printing a dotted graph of incoming data. The data source must send the correct 8-bit binary code for trace-on, 0-99 for the dot location, line feed, and finally trace-off. Use this feature to plot trends and trace profiles in addition to normal print out.

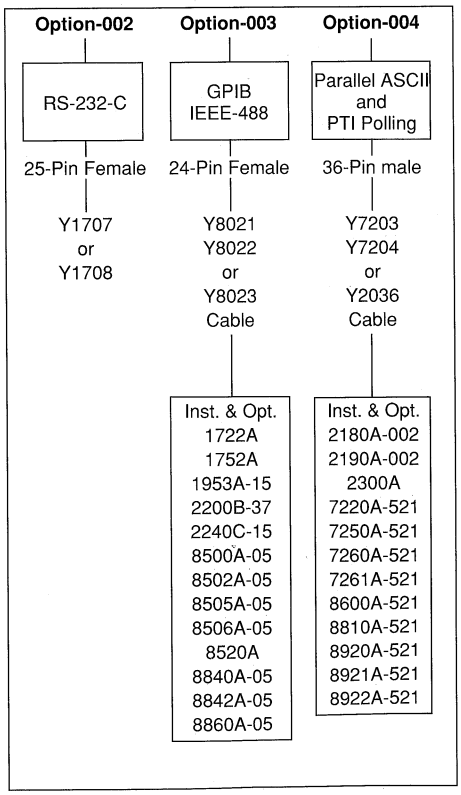
PTI Polling

The 2020A's PTI polling interface contains a microcomputer with addressing intelligence designed to generate the assigned addresses of several instruments in the PTI family. Select a print mode and the 2020A automatically begins polling by sequentially sending addresses one through nine until a measurement instrument recognizes its address. The 2020A then prints both the address and the instrument's current reading. A typical polling system might include the 2020A with a 2190A Thermometer and a 8920A Voltmeter.

Time Interval Printing

Fluke offers the 2020A with time interval printing (Option -006). It allows printing at preselected time intervals from ten seconds up to eight hours. When you use the time interval print option and a PTI polling interface, the 2020A will automatically label the printer tape with elapsed time each time it prints a set of readings.

Your choice of three field-installable interface circuit cards.



* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

2020A (TemPak Series)

Specifications

Option Specifications

RS-232-C Interface (-002)

Input Connector: Standard 25-pin, female
Signals: Transmitted Data, Clear to Send, Data Set Ready, Signal Ground, Received Line Signal Detector
Baud Rates: Switch-selectable for 110, 150, 300, 600, or 1200
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Buffer Storage: 32 characters

IEEE-488 Interface (-003)

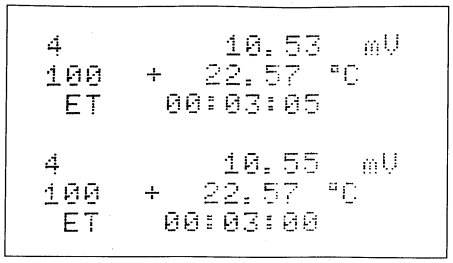
Input Connector: Standard 24-pin, female
Signals: Per IEEE Std 488-1978
Modes: Listen only or Addressable Listen, Switch-selectable
Repertoire: AH1, L1
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,μ,z
Graphic Printing: Dotted trace activated by receipt of the following binary-coded decimal numbers on incoming data lines: in-trace—16, dot location — 0 through 99, line feed—254, out-trace—255.
Buffer Storage: 1 line of data

PTI Polling Interface (-004)

Multi-Instrument Scanning: Up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300B; Adr 2—7250A, 7260A, 7261A; Adr 3—7220
Input Connector: 36-pin AMP CHAMP, male
Signals: Data, 8 lines, Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Buffer storage: 1 line of data

Time Interval Print (-006)

Print Intervals: Choice of 10, 20, 40, or 80 seconds, 1, 2, 4, 8, 10, 20, 40, or 80 minutes, or 1, 2, 4 or 8 hours
Time Annotation: Elapsed time printed with each reading (if Option -004 also installed)
Clock: Internal, crystal-controlled



Sample section of printed tape showing two readings 5 seconds apart. Reading from bottom to top: Elapsed time (ET) is 00 hours, 03 minutes, and 00 seconds. Address 1 Channel 00 is for the thermometer and address 4 is for the voltmeter.

Comparison of 2020A and 2030A Printers

Features	2020A	2030A
Printers		
Measured data	Yes	Yes
Computed data	No	Yes
Data source identification	Yes	Yes
Real time	No	Yes
Elapsed time	Opt-006	Yes
Engineering units	No	Yes
Header	No	Yes
Strip chart graph	*	Yes
Print Cycle		
Front panel trigger	Yes	Yes
Remote trigger	Yes	Yes
Front panel continuous	Yes	Yes
Remote continuous	Yes	Yes
Pre-selected intervals	Opt-006	Yes
When limits crossed	No	Yes
Intervals and crossings	No	Yes
Computed Data		
mx+b scaling	No	Yes
± difference (delta)	No	Yes
±% (% delta)	No	Yes
Interfaces		
Fluke PTI	Opt-004	Yes
RS-232-C	Opt-002	No
IEEE-488	Opt-003	No

**Using Option -003 and 1722A Instruments Controller or similar computer.*

General Specifications

Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Print Rate: 3 lines per second maximum
Spacing: 6 lines per inch (2.4 per cm)
Paper: 2.5 in (6.3 cm) wide, 240 ft roll (74m)
Advance: Stepping motor, belt drive
Remote Operation: Rear input, by external contact closure, TTL/DTL compatible
Safety: IEC 348, Protection Class 1
Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤95% to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250V ac, switch-selectable, 47 to 440 Hz, 40W maximum
Size: Style D PTI Case—13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in H x 8.05 in W x 12.85 in L)
Weight: Approximately 9 lb with paper

Included with Instrument: Instruction manual, power cord, one roll of paper

Ordering Information

Model

2020A Universal Printer

Each printer requires one interface option and can only use one at a time.

Options

-002 RS-232-C Interface
-003 IEEE-488 Interface
-004* PTI Polling Interface
-006 Time Interval Print

All options field-installable. Cables not included.
**Accepts Y7203 or Y7204*

Accessories (Also see Section 20)

Y2016 7" Rack Mount Kit PTI Single
Y2017 7" Rack Mount Kit PTI Double
Y2021 5.7" DIN Panel Mount Kit PTI
Y2026B RS232-C Cable Adapter
Y2035 Thermal Paper, 10 rolls
Y2036* PTI Polling Cable
Y7203 Ribbon Cable, 2 ft, PTI
Y7204 Ribbon Cable, 5 ft, PTI
Y8021 Cable for IEEE-488 bus, 1m
Y8022 Cable for IEEE-488 bus, 2m
Y8023 Cable for IEEE-488 bus, 4m

** Uses when 2 or 3 PTI instruments are to be simultaneously connected to 2020A via Option -004. Use two cables for 4 or 5 instruments.*

2030A (TemPak Series)



2030A

2030A Computing Printer

- 20-column thermal printer for recording data from a variety of instruments
- Multi-instruments scanning (up to 9)
- Time annotation - real, elapsed, interval
- Engineering units annotation - up to 4 alphanumeric characters
- Seven print modes
- Runs off 12V dc or ac line power
- Trace mode allows for plotting of data
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- Math mode allows you to program delta, % delta, and mx+b scaling
- Checks for both high and low alarms

The 2030A is a 20-column thermal printer with computing power. It combines standard printing-performance with a multitude of other special features. It is capable of mathematically scaling data and automatically documenting the printed results. It can translate numeric data into a visual trace, and it can apply limits and activate alarms. The 2030A prints data in any one of seven modes—from a single reading to programmed printing at periodic intervals.

Seven Print Modes

Trace: Data graphically plotted between programmable limits.
Interval Trace: Graphic trace of data plotted at programmed time intervals.
Interval: Prints at programmed intervals.
Interval Limit: Prints at programmed intervals and monitors for alarms when not printing.
Single: Prints one reading when pushbutton is pushed.
Continuous: Continuously prints up to three readings per second.
Remote: Prints continuously when activated (via rear panel).

Time Interval Printing

Inside the 2030A is a precision crystal measuring time and allowing you to control when data is scanned and/or printed. A 99-hour clock is set from the front-panel keyboard; elapsed time starts automatically when the power is turned on. The 2030A automatically annotates the tape with the selected time whenever it prints data.

Multi-instrument Scanning

The 2030A's microcomputer contains addressing intelligence designed to generate the assigned addresses of Fluke PTI family instruments. Select a print mode and the 2030A automatically begins scanning by sequentially sending addresses on through nine until a measurement instrument recognizes its address. The 2030A then prints both the address and the instrument's current reading, and polls the next instrument having a higher address. A typical printing system might include the 2030A with a 2190A Thermometer and an 8920A Voltmeter. One or more Y2036 PTI Polling Cables are needed for connecting more than one instrument in parallel to the 2030A.

Math Power

Simply enter two 6-digit constants from the front panel and the printer can calculate the difference (delta) or percent difference (% delta) between a preselected reference value and the input data. You can also program the 2030A to scale the incoming data using the general formula mx+b.

Graphic Printing

Select the range of data you want to analyze and the 2030A will plot a dotted graph over a 2 inch full scale band of tape. Simply program the right and left limits of the graph area as if they were 0% and 100%. Whether the measurement range is "0 to 1000" or "500 to 510" the 2030A automatically expands or contracts the range to fit within the 2 inch scale, and dot by dot plots a graph of the data you're recording.

Alarms

To control and monitor processes, the 2030A gives you the ability to continuously compare the reading of a measuring instrument against two programmable limits with six-digit resolution. If the reading exceeds either the high or the low limit, the 2030A prints the reading, the time, and activates an alarm output.

When the 2030A is in its trace mode, the edges of the graph also act as alarm set points.

Digital Thermometers

2030A (TemPak Series)

Engineering Units

The 2030A can be programmed to annotate data with the engineering units you choose. It overrides the basic measuring instrument's units with four alphanumeric symbols. Use this feature for math scaling and offset to put converted data in the proper units, or to indicate % when printing percent or difference (% delta).

Mode and Function Identification

Each print mode and special function has a distinct label. At the beginning of each print cycle, the 2030A automatically prints the appropriate labels so you know just what operations are to be performed. In the "interval limit" mode, for example, the 2030A prints Hi and Lo followed by the values assigned to each limit.

All labels include real time or elapsed time when in use, instrument address, and a 6-digit header (HD) to indicate the month, day and year or other meaningful documentation. The diversity of symbols and special diagnostic messages add up to data that's easy to interpret today or weeks from now.

Specifications

Technical Specifications

Printer Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Character Set: 64 upper case ASCII plus °,f,k, m,n,p,Ω,s,μ,z
Print Rate: One line for each linefeed command, 3 lines/second max
Spacing: 6 lines per inch (approximately 2.4 lines per cm)
Paper: 2.5 inches wide, 240-foot roll
Paper Advance: Stepping motor, belt drive
Buffer Storage: 1 line of data
Decimal Point: Automatically printed in correct location
Print Head Test: Test pattern printed in all columns if paper advance depressed within 1 second of power turn on
Print Modes: SINGLE, CONTINUOUS, INTERVAL, INTERVAL LIMIT, TRACE, INTERVAL TRACE, and REMOTE (operated by contact closure, TTL- or DTL-compatible)
Programmable Units: Up to four characters programmed from front panel. Code set is 64 upper case ASCII characters plus °,f,k,m,p,Ω, s,μ and z. Overrides incoming units.
Programmable Parameters: TIme, Interval, Header, A constant, B constant, Hi Lim, Lo Lim, Units, Spec Adr. All are programmed from front panel.
Clock: Internal crystal. Will measure time intervals and either elapsed time or real-time. Resolution is one second; range is 99 hours, 59 minutes, and 59 seconds. Four modes: Elapsed time only, real-time only, elapsed time and time interval, or real-time and time interval. Real-time runs continuously and elapsed time is reset at the start of each print cycle.
Alarm: Two 6-digit setpoints, assignable, corresponding to six least significant digits of any one measurement instrument. Output is open collector, 28V max. Sinks 30 mA max.
Graphic Printing: Trace is programmed by proper selection of A and B constants. Operates on one instrument. Graph scale is 2 1/8 inches (100 dots) wide. Ten percent scale markers printed. Accuracy ±2% of graph scale.
Math: Programmable to do scaling, delta, and % delta computations by proper selection of A and B constants. Operates on one instrument. Six-digit printout, maximum. Accuracy dependent on scale selected.
Compatible Instruments & Options: 2180A-002, 2190A-002, 2300A, 7220A-521, 7250A-521, 7260A-521, 7261A-521, 8920A-521, 8921A-521, 8922A-521
PTI Polling: Prints sequential readings from up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2 — 7250A, 7260A, 7261A; Adr 3 — 7220A; Adr 4 — 8920A, 8921A, 8922A; Adr 6 — 2180A, 2190A, 2300A; Adr 7, 8, and 9 — Indirect Addresses. When a thermometer accessory is attached to the 2180A or 2190A via the thermometer accessory connector, the combination of thermometer and accessory acts as one instrument when polled.
Thermometer Interface: Plug compatible with 2180A/2190A with 21X0A-002 output option installed
Scanner Interface: Plug compatible with 2300B Scanner. The 2180A or 2190A Thermometer attached to the 2300A Scanner does not require a 21X0A-002 output option.
Interface: Through 36-pin AMP CHAMP, male connector. Signals: Data, 8 lines; Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress.

General Specifications

Safety: IEC 348 Protective, Class 1
Temperature: 0°C to +50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤95%, 0°C to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250V ac, 47 to 440 Hz, 40 VA maximum
Size: PTI style D case — 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in H x 8.05 in W x 12.85 in L)
Weight: Approximately 9 lb with paper

Included with Instrument: Manual, power cord, one roll of paper

Ordering Information

Model

2030A Computing Printer w/PTI Interface
Interconnecting cables not included. Order Y7203 or Y7204

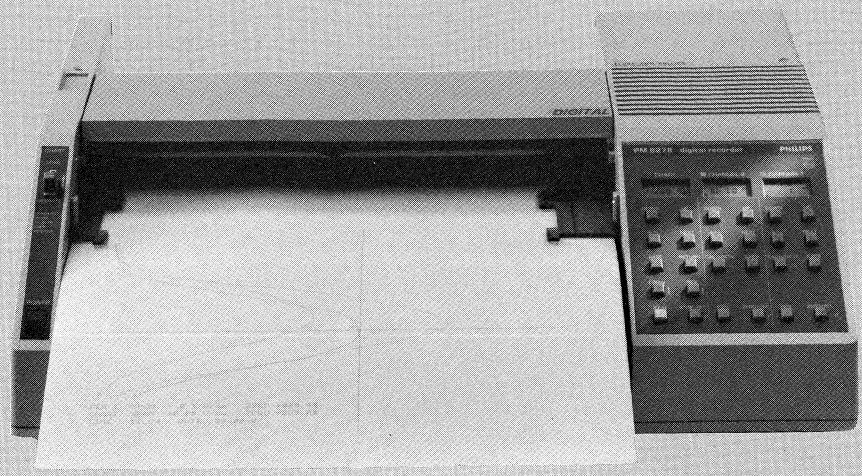
Accessories (Also see Section 20)

Y2016 7" Rack Adapter, Single
Y2017 7" Rack Adapter, Double
Y2021 5.7" DIN Panel Mount Kit, PTI
Y2035 Thermal Paper, box of 10 rolls
Y2036* PTI Polling Cable
Y7203 Ribbon Cable, 2 ft, PTI
Y7204 Ribbon Cable, 5 ft, PTI

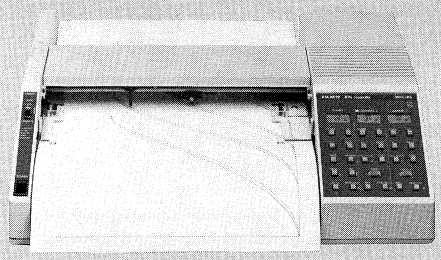
** Required when 2 or 3 measurement instruments are simultaneously connected to 2030A. Use two cables for 4 or 5 instruments.*

Recorders & Plotters

NEW



PM 8277 & PM 8278 Page 480



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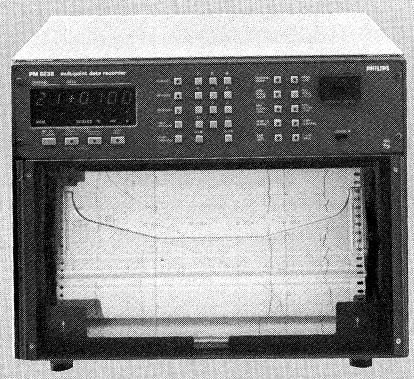

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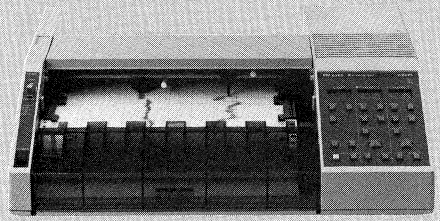
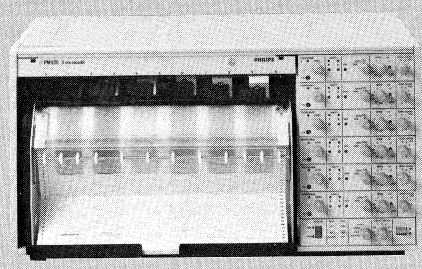
NEW



PM 8262 Page 472

NEW



PM 8116 Page 474

With the range of Fluke and Philips instruments now available to meet a variety of analog and digital needs hard copy documentation of test results is often needed.

The new PM 8277 and PM 8278 are versatile analog recorders, providing both XY and Xt (strip chart/line) results on sheet or z-fold formats. This flexibility is further extended with digital enhancements over the PM 8271 and PM 8272 configurations, to easily annotate the chart with critical recorder settings and time-stamping. In addition to thus providing powerful performance to analog applications, these recorders are ideal output devices for Philips Digital Storage Oscilloscopes (DSOs).

For more powerful DSO hard copy output, as well as general graphics use, the PM 8155 digital color plotter excels. With both HPGL and Philips GL graphics language, and GPIB/IEEE-488 or RS-232C optional interfaces, it is compatible with a variety of applications. Its optional automatic sheet feeder makes it ideal for repeated plot use.

And for measurement and recording of up to 30 voltage or temperature inputs, the PM 8238 multipoint recorder offers the combined advantages of traditional graphic recording as well as numerical recording. With its reliable thermal printing system, the PM 8238 is ideal for long-term recording of tests and monitoring applications.

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XY & Xt Recorders	Page 478
Digital Plotters	Page 482
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Introduction

Complete Range

The range of Philips instruments offered covers practically every requirement to be found in R & D labs, specialized research and observation, production line and field operation. Without overlooking the needs of the OEM sector.

There are many options to choose from. The X-t group embraces several different styles and types which include single-, double-, four- and six-pen models plus an extremely versatile µP-controlled digital data recorder offering up to 30-channel operation and featuring the combined advantages of both graphical and numerical printout. Also included in the range is a mini-model for general back-up work.

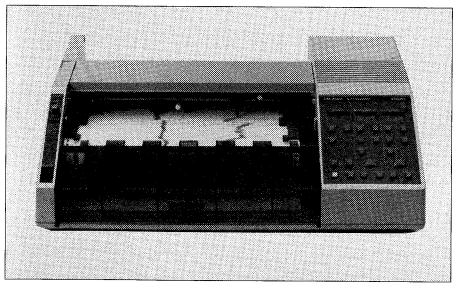
The flat-bed Philips X-Y recorders, have already proven highly successful in the field.

The concept of a combined X-Y and X-t recorder for both A4 and A3 size paper has become a very important feature, amongst the range of more usual features such as a standard time base and extended zero suppression facilities. The range consists of one pen, two pen and OEM versions.

Which X-t Recorder?

There are several types of X-t recorders to choose from.

The PM 8261 & PM 8262 offer one- or two-pen recording on 250 mm wide chart, for conventional analytical work, through to applications which demand a remotely controllable instrument.



PM 8262

Multiline instruments which complement the family of X-t recorders are the PM 8104 and PM 8106 for 4- and 6-line recording applications. Both high-precision units, are designed for laboratory or industrial situations. Standard features include dipmarker, electrical pen lift, remote control, etc. Pen offset compensation is available as standard on the PM 8114 and PM 8116.

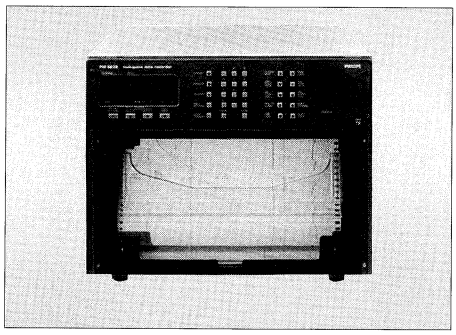
The Minirecorder is ideal for back-up work. It uses 120 mm chart width, yet retains all the features of a conventional laboratory recorder PLUS portability.

Note: All products with a PM and PE prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

The Multipoint data recorder PM 8238 offers the unusual facility of a choice of either graphical or numerical printout. It will record up to 30 channels and will accept a mix of 2-and 4-wire connections. Useable as a stand-alone unit, it can be interfaced with a bussable system (IEC/IEEE hardware is optional). It measures differential temperatures with very high accuracy, having a wide choice of thermocouple linearization. The very flexible zero suppression gives high resolution and the thermal print head has few moving parts, resulting in excellent reliability in use. Useable in a stand-alone function or within more sophisticated systems.

The clock used for sequential time/date labelling is powered by a trickle-charged battery to maintain a continuous realtime reference in the event of a power failure. The operator is thus able to pinpoint any downtime, retrospectively (time, day, month, year).

The PM 8271/2 also function very well as X-t recorders, thus providing 2 instruments in one unit.



Operating PM 8238 requires no software knowledge. All programs are µP controlled and input is via a simple keyboard.

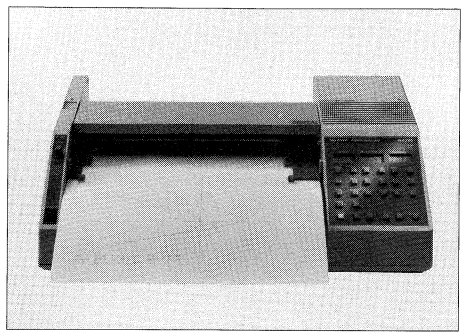
Which X-Y Recorder?

The most comprehensive and versatile answer is the PM 8277/78 recorders, which offer all the facilities of the most advanced X-Y recorders and more. PM 8271/ 72 offer:

- A3 and A4 X-Y functions
- A time base in Y-t mode
- A complete line recorder in X-t mode
- Accepting of sheet and Z-fold paper

In addition, both the PM 8271 and 8272 can operate from a 24 Vdc supply for field operation. A lightweight writing head and improved electronics provide accurate recording at diagonal speeds over 130 cm/s in the X-Y modes. Seven calibrated zero suppression levels up to 500% of signal level are available for measurements with a DC offset. In addition, in line recorder mode the user can define 10 extra chart speeds to meet his application needs.

PM 8271/72 single and double line X-Y-t recorders can meet virtually any X-Y or line recorder requirement in the laboratory or the field. The new XY recorders PM 8277 and PM 8278 offer all capabilities from the PM 8271 and PM 8277 resp., but due to their digital electronics they have even more versatility. These instruments can, for instance, write down their own settings on the chart. This gives an explanation to the recording made on this chart.The Philips X-Y recorders also includes a large range of A3 and A4 flat-bed models in multi-purpose, standard and OEM versions. A timebase is standard on all devices except the OEM and a chart transport unit extends measurement versatility even further.



PM 8278.

A3 Plotters

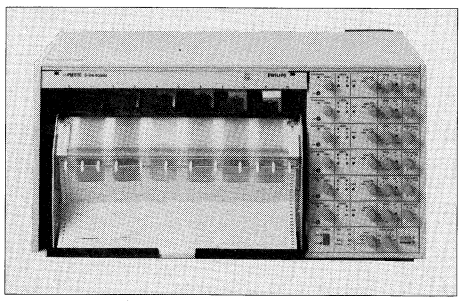
With the newly introduced PM 8155 low cost A3 plotter and the PM 8153 full A3 sized plotter for high speed, high accuracy applications, almost all T&M plotter applications can be covered.

PM 8153 is suited for applications requiring very accurate production of complex, detailed drawings in many colors. The instrument is available in four versions, with an V24/RS 232 or GPIB interface; and with HP-GL or Philips GL standard graphics language. PM 8153 is equipped as standard with a dust cover and an A3 paper transport for continuous plotting.

PM 8155 is designed for all A3/A4 applications where business information and graphics (pie-charts, bar charts, etc.) have to be plotted on paper or transparencies.

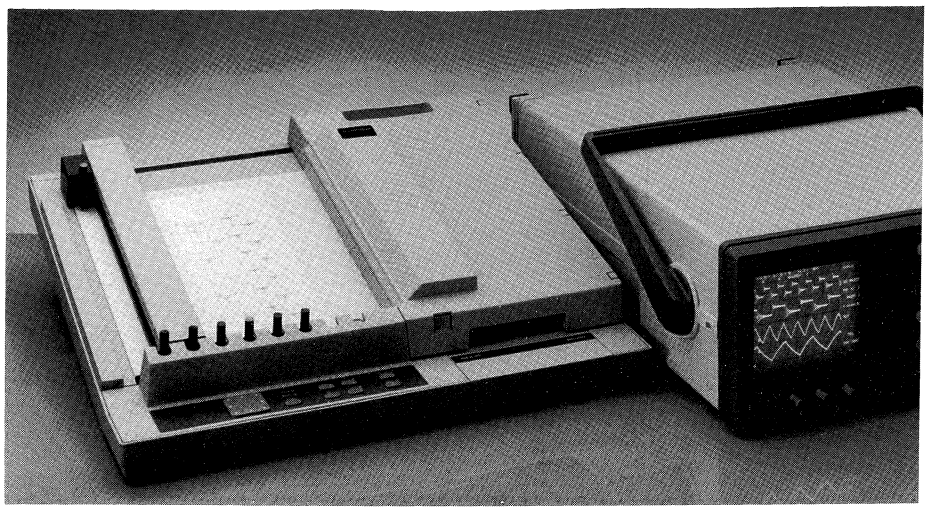
As an option, PM 8155 has a sheetfeeder for multiple plot operations. It is available with a V24/RS 232 or a GPIB interface, both with HP-GL and Philips GL software for extra flexibility.

PM 8155 has a 32 kB input buffer which can store large quantities of data, thus freeing the PC or other instrument for further work at the earliest possible moment.



PM 8116

Introduction



PM 8155 is ideal for the production of multicolor hard copies using data from the PM 3320A digital oscilloscope.

Quality - the Common Denominator

In the world of electronic equipment production, quality standards have been established over the years by various national and international institutions. With the common aim of constantly improving instrument design and the manufacturing processes to ensure good product performance, a high level of reliability and long-term stability.

These three essentials create 'spin-offs' in other product aspects, but remain the essential, basic ingredients of the 'quality formula'.

Philips is totally dedicated to quality: at all stages of design, development and production. Apart from reasons for its own survival in the competitive technological instrument world, there is an inherent attitude of mind by Philips personnel involved in the various processes. Personal pride in producing the best quality product, consistent with their particular eventual application, is the normal approach. From basic design, through development, through production, right down to protective packaging.

Another Philips First

The familiar IEC, UL, VDE, AQAP standards have been generated in various countries all over the world. These are internationally recognized and adhered to by many, but not necessarily all, electronic instrument manufacturers, The Netherlands has also made a contribution to these standards. The Dutch Ouality Assurance Standard NEN2646 was recently promulgated. Its requirements are identical with those of AQAP1. Its application requires careful analysis of all the relevant processes involved in designing and producing. (For this reason some parts of industry have been slow to adopt it)

However, the already high standards which were the everyday norm in Philips own internal processes required little change, A few refinements, only, were necessary to comply with the stringent demands of NEN2646.

As a result it was one of Philips own factories that achieved the unique distinction of receiving the very first Dutch Ouality Assurance Certificate for complying with NEN2646.

This was the Philips T & M, Almelo-based factory which produces recorders and multimeters. The Almelo operation now becomes the first of many Philips production units to be structured to meet NEN2646, as well as being the first ever in Holland.

What Does this Mean to the Buyer?

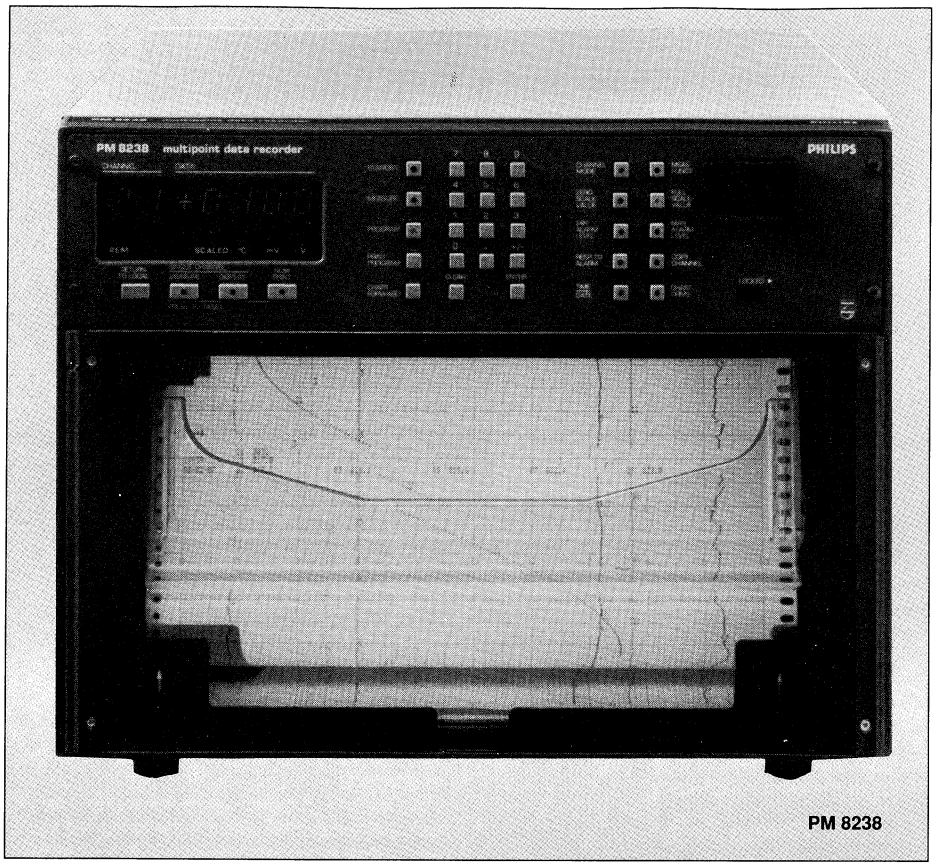
The fundamental and obvious benefit is that the customer can have confidence built on the knowledge that instrumentation meeting such high standards of quality must be very good investment.

But not only in basic 'value-for-money-' terms: such a purchase will give the performance specified, continuously and reliably. More important, it will not give the user any embarrassment while being applied within his own operation.

The key aspect for the buyer is simply, confidence: in the product, in the supplier, the wisdom of his own choice.

PM 8238

GPIB
IEEE-488



PM 8238

PM 8238 Multipoint Data Recorder

- Maximum 30 input channels, scanned at 10/s
- Graphic or numeric data presentation
- Optional alarm output plug-in cards
- Interpolation between measuring points for continuous line-plots
- Memory modules for user-program storage
- AX + B scaled measurements
- Maintenance free thermal printing

The PM 8238 is a 30 channel data recorder of the highest quality and reliability and is specifically designed to be set and left running for extended unattended operation. It offers real measurement versatility with features such as memory modules, which allow storage of settings. It can directly record voltage or temperature, with a wide choice of sensors in 2- or 4-wire configurations. Scanning takes only 100 ms/channel, for quick alarm detection. Individual measurement values are presented on a front-panel display: chart output can be numeric for clear presentation of values; graphic, for spotting trends; or both in combination.

Dependable Plotting, Durable Construction

The PM 8238 has been designed and constructed to give the highest quality and reliability in operation. Very reliable low noise reed relays are used for channel switching. The relays are tested to three times the normal operating life of the instrument. The number of components and PCBs is less than in similar instruments and the wiring has been reduced, cutting the chance of instrument failure; and special attention has been given to a rugged, durable construction. Quality and reliability is such that a high MTBF has been achieved.

Printing is by a high quality, maintenance free thermal print head. The user does not have to change pens, replace ribbons, fill ink reservoirs or clear inkjets. The head is virtually unaffected by dusty environments, ensuring sharp, quality plots throughout the life of the instrument.

To match the quality and reliability, the PM 8238 offers high accuracy and has a very broad spectrum of functions.

Systems Use

This instrument is ideally suited for unattended, preprogrammed operation, where the reliability is of maximum benefit. With optional IEC-625/IEEE-488 (GPIB) or V24/RS 232-C interfaces, operation in a computer controlled environment is possible. These allow various functions such as output of measured values to a computer/controller, remote control and set-up, presetting and programming and synchronized measurements. An optional extended TTL-control interface card provides remote control of some other functions such as chart speed, scan start, channel changing and printing event markers, all via TTL level signals. At any time, a complete survey of parameters can be requested.

Comprehensive Presentation Capabilities

The full scale definition of 1000 dots represents a resolution of 1 μV over the 250 mm (10 in.) plot width (at 1 mV span). Each channel is stamped with its number and the plots are date and time stamped if required, allowing easy archiving and copying of plots for distribution. Measurement speed is such that all 30 channels are scanned in 3s; this makes the PM 8238 ideal for real-time monitoring and control of many variables; it also provides for quick reactions to alarms. Because of the high speed, it can also be used for monitoring cause and effect on adjacent channels and for most applications, the plotting on such channels may be regarded as simultaneous. Charts are plotted on standard z-fold 250 mm (10 in.) wide thermal paper.

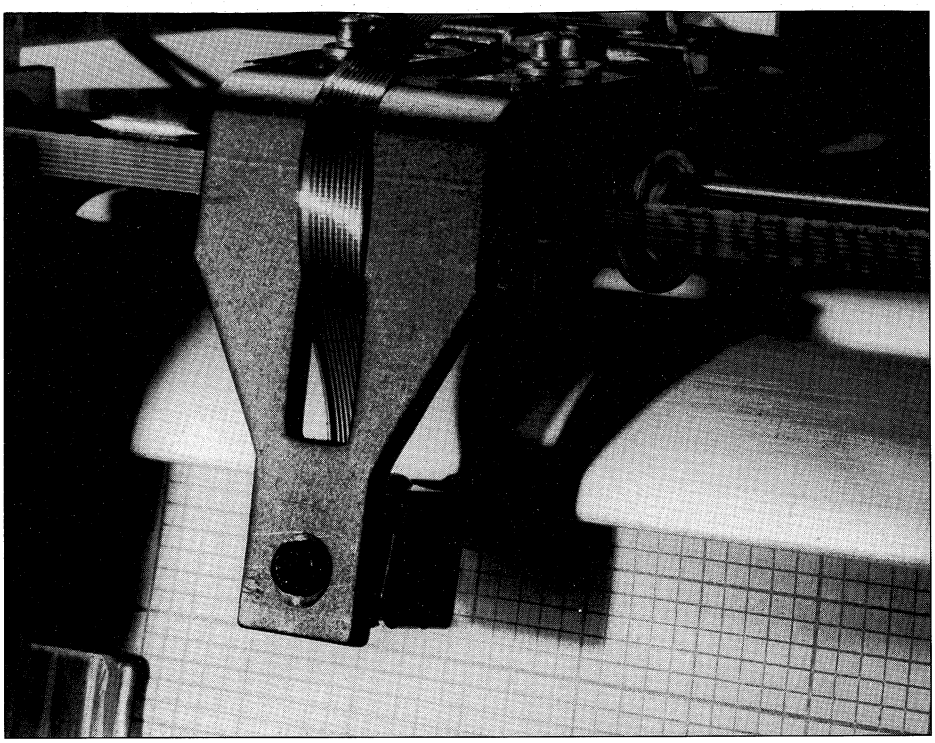
The AX + B scaling function allows display of the appropriate range for the variable: for example when operated with a humidity sensor, instead of displaying the mV output, that channel can be scaled to read from 0...100%.

In standby mode, input from the front panel or from a controller in a system set-up is directly recorded on the chart. Other information recorded on the chart includes chart speed; temperature at the isothermal input block for cold junction compensation; alarm points; functional units - V, °C or scaled; and the time of unexpected events such as power interruption. Dot density is alterable for each channel if the operator wishes one to be highlighted.

Numeric or Graphic Mode

Numeric mode directly outputs the values of individual measurements, in a 10-column tabular form, and this mode can be instantly selected at any time while recording. It can also

PM 8238



print out automatically, at user defined intervals of one minute from 1 to 99, allowing quick overviews of actual measurement results. Printouts include codes to show fault conditions such as out-of-scale, under-scale, thermocouple break or alarm conditions met.

Graphic mode gives optimum interpretation of results. It has a switchable interpolation mode that fills in dots between the actual measurement points. This gives continuous line plotting for direct detection of trends, peaks and irregularities. The fast measurement time (100 ms/channel) ensures the user can interpret events virtually in real-time. Comprehensive zero suppression facilities permit a flexible choice of scale positioning, so together with a chart speed continuously variable over 60 mm/min to 60 mm/h, optimum use is made of printout area. Multiple readings in the same range can be re-scaled for immediate comparisons. Direct plots can also be automatically made of the difference in measurements on different channels, speeding up comparisons and eliminating the potential for calculation error. A numeric print out can be selected automatically, while in graphic mode, at user defined intervals in steps of 10 minutes.

Simple Yet Versatile Operation

No previous knowledge of the instrument, or knowledge of software or programming are needed to operate this instrument. All tasks such as linearization and mixing of variable measurements on different channels are automatically handled by the recorder. PM 8238 can handle any combination of voltage or 2- or 4-wire temperature measurement on the maximum 30 channels (15 for 4-wire operation). Parameter settings are entered directly at the instrument keyboard, or from a remote PC or controller via one of the systems interfaces. All function keys have an LED to indicate activation. Keyboard settings are lockable to prevent accidental changes.

Programming is simple, via front panel keystrokes and clear error messages are provided. The range of possibilities for unattended operation is extended by the programming modules which can store settings. There is even a "copy channel" function for fast repeat programming.

Voltage Measurements

Choice of voltage ranges up to a maximum of ±30 V, with spans of 1 mV to 30V. The zero suppression facility allows the span to be located as a window over the selected range, and is entered by typing in the zero- and full-scale values of the window.

Temperature Measurement

Pt 100 uses the 4-wire connection, eliminating errors due to wire resistance; and the low 0.77 mA source current prevents self-heating.

For thermocouples three different forms of cold junction compensation are provided:

- automatic
- fixed at 0°C, 20°C or 50°C
- compensation from any other channel, eliminating the need for long compensation wires if the instrument is not near the measurement point.

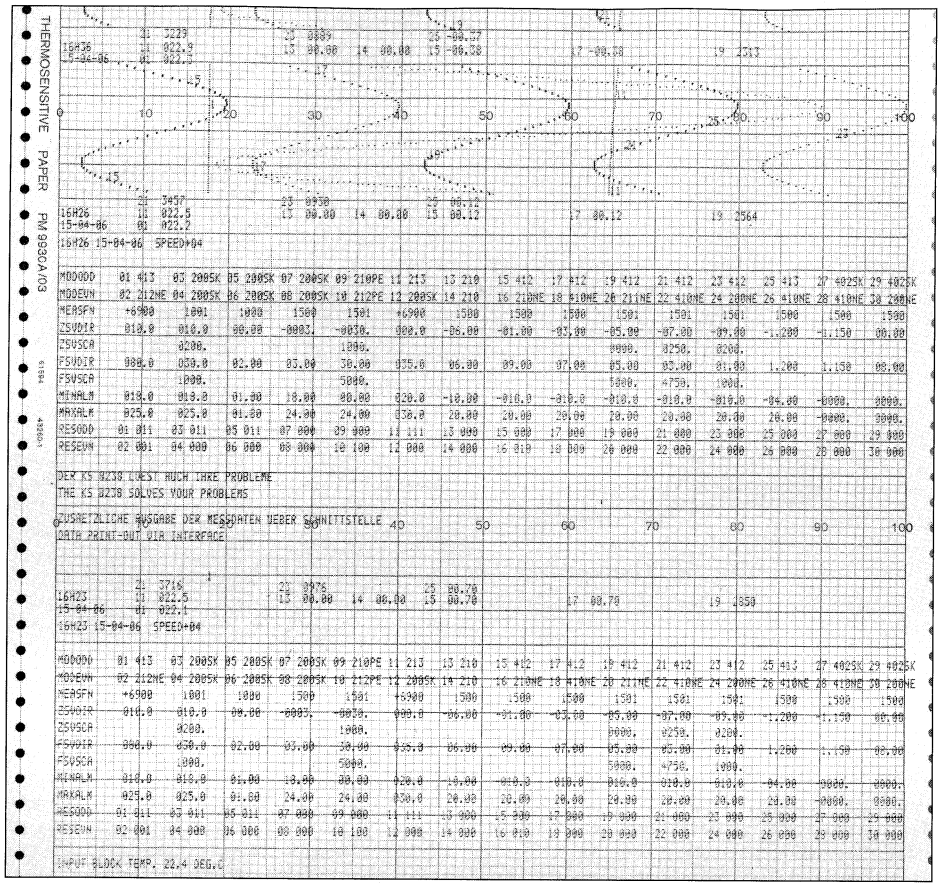
Cold junction compensation is achieved by a built-in isothermal block ensuring <1/4°C difference between terminals. The block is in a lockable compartment at the back, to protect it from any external effects such as direct heat radiation or convection. The difference measurement facility also helps eliminate cold junction errors; it automatically calculates the difference in readings beeen two channels, greatly reducing this type of inaccuracy (common to two channels).

Linearization is automatic for the 4 most common thermocouples: J-, K-, S- and T-type, with options for R-, B-, E-type, Nicrosil/Nisel and Ni-Ni. The zero suppression facilities described in the voltage measurement section are also available for temperature measurement. Error messages alert the operator if something goes wrong such as a break in thermocouple connection.

Alarms

The alarms may initiate one of several responses: e.g. increasing line intensity, print only on alarm or vary the chart speed. The PM 8328 unit provides for a maximum of two alarm cards to provide several alarm combinations. Slot 1 provides one minimum alarm and one maximum for odd numbered channels; slot 2 the same for even numbers. The cards simply plug-in and two common contacts for min/max values are provided.

PM 8238



Specifications

Technical Specifications

Voltage Measurements

Ranges and Spans:

Function	Permitted span	Full- and zero-scale limits	Range
mV	1...30 mV	-30...+30mV	30 mV
	5...300 mV	-300...-30 mV +30...+300 mV	300 mV
	50...3000 mV	-3000...-300 mV +300...+3000 mV	3000 mV
V	0.5...30 V	-30...+30 V	30 V

Accuracy: ±0.1% of input value ±0.1% of span
Temp. Coefficient of Accuracy: 0.2% of the input value per °C

Input:
Input Offset Voltage: <5 µV (= 1.25 mm at span of 1 mV)
Input Offset Voltage Drift: <0.5 µV/°C
Input Current: <100 pA
Input Impedance: 10 MΩ
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Possible Input Configurations: 2- and 4-terminal
Common Mode Rejection Ration (CMRR): >132 dB for DC
Series Mode Rejection Ration (SMRR): >38 dB for 50 and 60 Hz ± 1%
Measurement Time: 100 ms per channel

Thermocouple Measurements

Thermocouple Types:
J-type (Fe-Const)[1]
L-type (Fe-Const DIN)
K-type (Chromel-Alumel[1] + DIN)
S-type (Pt-Rh 10Pt[1] + DIN)
T-type (Cu-Const[1])
U-type (Cu-Const DIN)
[1] *IEC 584-1, IPTS 68*

Ranges and Spans

Type	Permitted span	Full- and zero-scale limits °C (see note)	Range
J, L	25...700 250...850	-200(-50)...+500 -100(-20)...+705	500 750
K	30...900 300...1470	-200(-50)...+700 -100(-20)...+1370	700 1370
S	250...1600	0...+1600	1600
T, U	35...600	-200(-50)...+400	0400

Note: The minimum input temperature above which full resolution (100 points) is obtained at the minimum span is indicated between brackets.

Accuracy (excl. Thermocouple): basic accuracy ± cold junction contribution ±0.1% of span

Basic Accuracy (over rated temp. range):

Type	Range	Basic Accuracy
J, L	500°C	±0.1%, T_{in} ±0.2°C (±0.55°C, T_{in} <50°C)
	750°C	±0.1%, T_{in}±0.3°C (±0.4°C, T_{in} <-20°C)
K	700°C	±0.05%, T_{in} ±0.35°C (±0.75°C, T_{in} <-50°C)
	1370°C	±0.1%, T_{in} ±0.7°C (±0.8°C, T_{in} <-20°C)
S	1600°C	0.1% T_{in} ±1.3°C
T, U	400°C	±0.1%, T_{in} ±0.3°C (±0.6°C, T_{in} <-50°C)

Cold Junction Contribution: ≈ 1.2 x cold junction
Cold Junction Accuracy:
Measured Internally (Automatic): ±0.45°C ± 0.02(T_{amb} - 23)°C
Measured Externally (in Channel NN): Accuracy of external channel NN
Fixed (at 0°C, 20°C or 50°C): accuracy of external supplied temperature
Input Configurations: 2- and 4-terminal
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

PT 100 Measurements

Pt 100 Temperature Measurement Current: 0.7685 mA
Span: 25...1050°C (span is the difference between the selected full-scale value FSV and the selected zero-scale value ZSV)
Full- and Zero-scale Limits: -200...+850°C
Accuracy (excl. Transducer): ±0.10% of T_{in} ± 0.25°C ± 0.06(T_{amb} - 23)°C ± 0.1% of span
Linearization: Acc. to DIN 43760/BS 1904: 1964
Input Configuration: 4-terminal input
Max. Voltage between any Terminal and Earth: 42 V_{DC} or 30 V_{AC}
Measurement Time: 100 ms per channel

Resistance Measurements

Transducer Resistance: 0...3.9kΩ
Measuring Current: 0.7685 mA
Accuracy of the Current: ±0.015%
Temperature Coefficient of Current Source: 0.005% per °C
Input Configuration: 4-terminal

Differential Measurements
A channel X can be programmed to measure the difference relative to another channel Y

Alarm Relay (in PM 8238 and PM 9895)

Contact Ratings:
Switched Power: 10 W max.
Switched Voltage: 45 V_{DC} or 30 V_{AC} max.
Maximum Voltage between Contacts and Earth: 42 V_{DC} or 30 V_{AC} (rms)
Alarm to Contact Closure Time: depends on number of measured channels
Current through Closed Contacts: 2 A, DC or AC (rms) max.
Contact Resistance: 50 mΩ

General Specifications

Mains Voltage (Factory Set): 220...240 V_{AC} ± 10%; 110...127 V_{AC} ± 10%
Mains Frequency: 50 Hz ± 5% (can be set to 60 Hz)
Electrical Safety: Acc. to IEC 348 class 1; VDE 411 class 1
Dimensions (h x w x d): 284 x 352 x 444 mm (incl. feet)
Weight: Approx. 13 kg.
Climatic Conditions: Acc. to IEC 359, C1 tested acc. to IEC 68
Rated Temperature Range: operation within spec, +5...+50°C; limits of operation, 10...+50°C
Humidity: 20...80% RH non-condensing
Max. Dewpoint Temp: 26°C
Storage and Transport: Acc. to IEC 359; temperature -40...+70°C
Reference Conditions: Acc. to IEC 359; temperature 23°C ± 2°C; humidity 45...75% RH
Warm-up Time: 30 Minutes

Resolution:
Recording in Dot Mode: 0.1% of span (1000 points)
Recording in Numeric Mode: absolute value of the measured input with signal printed to four digits
Displayed Value: absolute value of the measured input with signal indicated to four digits.

Included with the instrument:
- package of 5 books of folded thermo-sensitive paper (20 m each), black imaging
- 2 fuses 1.6 A-T
- mains cord
- paper output tray
- program module
- operating manual "PM 8238 Multipoint Data Recorder"
- operating manual "PM 8238 Interfaces to other devices"

Ordering Information

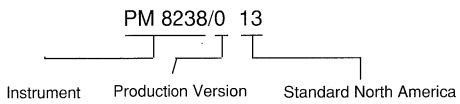
Model

PM 8238/01 30 Channel Multipoint Recorder

Accessories

PM 9141/02 3 Program Modules
PM 9838/20 19 inch Rackmount Unit
PM 9890/02 RS 232C/V24 Interface
PM 9891/02 IEC-625 Interface
PM 9893/01 Extended Control Interface
PM 9895/02 Alarm Relay Card for 15 channels
PM 9930A/03 5 books Z fold Paper, length 20m
Country Versions
/013 Standard North America
/011 Universal Europe
/014 UK
/015 Switzerland
/018 Australia

Ordering Example:



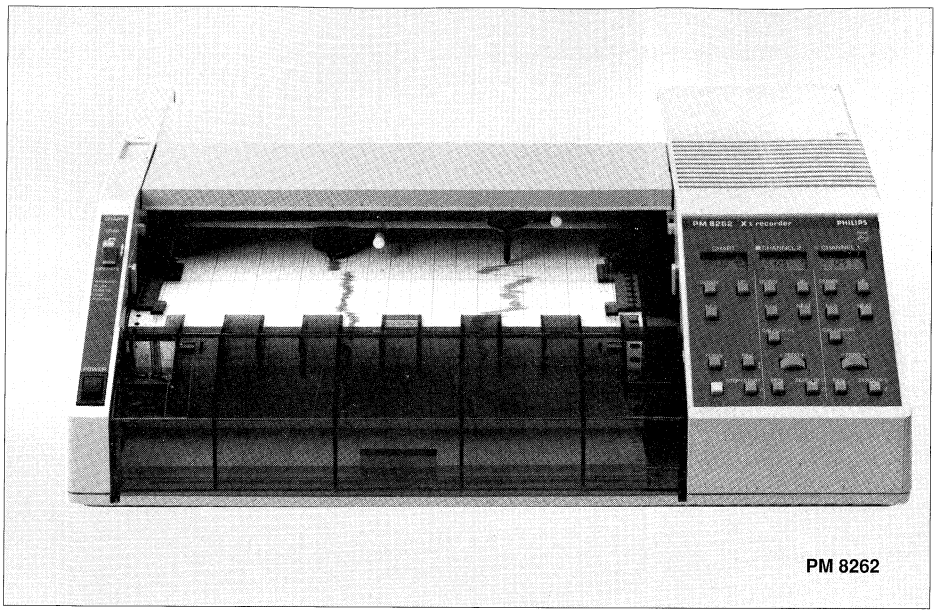
Additional Thermocouple Linearization Units
PM 9897/01 Type R (0...1765C)
PM 9897/11 Type B (250...1820C)
PM 9897/21 Type E (-200...400C)
PM 9897/31 Type E (-100...1000C)
PM 9897/41 NiCrSi/NiSi (0...800C)
PM 9897/51 NiCrSi/NiSi (0...1200C)
PM 9897/61 Ni/Ni, 18% Mo (0...1400C)

Cables
PM 9840/00 (1m) IEC-625
PM 9841/00 (2m)
PM 9842/00 (4m)
PM 2295/05 (1m) IEEE-488
PM 2295/10
PM 2295/20 (4m)
PM 2296/60 Socket to adapt IEC-625, socket to IEEE-488 cable

15

PM 8261/ PM 8262

NEW



PM 8262

PM 8261 & PM 8262 Single- and dual-pen line recorders

- PM 8261 and PM 8262 single- and dual-pen chart recorders
- Sensitivity range from 1 mV...50 V
- Chart speed range from 10 mm/h...1200 mm/min
- High-quality engineering for outstanding reliability
- Standard remote control input; GPIB and RS-232 interfaces optional
- Auto zero and 24 VDC standard

The new PM 8261 and PM 8262 horizontal chart recorders with one and two pens, respectively, offer economic solutions to the need for reliable, high-precision registration of one or two parameters against time.

These precision instruments have the versatility to handle a wide range of chart recording requirements in both lab and industrial situations. The wide range of input sensitivity settings - from 1 mV to 50 V - allows signals from virtually all transducers or voltage sources to be handled. The switch-selectable chart speeds range from 10 mm/h to 1200 mm/min; a variation in time scale by a factor of 7200.

The standard remote control input allows selection of chart start/stop and speed and the 'dip marker' function, facilitating the integration of these instruments in process control systems.

Optimum resolution is ensured by the zero suppression which is freely variable between -0% and 500%. The fast pen response of only 0.25 s allows even fast signal peaks to be recorded precisely. An analog output signal provides a constant indication of the pen position.

An optional sliding rack-mount kit allows convenient and compact pull-out mounting in instrumentation racks. As well as its limited height requirement, the horizontal recorder concept offers the additional benefit of easy access to the chart for making annotations.

High-quality engineering

These models are based on a well-proven Philips recorder concept of advanced design. The high-density engineering-grade polycarbonate casing provides outstanding mechanical properties in terms of rigidity, dimensional stability and durability.

The injection moulding technique results in extremely low mechanical tolerances, so that all mechanical parts fit accurately. This high-quality engineering makes an important contribution to long-term accuracy and reproducibility of recorded results.

At the same time this design allows a high degree of functional integration to be achieved, thereby reducing the component count and further enhancing reliability, as shown by the outstanding MTBF figure.

Optional temperature modules

The optional PM 9877-series temperature modules provide linearization and cold-junction compensation for J- and K-type thermocouples, allowing temperature registration within the range -50°...+600°C and -50°...+1200°C, respectively.

Also available is the PM 9877/01 module, which provides linearization for Pt100 temperature sensors within the range -100°...+700°C. These modules also offer the possibility of direct temperature readouts using a digital voltmeter. Current measurements up to 20 A are also possible by using the Fluke 80J10 current shunt.

Optional interfaces

A choice of GPIB (IEEE-488) and RS-232 interfaces further enhances the facilities for use of these instruments in system environments, for example making it possible to control functions like sensitivity and zero suppression remotely.

Specifications

General Specifications

Models

PM 8261: chart recorder with single pen channel
PM 8262: chart recorder with dual pen channels
Recording width: 250 mm charts

Inputs

Floating, asymmetric
Sensitivity ranges: 25, from 1 mV to 50 V in 1, 1.25, 2, 2.5, 5 sequence; variable adjustment from 0.5x to 1.0x
Zero setting: 0% to 500% of span and auto
Input impedance: 1 MΩ ±1%
Insulation resistance: ≥2000 MΩ between input and earth
Max. input voltage: 30 VDC or 20 VAC (1 mV...500 mV range); 42 VDC or 30 VAC (1V...50 V range); test voltage between Hi/Lo and earth 500 VAC
Safety characteristics: comply with IEC 348 Class 1

Accuracy

Linearity error of potentiometers: <0.1% of FSD
Dead zone: <0.2% of FSD
Gain error: <±0.4%
Zero drift: 0.1 µV/K
Zero shift when switching to another range: <0.2% of FSD
Settling time: 0.25 s between 5% and 95% recording width
Frequency response (amplitude decrease for sinewave signals):
10% with 1.25 Hz and 66% of FSD
10% with 5 Hz and 10% of FSD
Overshoot: <1% of FSD
Interference suppression:
CMRR: DC ≥150 dB
AC (<100 kHz) ≥130 dB
AC (>100 kHz) ≥100 dB
SMRR: (>50 Hz) ≥56 dB

Chart data

Chart speed: 14 speeds, 10, 20, 30, 60, 120, 300, 600, 1200 mm/h and 30...1200 mm/min
Pen lift: electrical for each channel
Recording medium: replaceable fibre-tipped pens
Replacement pens:
PM 9856/05 10 blue pens for PM 8262 (lower channel)
PM 9857/05 10 red pens for PM 8261 and PM 8262 (upper channel)
PM 9857B/05 10 blue pens for PM 8261 and PM 8262 (upper channel)
Chart paper:
PM 9920/00 0 - 10 linear-scale Z-fold paper with 10 mm grid
PM 9920/05 0 - 10 linear-scale Z-fold paper with 20 mm grid
(each number comprises 5 packs of 20 m each)
Chart length: 20 m

Electrical data

Power supply: 115 V, 230 V, _15%, 50/60 Hz and 24 VDC standard
Consumption: PM 8261: 30 VA standby, 130 VA max.; PM 8262: 40 VA standby; 160 VA max.

Physical data

Dimensions: 444 x 132 x 356 mm (W x H x D)
Weight: 5 kg

Optional linearization units

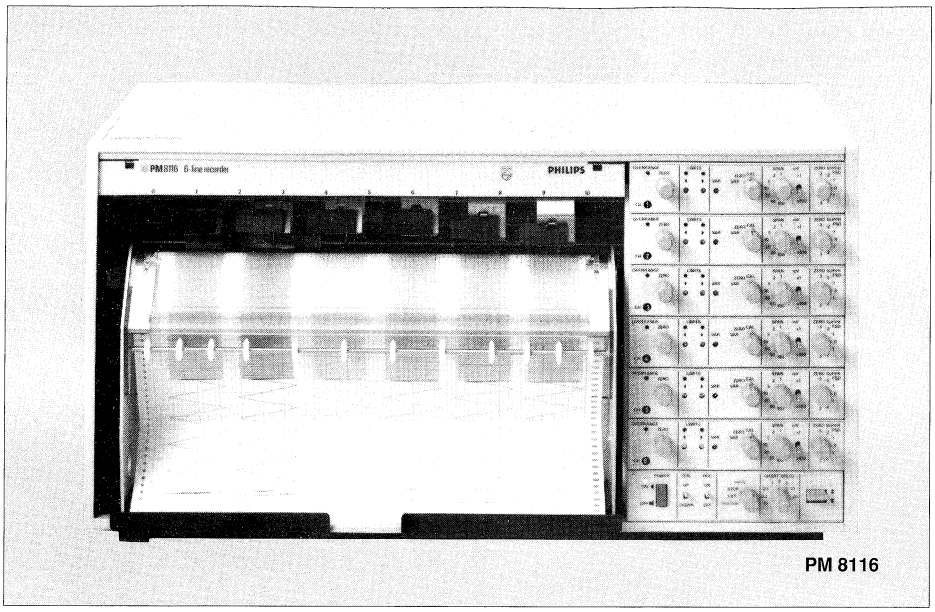
PM 9877J/2: J-type thermocouple module (-50°...+600°C)
PM 9877K/2: K-type thermocouple module (-50°...+1200°C)
Both these thermocouple modules provide linearization and automatic cold-junction compensation for temperature measurements
PM 9877/01: Pt100 temperature module (linearization in the range -100°...+700°C)

Ordering Information

PM 8261 Chart recorder with single pen channel
PM 8262 Chart recorder with dual pen channels

PM 8104, PM 8106, PM 8114 & PM 8116

NEW



PM 8116

PM 8104/06 & PM 8106/16 4- and 6-pen recorders

- Choice of 4- or 6-pen models
- Base models PM 8104 and PM 8106 for economic general-purpose chart recording
- PM 8114 and PM 8116 incorporate zero suppression, limit switching and pen offset compensation functions
- Input sensitivities variable from 1 mV...10 V
- Variable input gain from 100....250 % of selected range
- Remote control of chart transport and penlift by TTL-level signals

This new family of chart recorders offers economic and effective solutions for the simultaneous registration of up to 6 parameters like temperature or other low-frequency phenomena against time.

These instruments have a vertical design concept which is ideal for both free-standing use and mounting in 19-inch instrumentation rack systems. The most recently drawn traces can always be seen clearly at the front of the instrument, allowing convenient visual monitoring.

The four models comprise two distinct lines: the basic models PM 8104 and PM 8106, with 4 and 6 pens, respectively, and the PM 8114 and PM 8116 incorporating enhancements in the electronic control circuits.

Each input module has a standard floating voltage- measurement input with a sensitivity adjustable between 1 mV and 10 V for a full-scale deflection of 250 mm. Variable gain allows the input sensitivity to be varied between 100% and 250% of the selected range within the calibrated region.

Automatic 'overrange' function

If the input signal attempts to drive the pen off the chart paper, the servo system is automatically switched off to prevent damage. At the same time an 'overrange' warning LED lights up.

The common chart unit of all four models allows both local and remote control of the chart transport and penlift functions using TTL-level signals. Any desired chart speed can therefore be achieved by the use of an external generator. The chart type used is Z-fold paper with a recording width of 250 mm.

Additional functions of PM 8114 and PM 8116

The PM 8114 and PM 8116 models incorporate three additional electronic functions: zero suppression, limit switching and pen offset compensation

Zero suppression

Zero suppression makes it possible to record small signal variations superimposed on larger ones. For this purpose, the instrument's full-scale value can be suppressed by one, two or three full-scale lengths to either left or right.

Limit switching

The limit switching function allows two limit points to be preset for each pen channel, representing minimum and maximum signal values. When the input signal moves outside these defined limit values, an LED indicator lights and a relay is activated. The relay contacts - available at the rear of the instrument - can be used for any desired external switching functions, for example alarm or process stop, as well as to initiate internal recorder functions like penlift.

Pen offset compensation

The pen offset compensation (POC) function compensates for the small physical distances of 2.5 mm between adjacent pens, which means that it is not possible for two pens to write on the same spot on the chart at the same time. The signal to each successive pen is delayed for exactly the period required to advance the chart by a further 2.5 mm. On the 4-pen PM 8114 recorder, the third and fourth pens are therefore 'delayed' by 5.0 and 7.5 mm. As a result, all signals are drawn relative to the same axis, which greatly simplifies interpretation of the charted results and comparison of the individual traces.

Optional temperature modules

The optional PM 9877-series temperature modules provide linearization and cold-junction compensation for J- and K-type thermocouples, allowing temperature registration within the range -50°...+600°C and -50°...+1200°C, respectively. Also available is the PM 9877/01 module, which provides linearization for PT100 temperature sensors within the range -100°...+700°C. These modules also offer the possibility of direct temperature readouts using a digital voltmeter. Current measurements up to 20 A are also possible by using the Fluke 80J10 current shunt.

High reliability

These new analog recorders have been designed to meet users' requirements for highly reliable long-term operation. The thoroughly proven design concept ensures trouble-free unattended recording over extended periods.

Specifications

General Specifications

Models

PM 8104: 4-pen chart recorder
PM 8106: 6-pen chart recorder
PM 8114: 4-pen chart recorder with zero suppression, limit switching and pen offset compensation
PM 8116: 6-pen chart recorder with zero suppression, limit switching and pen offset compensation

Recorder Specifications

Pen type: fibre-tip cartridges
Pen travel width: 250 mm

PM 8104, PM 8106, PM 8114 & PM 8116

Pen travel limitation: 1 mm over each side of pen travel width, LED indication on front panel
Nonlinearity: 0.1% FSD
Dead zone: 0.1% FSD
Pen response time: 0.25 s max. for 0...95% FSD
Pen speed: 110 cm/s max.
Pen-to-pen offset distance: 2.5 mm
Monitor output: 5 V FSD
Chart: Z-fold, width 250 mm, length 15 m
Chart drive: stepping motor (0.05 mm step size)
Chart speed: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20 mm/s and mm/min
Max recording time: 12.5 min. ... 2500 h at highest and lowest chart speeds
External control: chart on~off: TTL or switch; chart speed, 1 step = 0.05 mm: TTL; chart direction, forward/reverse: TTL or switch; penlift for all pens: TTL or switch
Input: floating asymmetrical
Input impedance: 1 MΩ fixed
Range: 14 calibrated spans (per channel); 1, 2, 5, 10, 20, 50, 100 mV FSD (x1 or x100)
Gain inaccuracy: 0.3% of FSD
Variable sensitivity: 100%...250% of FSD
Zero setting: -50%...+150% of FSD
Zero suppression (PM 8114 and PM 8116): 1, 2, 3 times full scale to left or right
Inaccuracy zero suppression: 0.2%
Servo marker: TTL input, 6 mm max. displacement of pen (TTL or switch)
Limit switching (PM 8114 and PM 8116): two single-pole switches can be activated; front-panel setting over full scale; LED indicatio

Electrical Data

Power supply: 115V/230V ±15%
Consumption: 35 VA typical, 145 VA max.

Physical Data

Dimensions: 448 x 311.5 x 220 mm (W x H x D)

Optional Linearization units

PM 9877J/2: J-type thermocouple module (-50°...+600°C)
PM 9877K/2: K-type thermocouple module (-50°...+1200°C)
Both these thermocouple modules provide linearization and automatic cold-junction compensation for temperature measurements
PM 9877/01: Pt100 temperature module (linearization in the range -100°...+700°C)

Ordering Information

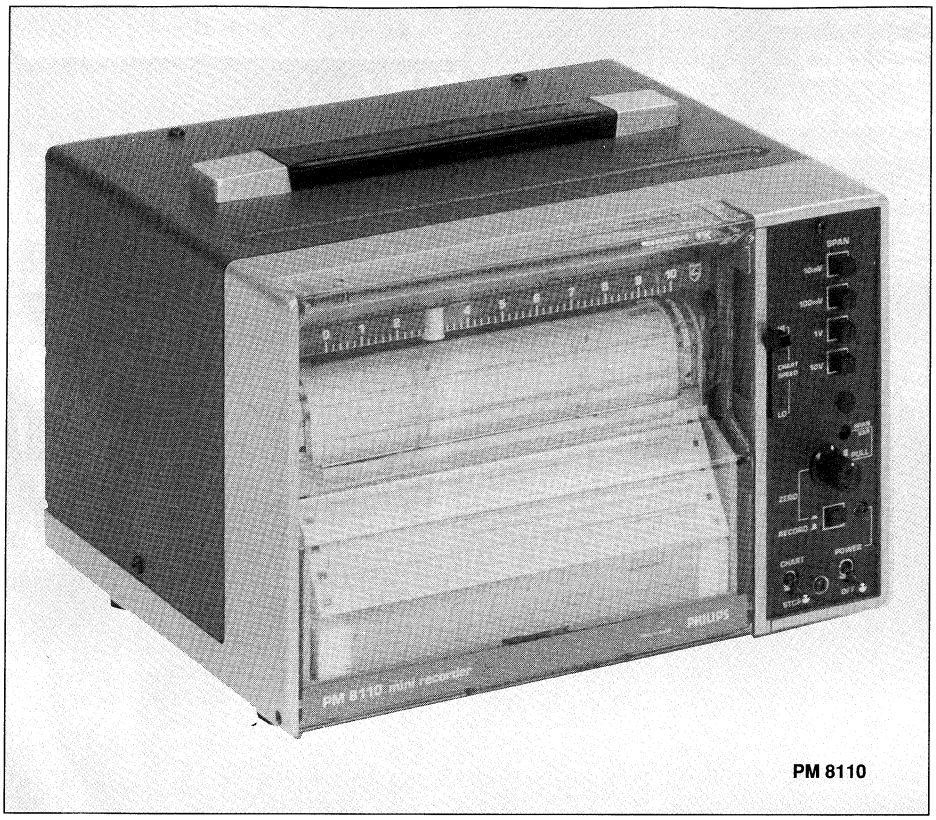
Models

PM 8104 4-line recorder
PM 8114 4-line recorder with Pen Offset Compensation, limit contacts and zero suppression
PM 8106 6-line recorder
PM 8116 6-line recorder with Pen Offset Compensation, limit contacts and zero suppression

Accessoires and Consumables

Fluke 80J10 Current shunt
PM 9849 19-inch rackmount kit
PM 9954/01 Z-fold recorder paper
PM 9875A/01 Set of 10 felt-tip pens, black
PM 9875B/01 Set of 10 felt-tip pens, blue
PM 9875U/01 Set of 10 felt-tip pens, brown
PM 9875G/01 Set of 10 felt-tip pens, green
PM 9875V/01 Set of 10 felt-tip pens, violet
PM 9875R/01 Set of 10 felt-tip pens, red

PM 8110



PM 8110

PM 8110 Single Line Minirecorder

- 120 mm chart width
- Four calibrated input ranges and variable span adjustment: adjustable zero setting
- Two standard chart speeds (3 options)
- Built-in calibration
- Compact dimensions and low weight
- Mains or battery operation

Most R&D labs will find the PM 8110 an ideal back-up recorder to support the more sophisticated types, especially where trends, rather than instantaneous values need to be seen. Industry too needs compact portable recorders for on-site monitoring or for incorporation in OEM equipment. The very compact and lightweight PM 8110 will fulfill these and many other varied applications.

Used with suitable transducers, for instance, it will monitor mechanical or physical parameters: it can also find application in pollution monitoring, gas chromatography or similar chemical analyses.

The 120 mm chart width achieves a 20% better resolution than conventional 100 mm types and the various options for chart speed enhance the general performance. The convenient Z-fold chart allows full access to all recordings over its full length and the nylon pen ink cartridge is easily fitted or removed.

All controls are located on the fronnt panel and a calibration facility is built-in. Easy servicing is assured by a modular design which gives easy access to all components.

Specifications

Technical Specifications

Accuracy: Maximum error ±1% of f.s.d.
Reproduceability: <0.5% of f.s.d.
Temperature Drift: <20 µV/°C max.
Input Sensitivity: Push-button control, 4 positions: 10 mV, 100 mV, 1V and 10V.
Variable span control between the ranges increases span to 100V f.s.d.
Zero Setting: Continuous zero adjustment over full scale and zero check switch
Step Response Time: <0.5s for f.s.d.
Frequency Response: 10% amplitude decrease for sinusoidal voltage with amplitude of 66% of scale: 2 Hz
Chart Speeds: Two speeds, on/off switch on front panel. (See Ordering Information)
Chart: Z-fold chart, refolding automatically
Effective Recording Width: 120 mm
Length per Book: 15m
Writing Systems:
Disposable nylon pen cartridge;
Recording Length 1500m min.;
Manual pen lift.
The chart and writing system is protected by a transparent front cover.
Potentiometer: Straight rod, with direct coupling to measuring carriage
Linearity: ±0.15% of f.s.d.
Input Impedance: 1 MΩ
Source Impedance: 10 kΩ max.
Damping: Factory adjusted. Overshoot <1 mm
Stray Voltage Rejection: With 1 kΩ between HI and LO
AC CMRR 80 dB
AC SMRR 15 dB
DC CMRR 90 dB
Max. Input Voltage: Between HI and LO
100 $V_{DC + ACpk}$ for 10 mV and 100 mV ranges
300 $V_{DC + ACpk}$ for 1V and 10V ranges
Max. Voltage between LO and Ground: 24 V_{DC} (Test voltage 500 V_{eff})
Isolation Resistance: >5 MΩ between input terminals and earth

General Specifications

Power Requirements: 100, 117, 217, 234V ±10%
Dimensions: 214 mm W x 130 mm H x 170 mm L (8.4 in W x 5.1 in H x 6.9 in L)
Weight: 3 kg (6.6 lb)
Measuring System: Null balance potentiometer servo-system with DC-amplifier and servo motor.
Calibration Voltage: At the rear a switch is provided which connects a 50 mV calibration voltage to the input of the instrument. This voltage serves to calibrate the variable span setting.
Included: Operating manual, PM 9910 Pack of 5, Z-folded chart books, PM 9856/05 1 set of nylon pen cartridges
Consumable Supplies
PM 9856/05 Nylon pen cartridges blue, set of 10
PM 9910/01 Pack of Z-fold charts, 5 books

Ordering Information

Models

PM 8110/02 Minirecorder with chart speed of 0.5...2 cm/min.
PM 8110/22 Minirecorder with chart speed of 2...8 cm/h
PM 8110/42 Minirecorder with chart speed of 2...8 cm/min

Options

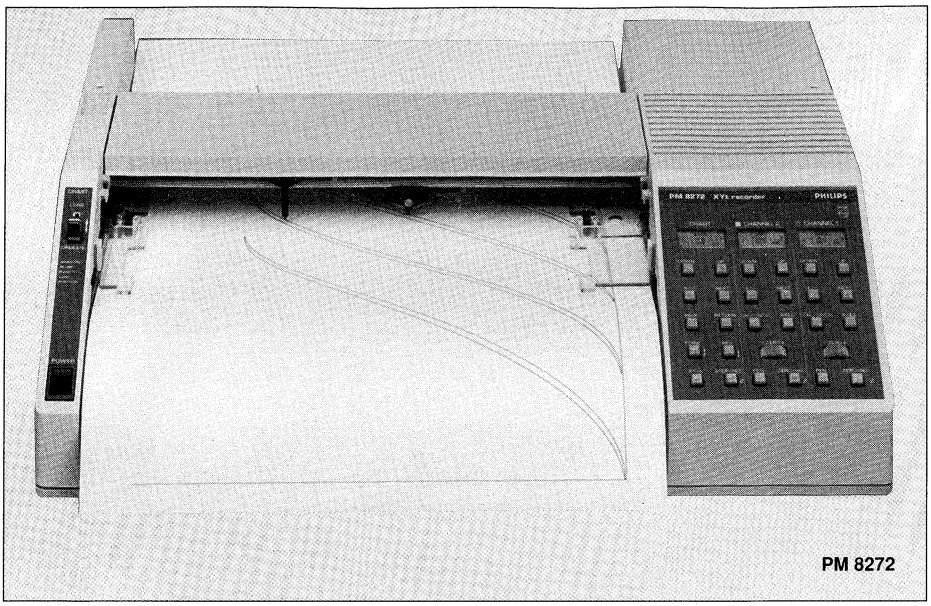
Versions with chart speeds of 0.25...1 cm/min., 1...4 cm/min., 1...4 cm/h, 4...16 cm/min., 4...16 cm/h and 8...32 cm/min. also available on request.

Accessories

PM 9859/01 DC-AC Inverter
PM 9397/01 Rechargeable Battery (2 required)
PM 9398/01 Battery Charger
PM 9880/01 19-in Rackmount Kit
Service Manual

PM 8271, PM 8272, PM 8071 & PM 8072

GPIB
IEEE-488



PM 8272

PM 8271/PM 8272 and PM 8071/PM 8072 Universal Recorders

- XY and Xt (line) recording, single or dual pen
- A3, A4, A and B size sheet or Z-fold paper
- High slew rate to record fast signals
- 24 timebase settings/chart speeds (including 10 user programmable)
- 40 µV/cm to 2 V/cm sensitivity (1 mV to 50 V full scale)
- Auto-zero suppression
- Optional rackmount kit available

The PM 8271 single pen and the PM 8272 dual pen recorders offer precision XY and line recording in the same instrument, with many functions built-in for both modes. Now you can have top quality XY and Xt recording without having to specify two instruments. They can be used with sheet paper up to ISO A3 (297 x 216 mm)/ANSI B (11 x 17 in.) size, or with Z-fold paper for charts or multiple X-Y recordings.

Most XY recorders hold the paper stationary on a flatbed writing surface, and then move the pen in X and Y axis. The PM 8271/72, however, moves the paper in one axis, and the pen is then moved in a perpendicular axis. The result is superior versatility for both XY and Xt recording.

The PM 8271/72 range of standard functions includes automatic paper edge detection and sheet positioning for A3, A4, A and B size paper for simplified X-Y recording. When Z-fold paper is used, these recorders offer a large flat-bed area for convenient note-taking. Throughput is very high as there is no need to wait for electrostatic chart holds to release (as on standard flatbed XY recorders). Other problems related to electrostatic chart holds such as paper bubbling and susceptibility to dust are also eliminated.

X-Y Recording

For recording one measurement parameter versus a second (generally not time), the PM 8271 provides a reliable, accurate paper transport, high sensitivity input, timebase and remote control interface.

The PM 8272 expands on this performance, with dual pan performance to record two parameters versus a third.

Line Recording

As line recorders, for recording one or two parameters versus time, the PM 8271/72 have high input sensitivity and exceptional long-term stability, making them ideal for product endurance tests requiring consistent, precision recording over extended periods.

They have a unique auto zero-suppression mode, which ensures fast connection to unknown signals by automatically setting a calibrated offset. This facility will read just the zero-suppression if the measured signal moves off-scale. With this feature it is possible to make unattended high resolution measurements without the risk of losing important information through off-scale pen movements.

The PM 8271/72 have low-cost temperature inputs covering PT100, J-type and K-type thermocouples. These simply plug into the rear panel of the recorder, and provide full linearization and cold junction compensation.

Optional accessories such as event markers and rack mounts, plus wide-range mains and DC power supplies further increase the versatility of these instruments.

Keyboard Operation

A keyboard with full LCD indication for each channel setting has replaced the conventional rotary switches. To ensure that important tests cannot be disturbed by unauthorized personnel, a keyboard disable function can be used to prevent keyboard access.

Enhanced Recording Features

The PM 8271/72 feature a variety of improved performance features. A diagonal speed of more than 130 cm/s for sheets in the X-Y mode ensures accurate tracking of incoming signals.

Recording versatility is enhanced through a selection of 25 measurement ranges for both the X (chart) and Y (pen) channels. These range from 40 µV/cm to 2V/cm, equating to full scale inputs from 1 mV to 50V. This large range often eliminates the need to use uncalibrated measurements for signals just above the range limits.

For the chart channel, user-programmable chart speeds or time-base settings allow custom settings to meet the needs of specific applications. Chart speeds can be set as required in the ranges 30 to 1200 mm/min. and 10 to 1200 mm/h.

Where measurement signals with DC offset are to be recorded, PM 8271/72 have 7 calibrated zero-suppression levels covering signal offsets of up to 500%. With this high performance level, special care has been taken to avoid measurement errors caused by noise and spurious signals, resulting in a CMRR of 150 dB for these recorders.

Bench, Rack or Field Operation

The PM 8271/72 will operate on a wide-range of power supplies. The high efficiency switched-mode power supply can be used on power voltages of 115V or 230V (+/-15%) without switching. A separate 24 VDC input is also provided as standard for convenient field operation (NOT for PM 8071/72).

The recorders are compact, making them ideal for bench use, while the optional slide-in rackmount allows them to be built quickly and easily into larger measuring systems housed in 19-inch rack units.

PM 8271, PM 8272, PM 8071 & PM 8072

Logic, RS 232 or GPIB Interfaces

The PM 8271/72 have a standard logic-level external control input for system measurements which allows basic functions like penlift, servokill, dipmarking and chart speed to be controlled. Alternatively, bus-controlled operation, via the RS 232/V24 and GPIB interfaces, enable functions like range and zero-suppression to be controlled. This makes these recorders suitable for integration into complete system measuring applications.

Advanced Mechanics and Materials

The use of high-density, engineering-grade polycarbonate casings provides outstanding mechanical properties in terms of rigidity, dimensional stability and durability, as well as giving an attractive appearance. A special injection molding technique results in extremely fine mechanical tolerance, so that each part fits exactly.

This construction technique ensures a high degree of functional integrity, as well as consistent high quality in manufacture through elimination of traditional assembly procedures involving numerous individual components.

PM 8071 and PM 8072

These models have equal functions as the PM 8271 and PM 8272 but only one (fixed) input sensitivity of 100 mV fsd. Other input sensitivities can be supplied on order (for OEM customers). These instruments do NOT accept 24V dc as power supply.

Specifications

Technical Specifications

Types: PM 8271 single pen and 8272 dual pen
Modes: XY and Xt (line) recording

Media Sizes

For XY Modes: For XY or line modes Z-fold sprocket paper, 20m long (PM 9920 types)
ISO A4: 210 mm x 297 mm (8.27 in x 11.68 in)
ISO A3: 297 mm x 420 mm (11.69 in x 16.54 in)
ANSI A: 279 mm x 216 mm (11 in x 8.5 in)
ANSI B: 432 mm x 279 mm (17 in x 11 in)
Maximum Writing Area (XY mode): 250 mm x 380 mm (9.84 in x 15 in)
Variable Sensitivity Adjustment: By potentiometer from calibrated span (0.5 to 1.0 times span)
Accuracy: <0.25% fsd
Dead Band: <0.2% fsd
Linearity: 0.1% fsd
Calibrated Zero Suppression: 0%, 50%, 100%, 150%, 200%, 300%, 400%, 500% of range
Variable Zero Suppression, for both Chart and Pen Channels: By potentiometer from -5% to +105% of range
Input Impedance: 1 MΩ
Input Type: Floating
DC CMRR for Chart and Pen Channels: >150 dB
AC CMRR (<100 kHz): >130 dB
AC CMMR (50/60 Hz): >56 dB
Maximum Input Voltage: 30 VDC: range <500 mV fsd; 42 VDC: range >500 mV fsd
Timebase/Chart Speeds: 14 fixed speeds of 10, 20, 30, 60, 120, 300, 600 and 1200 mm/h; and 30, 60, 120, 300, 600 and 1200 mm/min. plus 10 user definable speeds
Power: AC: 115 or 230V 15%, 50 to 60 Hz (no switching required)
Dimensions: 132 mm H x 444 mm L x 345 mm W (5.2 in H x 17.4 in L x 13.5 in W)
Weight: 5 kg (11 lb)
Safety Approvals: IEC 348 class 1
Environment Approvals: IEC 359 class 1 (C1, M1, S2)
Operating Conditions: +5 to 40°C, 20 to 80% RH
Storage Conditions: -40 to +70°C, 5 to 95% RH
EMI: VDE 0871 B, VFG 1046
Warm-Up Time: <30 minutes

Chart/Y Channel

Calibrated Input Sensitivity: 25 calibrated ranges from 40 µV/cm to 2 V/cm in a 1:2:4:5:8: sequence
Writing Speed: Sheet paper 90 cm/s; Z-fold 30 cm/s
Step Response Time: Sheet paper 0.9s; Z-fold 0.28s (over 250 mm)

Pen/X Channel

Calibrated Input Sensitivity: 25 calibrated ranges from 40 µV/cm to 2 V/cm in a 1:2:4:5:8 sequence (Equivalent to 1 mV to 50V fsd)
Writing Speed: 100 cm/s
Step Response Time: 0.25s
Penlift: Front panel or remote control
Supplied with the Instrument: Two pens per channel, 50 sheets A3 paper, one packet Z-fold paper, fuses, operating manual, cleaning brush, potentiometer oil, screwdriver, sheet paper guide, dust cover, AC power cable, DC power cable, remote control DIN connectors.

Ordering Information

Models

PM 8271/01 Single Pen XY/Line Recorder
PM 8272/01 Dual Pen XY/Line Recorder
PM 8071/01 Fixed input single Pen XY/Line Recorder
PM 8072/01 Fixed input dual Pen XY/Line Recorder

Accessories

PM 9870/10* Left Hand Event Marker (only available as factory-fitted option)
PM 9870/20 19-inch Rackmount Kit 3E high
PM 9870/30 Sliding Rackmount Kit
PM 9870/40 Dust Cover (not for use with PM 9870/30)
PM 9191/02* GPIB Interface
PM 9190/01* RS 232 Interface
PM 9877/01 Pt 100 Unit
PM 9877K/2 K Type Thermocouple Unit
PM 9877J/2 J Type Thermocouple Unit.

** Must be factory installed. Please state these options clearly when ordering.*

Consumables

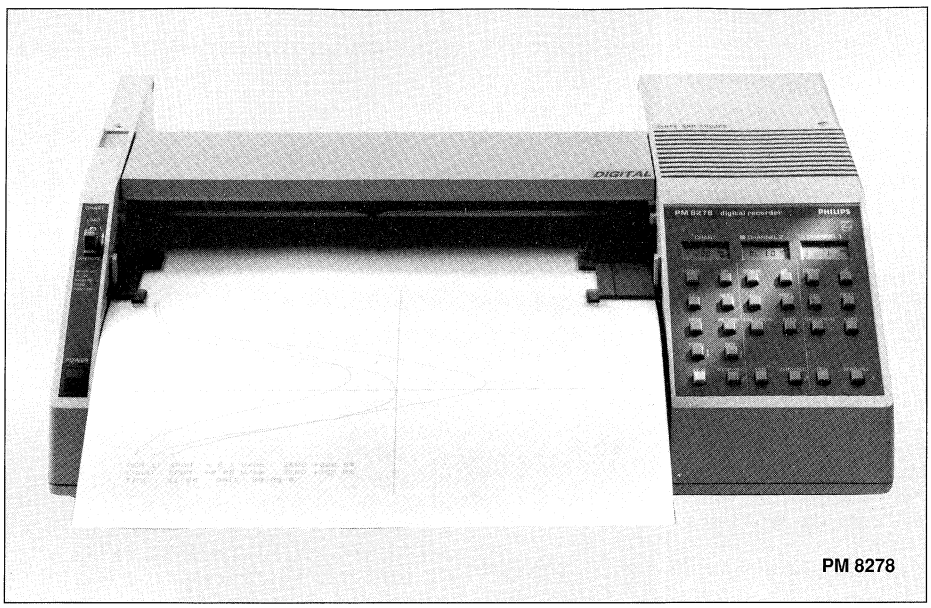
PM 9856/05 10 Blue Pens for PM 8272 only lower channel)
PM 9857/05 10 Red Pens for PM 8271 or PM 8272 (upper channel)
PM 9857B/05 10 Blue Pens for PM 8271 or PM 8272 (upper channel)
PM 98750/15 Set of 10 event marker pens
PM 9920/00 0 - 10 mm Linear ScaleZ-fold Paper with 10 mm grid (20m)
PM 9920/05 0 -10 mm Linear Scale Z-fold Paper with 20 mm grid (20m)
PM 9953/03 Pack of 250 Sheets A3 paper
PM 9953/04 Pack of 500 Sheets A4
PM 9953/53 Pack of 250 Sheets ANSI B Paper
PM 9953/54 Pack of 500 Sheets ANSI A Paper

Use of stated paper and pens is recommended for optimum drawing quality. Pen life: if kept covered when not in use, pens will draw lines approximately 1500m long.

PM 8277/ PM 8278

GPIB
IEEE-488

NEW



PM 8278

PM 8277/PM 8278 Single- and dual pen chart recorders

- Full digital control of plotting and printing of instrument settings
- GPIB (IEEE-488) or RS232 serial interface optional
- Data output of pen position and settings to PC or controller
- Even higher precision and reproducibility
- High versatility: multi-format XY and Xt (line) recording on sheet or Z-fold paper
- Hard copy from Philips DSO over IEEE interface

Two new Philips chart recorders have digitally enhanced performance that combines valuable extra control and plotting functions with significantly increased precision. The new PM 8277 (single-pen) and PM 8278 (dual-pen) have all the benefits of the well-proven range of Philips chart recorders, such as their ability to handle both XY and Xt (line) recording, on continuous Z-fold or single-sheet charts, and in a range of formats that includes A3, A4 and the US ANSI A and B sizes.

Extra digital control features

A wide range of digital control features and the GPIB (IEEE-488) or RS232 interface make the PM 8277 or PM 8278 the ideal choice for unattended use in automated measuring system environments.

The extended remote-control capabilities of these instruments include the ability to add text labels and comments to chart data under remote control. All the main recorder settings can be printed on the chart after the axes are drawn, providing at-a-glance documentation of channel number, span, zero suppression, chart speed, time and date.

In addition, chart time- and date- stamping and print-out of settings can be initiated under remote control. In system operation, plotting functions are controlled by a set of plot commands which can be called via the system interface.

All-digital electronics

The PM 8277 and PM 8278 use an all-digital electronics concept for even higher precision and reproducibility. For example, chart transport accuracy is further increased by electronic compensation of fluctuations in Z-fold paper dimensions caused by variations in temperature and humidity.

In line recording mode, the PM 8278 dual-pen recorder includes an additional Pen Offset Compensation (POC) function to compensate for the relative displacement between the two pens.

GPIB data output

A valuable extra facility in ATE environments is output of pen position and settings via the GPIB bus. This function for the first time adds a direct data output capability to XY recorders, allowing real-time monitoring and registration of measured values by the system controller.

Full information about specifications and delivery can be obtained on request from your local Philips sales office or representative.

Specifications

Types PM 8277 single-pen and PM 8278 dual-pen recorders
Modes of use: XY, Xt (line recorder)
Paper types For XY mode: A4 297 x 210 mm
A3 420 x 297 mm
ANSI A 279 x 216 mm
ANSI B 432 x 279 mm
For XY or Xt (line) mode: Z-fold sprocket paper, 20 m long (PM 9920 types)
Maximum writing area:
in XY mode 250 x 380 mm
Calibrated input sensitivity: 25 calibrated ranges from 40 μV/cm to 2 V/cm in a 1: 2 : 4 : 5 : 8 sequence
Variable sensitivity adjustment: By potentiometer from calibrated span 0.5x to 1.0x

Span accuracy: <0.25%
Dead band: <0.2% FSD
Non-linearity: <0.1% FSD
Writing speed: Sheet paper 90 cm/s, Z-fold paper 30 cm/s
Step response time: Sheet paper 0.25 s, Z-fold paper 0.9 s (over 250 mm)
Variable zero: Calibrated in steps of 0.1% in range -100 ... +500% and auto
Input impedance: 1 MΩ
Input type: Floating and guarded
DC CMMR: >150 dB
AC CMMR: (<100 kHz) >130 dB
Mains suppression (50/60 Hz): >56 dB
Maximum input voltage: 42 VDC (safety regulation)
Penlift: Front panel or remote control
Timebase/chart speeds: 14 fixed ranges of 10, 20, 30, 60, 120, 300, 600, 1200 mm/h, and 30, 60, 120, 300, 600, 1200 mm/min. plus 10 user-definable ranges

General Specifications

Power AC: 115 or 230V ±15%, 50 to 60 Hz (without selection) and 24VDC
Dimensions: 132 x 444 x 356 mm (L x W x H)
Weight: 5 kg
Safety: IEC 348 Class 1
Environment: IEC 359 Class 1 (C1 M1 S2)
Operating conditions: +5 to 40°C, 20 to 80% RH
Storage conditions: -40 to +70°C, 5 to 95% RH
EMI: VDE 0871 B, VFG 1046

Supplied with instrument: Pens, paper, fuse, operating manual, sheet paper guide, dust cover, mains cable, remote control DIN connectors.

Ordering Information

Models

PM 8277 single-pen XY recorder
PM 8278 dual-pen XY recorder
Optional accessories marked with '' are factory-fitted. When ordering, please state clearly which options are required.*

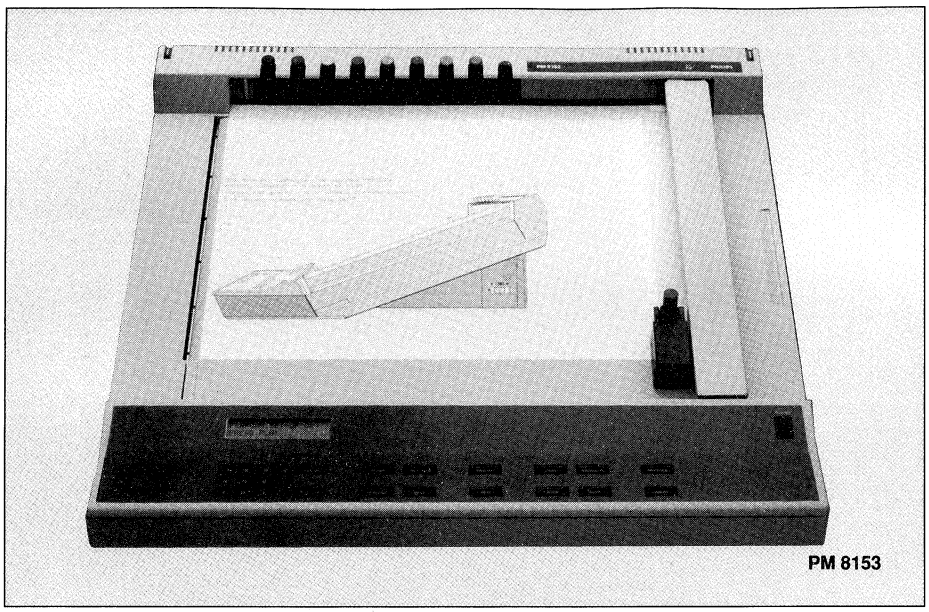
Accessories

PM 9870/10* Left-hand event marker
PM 9870/30 Sliding rackmount kit
PM 9191/02* GPIB/IEEE-488 interface
PM 9190/01* RS232 interface
PM 9877/01 Pt100 unit
PM 9877K/02 K-type thermocouple unit
PM 9877J/02 J-type thermocouple unit

Consumables

PM 9856/05 10 blue pens for PM 8278 lower channel
PM 9857/05 10 red pens for PM 8277 or PM 8278
PM 9857B/05 10 blue pens for PM 8277 or PM 8278 lower channel
PM 9920/00 0 - 10 linear scale Z-fold paper with 10 mm grid (20 m long)
PM 9920/05 0 - 10 linear scale Z-fold paper with 20 mm grid (20 m long)

PM 8153


PM 8153

PM 8153 Full DIN A3 Plotter

- Full A3 (420 x 297 mm) plotting area
- Built-in paper transport and guillotine for unlimited plot lengths
- Wear-free optical pen positioning
- HP-GL compatible
- GPIB/IEEE-488 and RS-232 interfaces (interchangeable)
- 8 kB input buffer

The PM 8153 has a full A3 plot size, 420 mm x 297 mm. Optical pen positioning is free from the normal mechanical error. Combined with a resolution of 0.025 mm and a maximum reproducibility of 0.1 mm, this ensures the highest quality and precision in plots, and an accuracy that never deviates from the "as-new" original. The plot length is unlimited with a built-in paper roll and guillotine. The PM 8153 supports HP-GL.

High Accuracy, Repeatability

This plotter has extremely fine resolution (addressable to 0.025 mm) even up to a plotting speed of 100 cm/s. When combined with a reproducibility of 0.1 mm (0.2 with a pen change), this allows extraordinary precision - characters are perfectly formed, curves are continuous and smooth. Also supplied is a digitizing reticle for optimal positioning.

Versatile Plot Area and Formats

A full A3 plot allows direct drawing with no downscaling. If a very long plot is needed, the built-in transport mechanism and guillotine allow plots of any length, a useful asset in CAD/CAM and drawing office environments.

If smaller drawing is required, this is easy with the automatic A3-A4 auto-scaling facility. Other scaling factors are easily programmed for both axes, even automatic changing from landscape to portrait. For really top quality drawings, 18 combinations of size/font are available with 7 line types/thicknesses.

Front Panel Operation

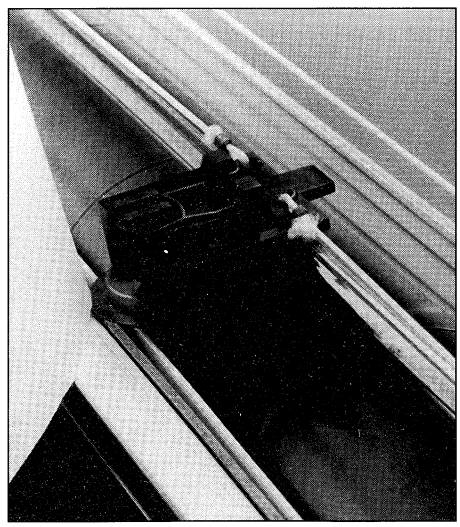
Operation of the PM 8153 is menu-based, with a 2-line LCD read-out for swift checking of parameters or display of software messages. Programming is quickly done via the front panel, with all the displays in English.

Built-In Intelligence/ Communications

The PM 8153 is provided with built-in intelligence, so all the programming of functions and pen parameters is done with simple yet powerful instructions. They cover all commonly required functions such as scaling, coordinate rotation, hatching and fill patterns. GPIB or V24/RS 232C interfaces are provided, allowing the PM 8153 to plot directly from a range of instruments and computers.

GPIB/IEEE-488 & RS-232 Interfaces

PM 8153 offers either GPIB/IEEE-488* or V24/RS-232 interfaces ensuring that this instrument is compatible with most computers or terminals.



** The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 8153

Specifications

Media Sizes
ISO A4: 210 mm x 297 mm
ANSI-A: 200 mm x 269 mm (8.5 in x 11 in)
ISO A3: 297 mm x 420 mm
ANSI-B: 269 mm x 410 mm (11 in x 17 in)
Maximum Plotting Area: 297 mm x 420 mm (11 in x 17 in)
Paper Hold: Electrostatic
Pens: 8 + 1 for digitizing reticle
Pen Type: Fibertip, rollerball, transparent permanent, liquid ink drafting (ceramic with 3 line thicknesses)
Media: Paper, transparent foil
Resolution: 0.025 mm (minimum addressable step size)
Reproducibilty: 0.1 mm (with given pen), 0.2 mm (after pen change)
Pen Velocity (maximum axial): 100 cm/s, programmable from 5...70 cm/s, in 1 cm/s steps
Pen Acceleration: Max. 1.5g programmable from 0.4 to 1.5g in 0.1g steps
Pen Force: 10...40p, programmable in 7 steps of 5p

Interfaces
GPIB: Implements functions SH1, AH1 T6, L3, SR1, RL0, PP1, PP2, DC1, DT0, CO, E11. Device address selectable at front of panel.
RS-232C/V24: Terminal wiring and 20 mA current loop (eavesdrop). Full duplex, baud rates 110-9600, settings via front panel.
Input Buffer: 8 kB
Character Fonts (acc. to HP-GL): ASCII, French, German, Swedish, Norwegian, English, Italian, Spanish, Katakana. Additional user-defined characters
Compatibility: HP 7475
Character Fonts (acc. to Philips GL): ASCII, French, German, Spanish, Swedish
Printing Styles: Matrix, Simplex, Multiplex
Compatibility: PM 8151, PM 8154
Display: 20 character/line LCD
Automatic Paper Transport: Handles paper height 297 mm, roll length 20m
Paper Feed and Cutting: Any length in 1 cm increments
Power Supply: 115 or 230V +20%, 40...400 Hz
Power Consumption: 70 VA
Environmental Range: 5 to 40°C (operating), -25 to +65°C (storage)
Dimensions: 227 x 620 x 530 mm (H x W x D)
Weight: 18.3 kg net
Included: User manual, protective cover, fibertip pens (red, blue, green, black) (2),liquid ink drafting pen 0.35 mm, pen caps (spare), drafting ink (20 ml), digitizing reticle, fuses, test connector (cutter), pad of A3 paper (50 sheets), roll of paper, power cord.

Ordering Information

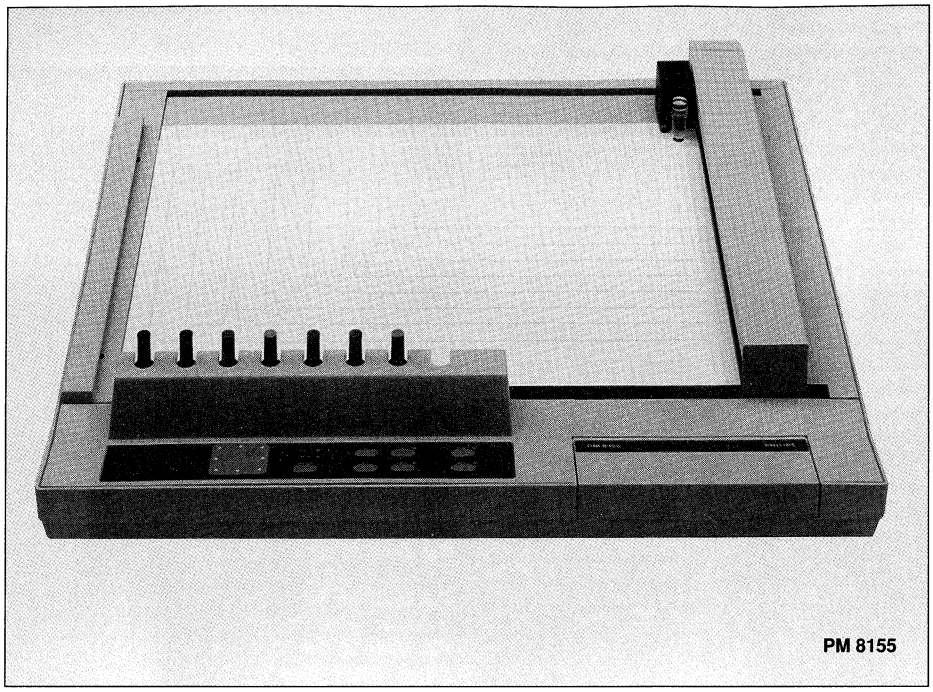
Models

PM 8153 B/1* A3 plotter with IEEE interface, standard software
PM 8153 S/1* A3 plotter with V24/RS232 interface, standard software
PM 8153 B/6* A3 plotter with IEEE interface, HP-GL software
PM 8153 S/6* A3 plotter with V24/RS-232 interface, HP-GL software
**Last figure changes per country*

Consumables

PM 9853/02 Set of 2 x 4 fibretip pens: red, blue, black, green
PM 9853/05 Set of 2 x 4 fibretip pens: purple, yellow, violet, brown
PM 9853/50 Set of 2 x 4 rollerball pens: red, blue, black, green
PM 9853/55 Set of 2 x 4 rollerball pens: purple, yellow, violet, brown
PM 9853/90 Set of 2 x 4 overhead pens: red, blue, black, green
PM 9853/95 Set of 2 x 4 overhead pens: purple, yellow, violet, brown
PM 9853/21 Set of 6 Staedtler/Rotring pen adapters
PM 9953/02 Set of 5 rolls A3 paper, length 20m
PM 9953/03** Pack of A3 paper (250 sheets)
PM 9953/04** Pack of A4 paper (500 sheets)
PM 9953/53** Pack of 250 sheets ANSI B paper
PM 9953/54** Pack of 500 sheets ANSI A paper
PM 9888/95 Cable 2m. 9 pin female to 25 pin male (plotter)
***Use of the stated paper and pens is recommended for optimum drawing quality.*

PM 8155



PM 8155 Digital Pen Plotter

- 50 cm/s pen speed, 0.05 mm resolution
- Accepts multiple media up to 11 x 17 inch (287 x 410 mm)
- Auto-Sheet feeder
- Full 32k Byte Buffer
- HP-GL™ and Philips-GL compatible, either RS-232C or GPIB/IEEE-488
- 8 Pens/Colors, Automatically Selected

The PM 8155 multicolor plotter meets your hard copy graphics needs with an outstanding combination of performance, versatility and ease-of-use. Compatible with a wide variety of Fluke and Philips instruments, it provides a strong complement to your test systems-as well as supporting your computer-generated graphics needs.

Fast, Precise Performance

This multi-purpose plotter produces easy-to-read graphics in up to 8 colors (all automatically selected) on a variety of media including both paper and transparency, in 11 x 17 inch (ISO A3) and 8-1/2 x 11 inch (ISO A4) sizes.

Resolution of 0.05mm, with reproduceability of 0.1 mm (0.3 mm with pen change) ensures precise, clean graphics. The maximum plot speed of 50 cm/s, regardless of pen direction, provides timely results. Plot speed is also fully programmable in 1 cm/s increments to further ensure superior trace quality.

Expanded Buffer for Improved Efficiency

With a full 32k Byke input buffer, the PM 8155 ensures user-efficiency by being able to accept a large volume of input data. This frees the source instrument (oscilloscope, etc.) or computer from which it is plotting to move on to the next task while the plotter is at work.

Convenient Auto-Sheet Feeder

Efficiency of use is further enhanced by the optional sheet feeder. Accommodating 8-1/2 x 11 inch (alternately ISO A4) sized sheets, the feeder includes a paper cassette and an output stacking tray. Both can easily be added to the plotter with no need for adjustment or modification, making the PM 8155 ideal for unattended production of large series of multiple plots.

Versatile Graphics Language and Interface Options

Built-in intelligence/firmware provides compatibility with both HP Graphics Language (HP-GL™) and Philips-Graphics Language, with simple rear panel selection. Further, both GPIB/IEEE-488* and RS-232C models are available, assuring compatibility with a wide variety of application needs.

The versatile PM 8155 can also be used as a straight-forward printer, printing out all data as received, including control characters and delimiters. This allows incoming data to be analyzed, providing information about the computer or instrument/plotter combination.

Added Fluke & Philips Compatibility

The PM 8155 is ideal as an output device for a variety of other Fluke and Philips instruments. Interface it directly to the PM 3350 or PM 3320A digital storage oscilloscopes, for example, with the need for a controller, to provide high resolution, hard copy documentation of both the signal and the scale factors displayed on the CRT. Add the Auto-Sheet feeder, and the DSO's Auto-Plot feature lets you document long series of single-shot events-unattended.

Specifications

Media Sizes: ANSI-A: 8 1/2 x 11 in; ISO A4 (210 x 297 mm). ANSI-B: 11 x 17 in; ISO A3 (297 x 410 mm)
Maximum Plotting Area: 11.3 x 16 1 in (297 x 410 mm)
Paper Hold: Electrostatic
Pens: 8 (or 7 + digitizing reticle); [7 (or 6 + digitizing reticle) when paper feed used]
Pen Type: Fibertip, transparent, permanent, liquid ink drafting
Media: Paper, transparency
Resolution (min. addressable step size): 0.05 mm; 0.025 mm internally
Reproduceability: 0.1 mm; 0.3 mm (after pen change)
Pen Velocity (max axial): 50 cm/s, programmable from 1-50 c/ms, in 1 cm/s steps
Pen Acceleration: Max 0.3g with pen down
Interfaces: IEEE-488; implemented functions SH1, AH1, T6, L3, SR1, RL0, PP1, DC 1, DT0, C0, E1. RS-232C; Terminal wiring, full duplex, protective ground, baud rates 300-9600
Input Buffer: 32k Byte
HP-GL Character Fonts: US ASCII, French, German, Swedish, Norwegian, English, Italian, Spanish, Portuguese, Katakana. Additional user-defined characters
HP-GL Compatibility: PM 8153, HP 7475
Philips GL Character Fonts: US ASCII, French, German,Spanish, Swedish
Philips GL Printing Styles: Matrix, Simplex, Multiplex

* *The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Philips GL Compatitibilty: PM 8151, PM 8153, PM 8154, 297 mm sizes, capacity 100 sheets, comprising paper cassette and stacking tray
Automatic Paper Transport: Optional sheet feeders for 8-1/2 x 11 in or 210 x 297 mm sizes, capacity 100 sheets, comprising paper cassette and stacking tray
Power Supply: 115 or 230V ±15%, 50-60Hz
Temperature Range: 5 to 40°C (operating); -27 to 70°C (storage)
Size: 170 H x 555 W x 483 D mm
Weight: 11.2 kg net, (30.02 lbs); 13.5 kg (39.19 lbs) with paper feed unit
Included: User Manual, Protective Cover, Fibertip Pens (red, blue green, black) 2 each, Digitizing Reticle, Pad of 11 x 17 in (287 x 410) mm) paper (50 sheets), Fuses, Power Cord, Soft Plastic Dust Cover
Power Comsumption: 45 VA

Ordering Information

Models

PM 8155B/13 Plotter w/IEEE-488 Interface
PM 8155S/13 Plotter w/RS-232C Interface

Options

PM 9855/01 Sheet Feeder, 210 x 297mm (ISO-A4) Paper Format
PM 9855/51 Sheet Feeder, 8-1/2 x 11 in (ANSI-A) Paper Format

Accessories

PM9955/01 Set of 2 x 4 fibertip pens; red blue, black, green
PM 9955/05 Set of 2 x 4 fibertip pens; purple, yellow, violet, brown
PM 9876S/901 Set of 10 overhead pens, 5 colors
PM 9953/53 Pack of 11 x 17 in (ANSI-B) Paper, (250 sheets)
PM 9953/54 Pack of 8-1/2 x 11 in (ANSI-A) Paper, (500 sheets)
PM 9953/03 Pack of 287 x 410mm (ISO-A3) Paper (250 sheets)
PM 9953/04 Pack of 210 x 297mm (ISO-A4) Paper (500 sheets)
PM 9888/95 Cable 2 m. 9-pin female to 25 pin male (plotter)

Use of stated paper is recommended for optimum drawing quality.

PM 8042/8043/8143, PM 8032/8033/8133/8134

Flat-bed X-Y Recorders

- Full range of DIN A3 and DIN A4 recorders
- High speed and acceleration for all models
- 5-speed timebase unit incorporated as standard (except PM 8042 and PM 8032)
- Multi-purpose, standard versions
- High-rigidity lightweight chassis for long-term dimensional accuracy
- Ergonomically designed control layouts for easy operation

Each one of this family of X-Y recorders exhibits high speed and acceleration combined with high accuracy resulting in an excellent overall response. The recording of fast phenomena, for example, is easily and faithfully accomplished. Moreover, performance is not affected by adverse ambient conditions.

The family of 6 units offers a choice of input ranges and sensitivities in both DIN A3 and DIN A4 versions, plus an OEM model for use in "dedicated" recording situations.There is also a two-pen unit in the DIN A3 range.

Input Circuitry

There is a choice between normal and high-sensitivity input unit modules. The latter offers the added advantage of up to -400% zero suppression, for magnifying dynamic signals superimposed on a static signal for example, or setting the zero point at any desired position.

A front-panel controlled filter suppresses any unwanted signals, such as noise or high frequency components, producing a clean, interference-free recording. An added feature is the provision of limiters to protect the input circuitry in the event of too high input voltages or unduly long offscale values.

Timebase

A 5-speed calibrated integral Y-t timebase is provided in all models, except the OEM version. This can be controlled from the front panel or remotely, as required. This variable Y-t facility, or the optional chart transport unit (A3 or A4), allows the user to make long, unattended recordings.

Fast Response and High Accuracy

The overall performance of this series has been enhanced through increased pen speed and acceleration. The pen speeds exceed 80 cm/s (X) and 120 cm/s (Y) with accelerations up to 2g (X) and 5g (Y).

Easy Drawing of Coordinates

Results readout and interpretation is very easy, simplified by the instant line-drawing function which allows horizontal and vertical lines to be drawn accurately (over the full horizontal/vertical direction), from any pen position. This is particularly useful for projecting coordinate values to the axes, or marking minimum/maximum value 'envelopes', etc. This facility is controlled from the front panel.

Robust Construction

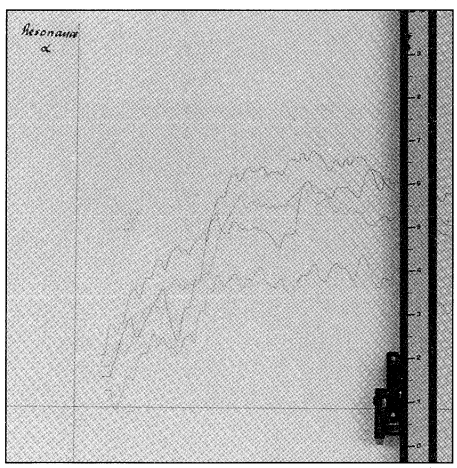
The use of an integral molded chassis for all models gives the combined benefits or exceptional strength and light weight. Most important, it makes every model highly resistant to accidental shock or damage in use, giving very long-term dimensional accuracy.

Chart Transport Units

Chart transport units are optionally available for all models. They can be used for either 'single-frame' or continuous operational modes. As previously mentioned, they will allow long-term unattended recording, if required.

Many Other Features

Other features, common to all units, include an ergonomically-designed front panel layout, with X, Y, and general controls located in clearly subdivided zones; easily accessible front panel-mounted X and Y input sockets for fast, convenient connection; servo-kill; no-mess disposable felt pens in a wide range of colors and so on.

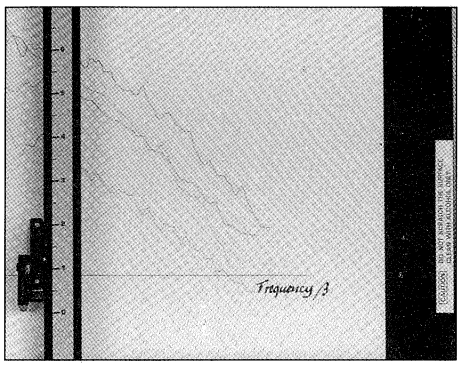


All models (except PM 8042) have a built-in variable timebase facility that allows many Y-t recording functions to be carried out. 5 timebases are provided: 0.5, 1, 2, 5 and 10 cm/s on the X axis.

A4 models PM 8043 and PM 8143

PM 8043 - the cost-effective "Standard"

PM 8043 is an economical standard-specification model that offers 9 standard ranges from 2 mV to 1 V/cm, plus all the other benefits of Philips X-Y recorders such as built-in Y-t capability, and a switchable low-pass filter to eliminate spurious high-frequency signals. Remote control of recording start, pen lift and timebase reset is possible, and the DC servo system for pen control permits accurate, high-speed pen movements, particularly where rapid signal changes are involved.



The models with additional input ranges (PM 8133 and PM 8134) feature built-in zero-point suppression, variable between 0 and -400% in 5 ranges.

PM 8143 - for Multipurpose A4 Recording

Wide ranging input signals from only 50 µV/cm right up to 20 V/cm are handled by PM 8143, divided into 18 individual measuring ranges. PM 8143 also offers the important benefit of a variable zero offset from -100% to -400% allowing precise examination of the particular signal range of interest. Other features are as for PM 8043, making this model a highly versatile general-purpose instrument.

A3 Models PM 8033, PM 8133 and PM 8134

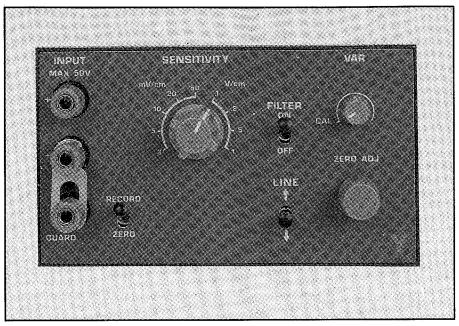
PM 8033 - Economy plus A3 Resolution

Where the inherent extra resolution of the A3 chart format is required, PM 8033 combines this with all the other Philips X-Y recorder benefits, as in the corresponding A4 model PM 8043. Inputs are from 2 mV to 1 V/cm, divided into 9 separate ranges; and high pen speeds and accelerations combined with precision construction, ensure a sustained high degree of accuracy. As in all these models, the convenient front-panel signal inputs are duplicated at the back for more permanent installations.

PM 8133 - A3 Recording plus Wide Input Choice

Where a wider range of signal inputs has to be covered, such as in general-purpose laboratory work, and A3 recording is needed, PM 8133

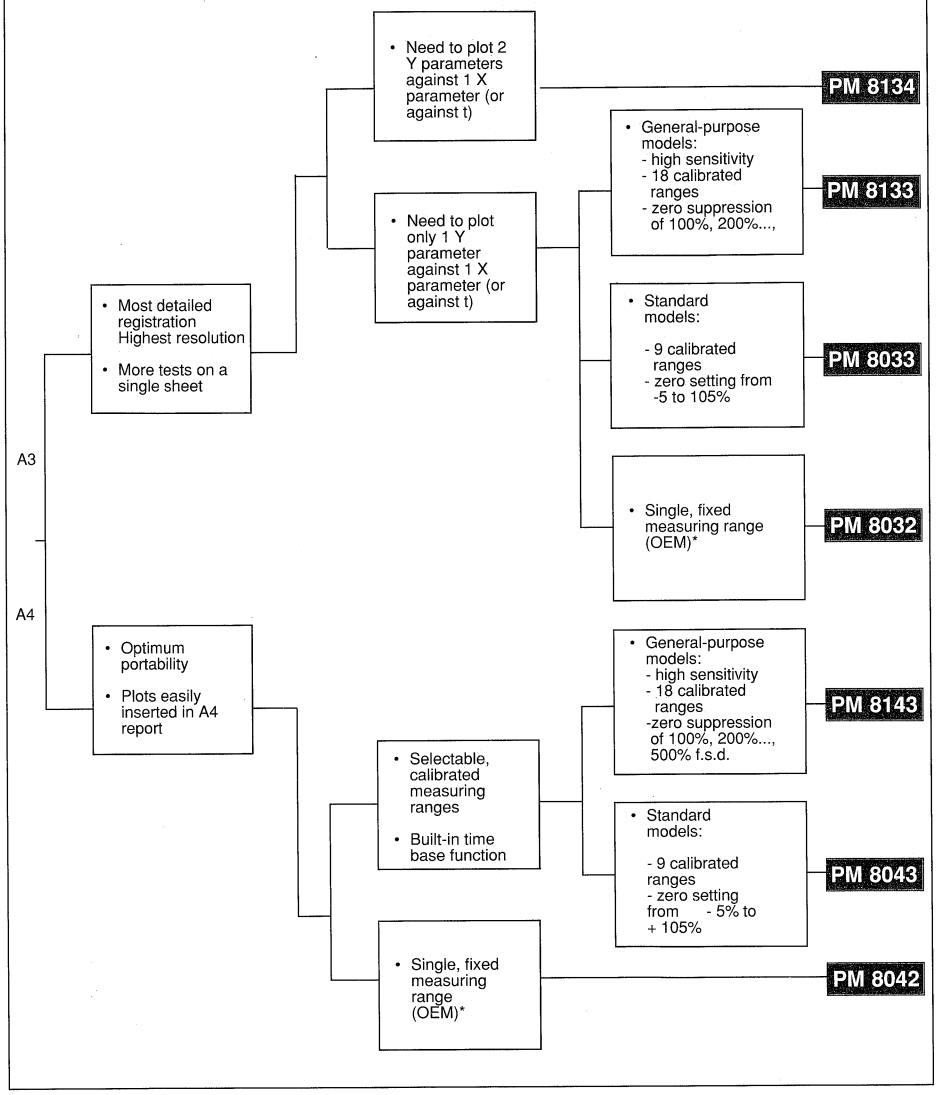
is the ideal answer. 18 voltage ranges from 50 µV/cm right up to a full 20 V/cm cover virtually every laboratory X-Y recording need, and the standard built-in timebase gives additional, versatile Y-t recording facilities. An optional chart transport unit is available for extended recording requirements.



A wide choice of sensitivities is provided to meet the needs of varying types of measurements: 9 ranges from 2 mV/cm to 1 V/cm on the standard models PM 8033 and PM 8043; and 18 ranges from 50 µV/cm to 20 V/cm on the extended-range models PM 8133 and PM 8134.

PM 8134 - for 2-pen Recording Versatility
Even greater versatility is offered by PM 8134, which combines all the features of the A3 recorder PM 8133 with the important additional advantage of 2-pen recording, allowing simultaneous recording of three related events, or plotting of two independent parameters against time using the built-in Y-t capability. Also, different pen colors can be used to enhance discrimination and interpretation of results, and pens can be quickly interchanged at any time without the need for messy and time-consuming refilling.

Performance Selection Chart



Ordering Information

XY Recoders	A4	A3
Fixed range XY-recorder OEM-version	PM 8042/01*	PM 8032/01*
Standard XY-recorder	PM 8043/01	PM 8033/01
General Purpose XY-recorder	PM 8143/01	PM 8133/01
Two-line, general purpose XY		PM 8134/01
Options		
Transparent dust cover	PM 9878/04	PM 9878/03
Chart transport unit	PM 9882/01	PM 9883/01
19 in rack-mount brackets	PM 9887/04	PM 9887/03

Accessories		A4	A3
5 rolls of chart paper	(page grid)	PM 9940/02	—
	(continuous grid)	PM 9440/03	PM 9951/03
10 pens	black	PM 9875 A/01	PM 9875 A/01
(same color)	blue	PM 9875 B/01	PM 9875 B/01
	brown	PM 9875 U/01	PM 9875 U/01
	green	PM 9875 G/01	PM 9875 G/01
	violet	PM 9875 V/01	PM 9875 V/01
	red	PM 9875 R/01	PM 9875 R/01
500 sheets A4 paper		PM 9953/04	PM 9953/04
250 sheets A3 paper		—	PM 9953/03

**minimum ordering quantity*

PM 8042/8043/8143, PM 8032/8033/8133/8134

Specifications

Technical Specifications For X-Y Recorders

	PM 8042 OEM	PM 8043	PM 8033	PM 8143	PM 8133	PM 8134
Recording Area	DIN A4 (250 x 180 mm)		DIN A3 (380 x 250 mm)	DIN A4 (250 x 180 mm)	DIN A3 (380 x 250 mm)	
Number of pens	1 felt pen					2 felt pens
	Fixed span	Multi-range in 1-2-5 sequence				
Input sensitivity for both X and Y channels	1 V f.s.d. variable 0.5 ... 1.2 V f.s.d. NB. other values on request	9 calibrated ranges 2 mV to 1 V/cm with increasing variable control (x 2.5)		18 calibrated ranges 50 µV...20 V/cm with decreasing variable control (x 2.5)		
Accuracy/Dead band	Max. error ±0.25% of f.s.d. (ref. temp. 23°C ±1°C, excl. dead band, incl. non-linearity)/max. 0.2% of f.s.d.					
Linearity	Max. error ±0.1% of f.s.d. (linearity of potentiometer)					
Writing/Vector speed	Writing speed: X: ≥80 cm/s Y: ≥ 120 cm/s			Vector speed: ≥145 cm/s		X: ≥75 cm/s Y: ≥120 cm/s
Acceleration	X: 2000 cm/s² Y: 5000 cm/s²		X: 1800 cm/s² Y: 5000 cm/s²	X: 2000 cm/s² Y: 5000 cm/s²	X: 1800 cm/s² Y: 5000 cm/s²	X: 1400 cm/s² Y_1: 5000 cm/s² Y_2: 4000 cm/s²
Zero adjustment	-5% ... +105%					
Zero suppression				0 to -400% in 5 ranges, inaccuracy ±0.1%/100%		
Impedances	Input impedance: 1 mΩ ±10%, source impedance: 10 kΩ or less					
Damping	Overshoot max. 1%					
Inputs	Floating and guarded. Inputs parallel at rear connector (PM 8042 rear only)					
Stray voltage rejection DC CMRR		≥140 dB typical		120 dB typical		
AC CMRR		≥70 dB typical		80 dB typical		
AC SMRR		≥40 dB typical		50 dB typical		
Max. overload voltage	100 Vpp ac, 50 Vdc	400 Vpp ac, 200 Vdc		100Vppac/ 50 Vdc for mV/cm ranges 500 Vppac/500 Vdc for mV/cm ranges		
Leakage resistance	500 MΩ between input terminals and earth at 500 Vdc					
Safety (IEC 348 class 1; VDE 411)	Max. voltage: Guard/earth 24 Vdc ; HI/LO and earth 42 Vdc; Test voltage 500 Vdc/700 Vdc					
Chart hold	Electrostatic with pin-point light guides					
Pen lift	Front panel, or remotely controllable via the rear connector					
Time base	n.a.	5 ranges 0.5-1-2-5 and 10s/cm on X-axis, accuracy ±3% of f.s.d. and linearity of ± 0.5% of f.s.d.				
Chart transport units	PM 9882: 12 ranges 60...1.5 cm/h and per min., continuous or one-frame mode		PM 9883	PM 9882	PM 9883: as PM 9882, but A3	
Power	110, 115, 220, and 240 Vac ±10%, switchable by selector, 50/60 Hz. Power consumption 100 VA (A4) or 120 VA (A3) max.					
Temperature range	Rated: +5...+40°C, operation -5...+50°C, storage/transport: -40...+70°C					
Dimensions: (h x w x d)	170 x 360 x 410 mm (6.7 x 14 x 16.1 in)		170 x 480 x 485 mm (6.7 x 14 x 16.1 in)	170 x 360 x 410 mm (6.7 x 19 x 19.1 in)	170 x 480 x 485 mm (6.7 x 19 x 19.1 in)	
Weight	9 kg = (19.8 lb)		11 kg = (24.2 lb)	9 kg = (19.8 lb)	11 kg = (24.2 lb)	12 kg = (26.4 lb)
Accessories	19 in rackmount: PM 9887/04 (DIN A4) PM 9887/03 (DIN A3) Dust cover: PM 9878/04 (DIN A4) PM 9878/03 (DIN A3)					

Table of Consumables

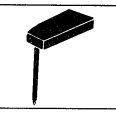
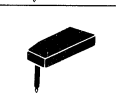
Chart paper for Philips recorders & plotters

			X-Y/Line recorders	Line recorders						Multipoint (data) recorders		Printing recorder	X-Y recorders		Plotters			
													A4	A3				
	Type number PM	/..	8071/72 8271/72 8277/78	8110	8251A 8252A	8202 8222	8224 8226	8104 8114 8106 8116	8261 8262	82XX 36	37/38	8210	8040 8141 8041 8042	8033 8043 8143	8151 8134	8153 8133	8154	8155
120 mm Z-fold paper	9910	01		•														
250 mm Z-fold paper 20m	9920																	
0 - 10 linear, 10 mm grid		00	•		•	•	•		•	•								
0 - 10 linear, 20 mm grid		05	•		•	•	•		•	•								
Z-fold paper 15m	9954	01						•										
250 mm Z-fold thermosensitive	9930A																	
Blank		02									•	•						
Grid 0 - 100		03									•	•						
Grid 0 - 10		05									•	•						
Roll paper A4 blank	9940	00															•	
Roll paper A4 page grid		02											•					
Roll paper A4 continuous grid		03											•					
Roll paper A3 blank	9950	02													•			
Roll paper A3 continuous grid	9951	03												•				
Paper, chart roll, 10 pcs																		
0 - 100	9901	00 for		8000 8100 8010														
Set of 5 rolls A3 paper, blank																		
length 20m	9953	02														•		
A3 paper 250 sheets	9953	03*	•						•					•	•	•		•
A4 paper 500 sheets	9953	04*	•						•				•	•	•	•	•	•
ANSI B paper 250 sheets	9953	53	•						•							•		•
ANSI A paper 500 sheets	9953	54	•						•							•		•

**Use of the stated paper is recommended with the sheet feeder PM 9855 to ensure correct operation.*
Use of the stated paper and pens is recommended for optimum drawing quality.
Note: This table includes references to older instruments that are no longer available.

Table of Consumables

Pen Cartridges for Philips X-Y and Line Recorders

	Description				Line Recorders						X-Y Recorders				
	Type number PM	/	/.	Color	8110	8104 8114 8106 8116 8224 8226	8202/8222 8251A/52A 8261/8262 ch 1	ch 2	9870/10 9868 event marker	8040 8041 8131	8033, 8042 8043, 8133 8134, 8143	8277/8278 8271/8272 8071/8072 ch 1	ch 2	8132 channel upper	lower
	9856	-	05	(Set of 10 pen cartridges) blue	•			•					•		
	9857	-	05	(Set of 10 pen cartridges) red			•					•			
		B	05	blue			•					•			
	9857	-	15	red					•						
	9856	A	10	black						•				•[2]	
		-	10	blue						•				•[2]	
		R	10	red						•				•[2]	
		S	10	set of colors						•				•[2]	
	9857	-	10	red											•[2]
	9875	A	01	black (10 pcs)		•					•			•	•
		B	01	blue (10 pcs)		•					•			•	•
		U	01	brown (10 pcs)		•					•			•	•
		G	01	green (10 pcs)		•					•			•	•
		V	01	violet (10 pcs)		•					•			•	•
		R	01	red (10 pcs)		•					•			•	•

[2]*Former writing system*

Also available: set of 4 ink wheels PM 9839/02 for PM 8236

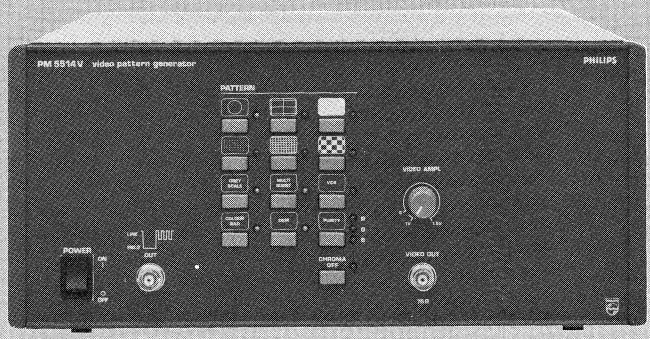
Pen Cartridges for Philips Plotters

	Description				Plotters				
	Type number	./	/.	Color	Quantity	PM 8151	PM 8153	PM 8154	PM 8155
	9876	S	90	5 colors	10	•[3]			•[3]
	9853		02	4 colors	8		•[4]		
	9853		05	4 colors	8		•[4]		
	9853		50	4 colors	8		•[5]		
	9853		55	4 colors	8		•[5]		
	9853		90	4 colors	8		•[3]		
	9853		95	4 colors	8		•[3]		
	9853		21	Rotring/Staedtler	6		•		
	9869		21	adapters	6			•[3]	•[4]
	9869		01	6 colors	12			•[4]	
	9869		90	6 colors	12			•[3]	
	9955		01	4 colors	8	•[4]			•[4]
	9955		05	4 colors	8	•[4]			•[4]

[3]*Fibertip, permanent* [4]*Fibertip, non-permanent* [5]*Rollerball*

Note: These tables include references to older instruments that are no longer available.

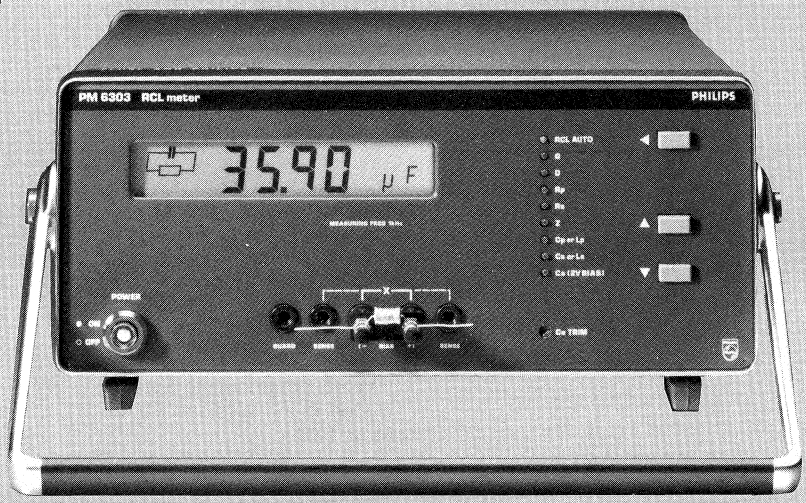
Video & Audio Test Equipment



PM 5514V Page 494



PM 5518 TX Page 503



PM 6303 Page 504

Philips, as one of today's largest manufacturers of video, TV and audio equipment has had considerable, everyday experience of the special problems related to testing and servicing. Information on the practical aspects of employing test equipment has been fed back continuously from Philips' many-in-house users to the design teams along with recommendations for improved product specifications.

It follows that the test and measuring equipment described in this section embodies the best practical features that will satisfy the most stringent demands of all maintenance and educational requirements.

For field service – compactness and low weight; for industrial electronic applications – consistency of performance over long periods; for education – simplicity of operation and physical robustness.

Whatever the application, whatever the environment, Philips video and audio test equipment will give long-term and absolutely reliable performance.

Introduction	Page 492
Color Pattern Generators	Page 494
Automatic RCL Meter	Page 504
Wow & Flutter Meter	Page 506
Distortion Meter	Page 508
Amplifier & Linear/Log converter	Page 510
RF Signal Generator	Page 511

Introduction

Video and Audio Test Equipment Introduction

Choosing the Right Instrument

In such a technologically complex area, choosing the right instruments is quite involved. The table below provides some help, showing all the products in this chapter and to which markets/applications they are best suited.

Of course, for many applications in this field, it is a combination of instruments that best satisfies application requirements and the table shows possible alternatives. In addition, other related products are often necessary. These can include multimeters, all types of generators including LF, HF and function generators, power supplies and oscilloscopes. Virtually any of these necessary related products can be found elsewhere in this catalog, and the available range is wide enough that there will almost always be an instrument with specifications very closely matched to your needs. For example, smart 'scopes, which have autoset and TV triggering and the PM 5109/PM 5133 generators with functions specific to Hi-Fi testing.

Video Equipment

Philips has a a long and successful track record in the design of basic and sophisticated monochrome and color TV pattern generators. Applications for this range of products has been directed towards the professional, servicing and educational fields.

Family of Color Pattern Generators PM 5515, 5516, 5518 Series

This series of color TV pattern generators offers multi-standard capability, covering all current TV standards worldwide. The range comprises several basic models, each having two or more versions. The basic series consists of:

PM 5515 for PAL/NTSC
PM 5516 for SECAM
PM 5518 for SECAM/PAL/NTSC

	Pattern Generators					Amplifiers	Meters			Other Generators
	Color P.G.	Color P.G.	Video P.G.	PAL/NTSC P.G.	SECAM/PAL/ NTSC P.G.	Amplifier/Lin-Log Converter	Automatic RCL Meter	Wow/Flutter Meter	Distortion Meter	RF Generator
	PM 5514	PM 5515 V	PM 5515	PM 5516	PM 5518	PM 5171	PM 6303	PM 6307	PM 6309	PM 5326
Hi-Fi AM/ FM stereo						•	•		•	•
Record player/ Recorders						•	•	•	•	
Color and monochrome TV	•		•	•	•		•			
PAL	•	•	•		•					
NTSC		•	•		•					
SECAM				•	•					
VCR/VLP	•	•	•	•	•			•		•
Video monitors	•	•	•	•	•					

Survey of video and audio test equipment

Note: All products with a PM or PE prefix are designed and manufactured by Philips. All other products are designed and manufactured by John Fluke Mfg. Co., Inc.

The complete range of variations is shown in detail in the product description.

These models feature: storage and recall of up to 10 complete programs, non-volatile memory, synthesized RF selection, a choice of over 70 patterns and output via BNC or Euro-connector (SCART). Special versions cater for teletext/ Antiope and/or stereo and dual-sound. For servicing of color TV monitors and applications involving computer graphics, a factory-fitted RGB option is available. Also newly available is the advanced TXI version, with a built-in IEEE (GPIB) interface for systems use. It also has RGB and universal chroma as standard.

RF Selection

The synthesized RF output is programmed using the keyboard step function. Thanks to the use of a crystal-locked frequency generator, a very high level of stability is achieved.

Precise indication of the RF frequency setting is clearly displayed on a bright LED display. Up to 10 memories can be used to store the RF frequency or TV channel number, for fast recall whenever required.

Wide Choice of Patterns

A choice of more than 70 monochrome and color test patterns or combinations is available for checks or alignment of the luminance and chrominance circuitry in CTV sets, monitors, VCRs and other video equipment. These test patterns range from circle, center cross/border line, grey scale and dots, to multiburst, purity, DEM, VCR, standard color bar, as well as combinations. Operation is simple, via 12 front- panel push-buttons.

Teletext/Antiope

PM 5515T and PM 5515TX versions have been developed to meet the highly specialized requirements for the alignment of teletext receivers and decoders. In addition to these models, the PM 5516T offers Antiope while the PM 5518TX offers both teletext and Antiope.

Sound Checks

Mono, stereo and dual-channel sound checks can be made with the PM 5515X, PM 5515TX and PM 5518TX according to the CCIR TV standard. With the approach of a second sound channel for stereo or dual language tracks, this feature caters for the growing sophistication of TV sound transmissions.

These versions allow external modulation with full stereo from tuner/amplifier, tape or cassette recorder, etc.

VPS

Video programming System — VPS — is included in the versions PM 5515 TXS and PM 5518 TXS.

Introduction

Full Status Indication

All selected parameters are clearly indicated on the instrument front panel by LEDs. The user is thus always aware of the program status at any time.

Advanced Features

The advanced features of this family of color TV pattern generators will cater for all your testing and alignment requirements in today's fast growing video market.

PM 5514 Color Pattern Generator for PAL

The PM 5514 is the most economic in the Philips range of color TV pattern generators. Over 70 patterns and combinations may be selected, simply by keying-in your choice. Sound may be modulated either internally or externally.

Audio Equipment

Distortion Meter

The PM 6309 distortion meter allows automatic, fast and accurate measurements to DIN standards. It contains its own low-distortion generator for providing either total or third harmonic distortion with a resolution of 0.01%. For complete ease of use, both a direct digital readout and an analog trend meter are provided.

Wow and Flutter Meter

The PM 6307 Wow and flutter meter is designed to measure unwanted variations in speed and indicate mechanical shortcomings in record players, cassette and reel-to reel recorders, VCRs, movie projectors, etc. It is therefore a must for checking and aligning audio and video equipment. It features separate drift and flutter indicators, a crystal-controlled oscillator and is extremely easy to operate.

Automatic RCL Meter

The PM 6303 Automatic RCL meter will rapidly determine the value, electric dimension and the equivalent circuit of passive components to a very high order of accuracy.

A 4-digit LCD indication of the component value, the unit of measurement and an equivalent circuit diagram, are all shown simultaneously.

Readout is automatic and connection is by 2- or 4-wire arrangement or an optional test attachment. If required, manual operation is possible, in which case nine different parameters may be selected using only two push-buttons. A separate test attachment can be added to the test adapter, to allow testing miniature passive Surface Mounted Devices (SMDs).

RF Signal Generator PM 5326

The PM 5326 is suitable for both audio and video applications. It covers the frequency range 100 kHz to 125 MHz with internal and external AM/FM modulation. It has sweep capabilities covering 4 essential frequency ranges for checking and aligning TV and FM circuits. Accuracy is guaranteed by markers. A further feature is that its internal frequency counter can be used to check external frequencies.

In addition to the foregoing list of instruments, the many other types covered in this catalog will meet practically any audio or video testing requirement, however sophisticated the product may be. All have been specially designed for ease of operation and employ advanced components to meet the demands of modern technology used in Hi-Fi, radio and TV today.

Amplifier, AC/DC Converter and LinLog Converter inOne Instrument

The PM 5171 is a very versatile instrument for many audio applications, providing three commonly needed functions from one unit. It is an AC- or DC-coupled amplifier operating over DC to 1 MHz with adjustable gain from 0 to 60 dB; it is an AC/DC converter with very low conversion error; and it is a linear/logarithmic converter, with conversion factor 1 V/20 dB and a very high dynamic range of 80 dB.

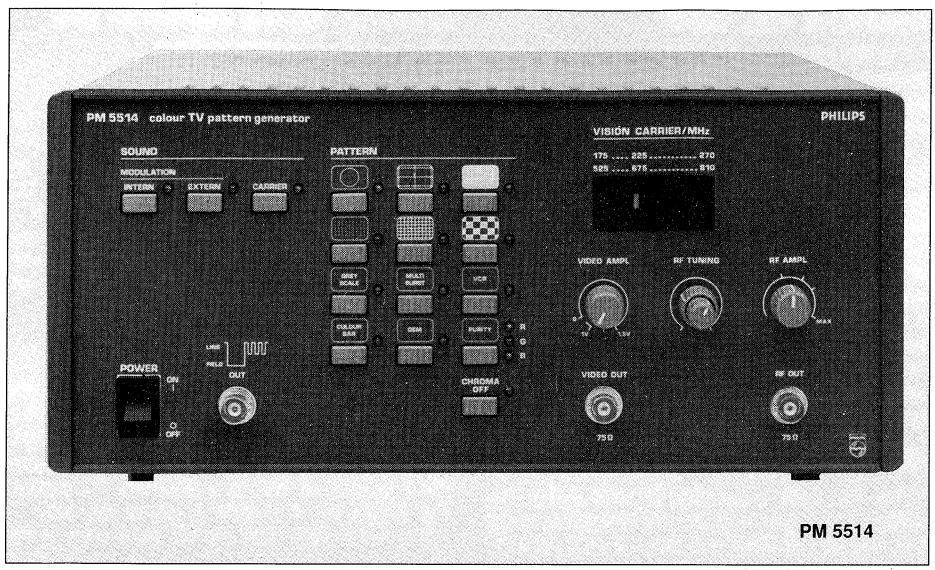
Audio Generators

The PM 5110 is an LF generator specifically designed to give very low distortion (0.02%), particularly valuable in Hi-Fi development, alignment and maintenance. It has sine and square wave outputs as well as a separate TTL output. Full details are in chapter 9, signal sources.

The PM 5109/5109S are RC generators in the LF range up to 100 kHz. They have the choice of fast settling mode for routine work or low distortion (0.02%) for more demanding applications. The 5109 has symmetrical and asymmetrical outputs and a low impedance DIN output for direct testing of loudspeakers; the 5109S has only the asymmetrical output, quite sufficient for Hi-Fi testing and more economic for audio work. Full details will be found in chapter 9, signal sources.

Response curves can be determined with a combination of instruments. For this, the function generator PM 5133S (chapter 9, signal sources) is used, a specially adapted version of the PM 5133 which can test Hi-Fi installation to DIN 45541 standards. When used with the amplifier and linear/log converter PM 5171 (this chapter), and one of Philips X/Y plotters (chapter 15, hard copy devices), the set-up is a very versatile and practical way of recording response curves.

PM 5514 & PM 5514V



PM 5514

PM 5514V Color Pattern Generators

- Economic TV and video testing
- Over 70 color and monochrome pattterns and combinations
- Simple to operate
- VHF/UHF output
- Special video version (PM 5514V)

For TV and video trouble-shooting, PM 5514 and PM 5514V have every function you need — at a very economic cost. PM 5514 is for monochrome and color TV testing, while PM 5514V meets the specific requirements of the fast-growing video equipment market, including computer and closed circuit TV monitors.

Both models offer a choice of over 70 color and monochrome patterns and combinations, together with simple and secure microprocessor-controlled operation. All you need to do is connect the TV or monitor to be tested, key-in the required test pattern, and check that the TV or monitor performance is correct.

The selected settings are clearly indicated by LEDs next to the pushbuttons. Setting-up couldn't be quicker or more convenient, giving you exactly the test pattern you want, in only a few seconds.

PM 5514 for CTV Testing

PM 5514 is the complete and economic answer for color and monochrome TV testing. As well as a full selection of color patterns and combinations, this versatile generator has an RF carrier in the frequency ranges 175 - 270 MHz and 525 - 810 MHz. The selected frequency band is clearly indicated by an LED array.

Sound modulation is also provided, with a choice of internal and external modulation modes and a switchable carrier signal. Units can be supplied to PAL B, G, I, and D TV standards.

PM 5514V for Monitor Testing

The economical PM 5514V is the ideal solution for workshops handling large volumes of computer or CCTV monitors.

A front-panel CVBS output is standard, and an additional rear-panel RGB output is available as a factory-fitted option. The RGB output includes SYNC and sub-carrier signals, to meet the specific requirements of color monitors and other video equipment. Since many monitors accept only RGB signals, this will in many cases be an essential testing facility.

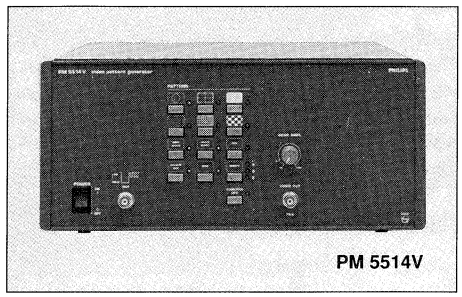
A choice of models is available for PAL B, G, I or D, or for NTSC M standards.

Every Pattern You Need — at the Touch of a Button

Twelve push-buttons make the selection of eighteen different test patterns possible. These patterns can be used for checking and aligning the monochrome and chrominance sections of color TVs, monitors and VCRs.

Patterns and uses include:

- **Circle** — for linearity and geometry.
- **Center cross/Border lines** — centering and pin-cushion correction.
- **White** — 'White D', purity and beam current adjustment.
- **Dot pattern** — static convergence.
- **Cross hatch/Center indication** — dynamic and corner convergence, centering.
- **Checkerboard pattern** — useful for basic alignments.
- **Grey scale** (8 step) — video amplifier linearity.
- **Multiburst** (8 bars of definition lines) — video bandwidth and resolution.
- **VCR** — specially designed for checking bandwidth, linearity, sensitivity and AGC of chroma amplifiers in VCRs.
- **Color bar** — overall color performance checks
- **DEM pattern** — color demodulator and sub-carrier frequency checks.
- **Purity** (3 primary colors and combinations) — purity checks



PM 5514V

Specifications

Technical Specifications

PM 5514 (for TV systems B, G, H, I and D)

Video Carrier

Frequency
Range A: 175...270 MHz
Range B: 525...810 MHz by harmonics
Frequency Selection: Dual-operating potentiometer
Tuning: Fine/coarse
Indication: 16-point (analog) bargraph

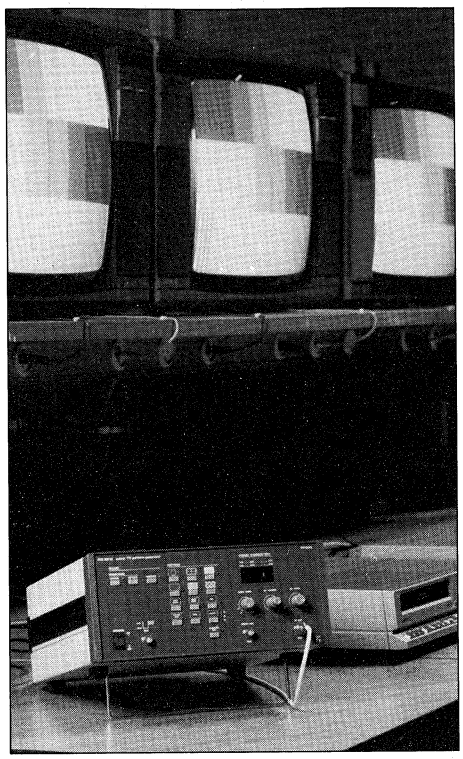
RF Output

Output Connection: BNC connector (front panel)
Impedance: 75Ω
Output Voltage: ≥10 mV (175...170 MHz)
≥2 mV (525...810 MHz)
Attenuation: >60 dB, continuous

Video

Modulation
Modulation Type: AM internal
Polarity: Negative
RF Sync. Level: 100%
Video Output
Output Connection:
a) BNC connector
b) SCART (Euro AV) connector pin 19 (rear)
Impedance: 75Ω
Voltage (P-P):
a) 1V fixed
b) Variable between 0...1.5V into 75Ω
Polarity: Negative
Coupling: DC

PM 5514 & PM 5514V



Chroma

Chroma Standard: PAL B, G, H, D or PAL I (fixed for each instrument; not switchable)
Sub-Carrier Frequency: 4.43 619 MHz, coupled to line frequency
Tolerance: <3 x 10^{-5} (+5...+40°C)
Burst: Position, number of cycles according to standard
Amplitude: Chroma with burst, fixed 100%, on/off switchable
Chroma Vectors Inaccuracy:
Phase: ≤3°
Amplitude: ≤5% relative to luminance amplitude

Sound Carrier and Modulation

Sound Carrier Mono: On/off switchable
Frequency: 5.5 MHz, standard B, G, H; 6.0 MHz, standard I; 6.5 MHz, standard D
Tolerance: <3 x 10^{-5} (+5...+40°C)
Vision/Sound Carrier Ratio: 13 dB, standard B, G, H, D; 12 dB, standard I
Sound Modulation: FM internal/external on/ off switchable
Pre-Emphasis: 50 µs
Internal: Frequency deviation
±30 kHz, standard B, G, H
±27 kHz, standard I
±24 kHz, standard D

External:
0.4V gives the same deviation as with internal modulation
Input: DIN connector pins 3 & 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max. Input Voltage: ±40V
Output:
SCART (Euro AV) connector, pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

Synchronization

Line Frequency: 15 625 Hz
Frequency Tolerance: <0.4 Hz (+5...+40°C)
Number of Lines: 625
Field Frequency: 50 Hz
Line + Frame Sync.: According to standard, interlacing
Sync. Signal: Combined signal; line and frame synchronization pulses with amplitude differences
Output: BNC connector (front panel)
Voltage (open circuit): 2.6V for line pulse, 5V for field pulse
Impedance: 6 kΩ
Polarity: Negative

RGB Option PM 9543 (Optional only for PM 5514V)

RGB Outputs: BNC connectors (rear)
Output Voltage (pp): 0.7V into 75Ω
Impedance: 75Ω
Subcarrier Output: BNC connector (rear)
Output Voltage (pp): 1V into 75Ω
Impedance: 75Ω
Sync. Output: BNC connector (rear)
Output Voltage (pp): 1V into 75Ω
Impedance: 75Ω

PM 5514V

Specifications as for PM 5514, with the exception of Video Carrier, RF Output and Sound Carrier and Modulation sections. Additional specifications of PM 5514V, are as follows:

Chroma

Chroma Standard: PAL, B, G, H, I and D, or NTSC M (fixed for each instrument; not switchable)
Sub-Carrier Frequency: 4.433 619 MHz for standard B, G, H, I
3.579 545 MHz for standard M NTSC
Both coupled to line frequency
Synchronization
Line Frequency: 15 625 Hz for CCIR, 15 734 Hz for RTMA
Number of Lines: 625 for CCIR, 525 for RTMA
Field Frequency: 50 Hz for CCIR, 60 Hz for RTMA
Included: Manual, rf ouput cable PM 9538, i.e. BNC-DIN 45325 (TV-coax connector)

General Specifications

Power Supply

Line Voltage: 110/127V or 220/240V
Tolerance: -12...+10%
Frequency: 50 Hz
Tolerance: 5%
Power Consumption: ≤42W
Dimensions: 300 mm W x 140 mm H x 395 mm L
Weight: 6.5 kg

Ordering Information

Models

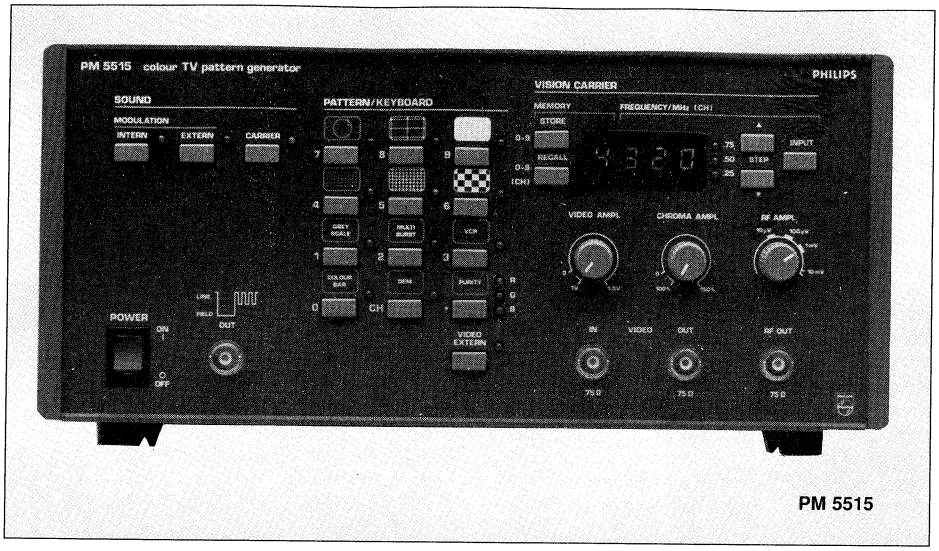
PM 5514 PAL Color Pattern Generator (VHF/UHF Video)
PM 5514V Video Pattern Generator (PAL or NTSC)
PM 5514V/RGB Video Pattern Generator with RGB

Accessories

PM 9075 Cable 75Ω BNC-BNC
PM 9539 RF Cable with 75Ω/300Ω Impedance Transformer
PM 9543 RGB Module (PM 5514V only)
PM 9561 19-inch Rackmount Unit
Service Manual

PM 5515, PM 5516 & PM 5518

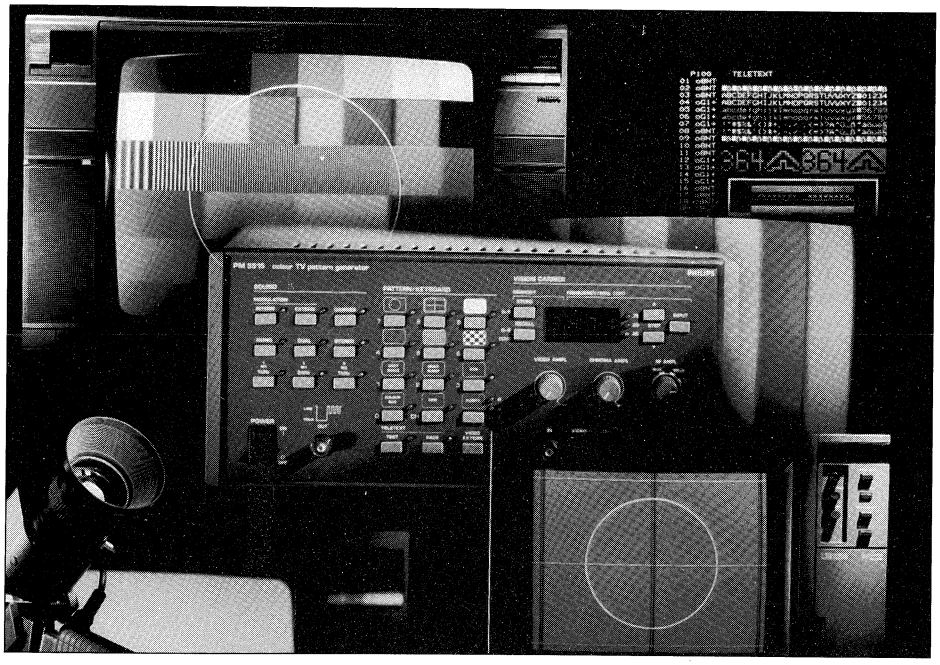
GPIB
IEEE-488



PM 5515

PM 5515/16/18 Color TV Pattern Generator Family

- Synthesized control of RF frequency
- Covering every RF band from IF to bands IV/V including cable TV bands
- Storage and recall of 10 complete programs, RF freq., pattern and sound settings
- Keyboard call-up of up to 70 test patterns/combinations
- Simple TV standard selection of PAL, NTSC or SECAM
- Operation of up to 3 to 4 receivers on a 10 mV output
- RGB option
- GPIB/IEEE-488 version with standard RGB and universal chroma



A Pattern for the Future

This family of versatile color pattern generators is designed to cover all available TV standards.

- PM 5515 is for PAL/NTSC
- PM 5516 is for SECAM
- PM 5518 is for SECAM/PAL/NTSC

All models are microcomputer-controlled with powerful, non-volatile memories, allowing predetermined user-programs to be stored and recalled at will. At the touch of a key.

Over 70 different patterns and combinations are achievable, as well as Teletext, FM stereo and dual-channel sound. All very simple to set up.

Each model in the series is available in a basic configuration, and also with enhanced versions to cater to the widest possible spectrum of applications. These are listed at the end of this section. For servicing of color TV monitors and applications involving computer graphics, an RGB option is available. A system version, the TXI, with GPIB/IEEE-488* interface built-in, RGB, and universal chroma as standard, is also available.

Thus many of today's video testing problems are well covered, with reserve capability ready for tomorrow's needs.

Versatility with Ease

The PM 5515/16/18 series offers you unparallelled versatility and ease of use.

Thanks to microcomputer control, one simply keys-in the programs required — R.F. frequency setting, pattern selection and sound modulation. Touch a button to store them — ready for recall. And, even a year later, just recall and the program is still there — ready for immediate use. Versatility plus simplicity.

Lowest Cost of Ownership

Microprocessor control offers more than versatility with ease. It offers security and reliability. Software modules and solid-state memories take over from mechanical switches, reducing service and maintenance costs to the absolute minimum. And with Philips built-in quality and reliability the user enjoys a sound guarantee of low cost of ownership.

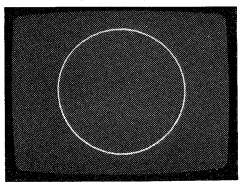
An Unparallelled Range

The PM 5515/16/18 series offers an unparallelled range of pattern generators. From the versatile basic model with its touch-button control of every parameter, through models offering FM-stereo and dual sound or Teletext test and page signals, up to the model that offers everything! A range from which one can choose a pattern generator for today — knowing that it will meet tomorrow's needs.

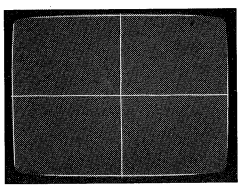
**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Patterns for Now and for the Future

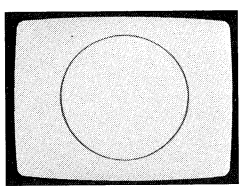
Twelve push-buttons make the selection of eighteen different patterns possible. These test patterns check and align the monochrome and chrominance circuitry of the color TV monitors and VCR.



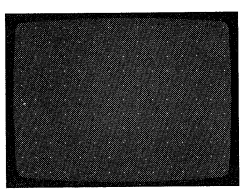
Circle on a grey background for checking the overall linearity and geometry. The white circle changes automatically to black when used with the white pattern and is useful for checking reflections.



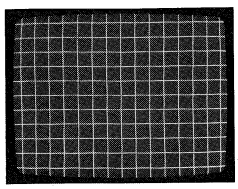
Center Cross/Border lines is ideal for centering TV monitors and TV screens. Also to check the deflection linearity and for pin-cushion correction.



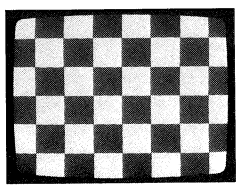
White 100% with swinging burst is designed for setting white D and for an overall check of purity. Also for beam current adjustment. White D is the correct white necessary for a natural color reproduction.



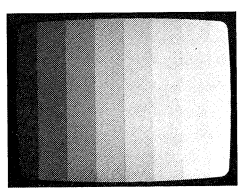
Dot pattern mainly for static convergence. The screen should contain pure white dots.



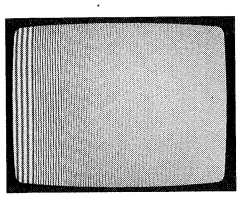
Cross hatch/Center Indication with 17 vertical and 12 horizontal lines is used for checking and re-aligning dynamic and corner convergence. The advantage is that there is no interlacing which would normally tire the eyes. If interlacing is required this can be achieved by superimposing another pattern such as center cross or circle.



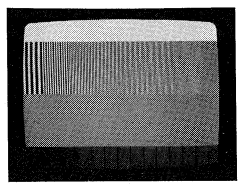
Checkerboard pattern of six times eight rows of squares provides a visual standard for basic picture tube alignments, for example: centering, focus, horizontal and vertical deflection and linearity.



Grey scale. Full-screen linear staircase signal with 8 equal steps from black to white is used to locate faulty linearity of the video amplifier or grey-scale setting.



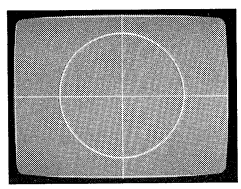
Multiburst contains eight full screen vertical bars of definition lines in the frequency ranges 0.8, 1.8, 2.8, 3.0, 3.2, 3.4, 3.8 and 4.8 MHz. This checks the bandwidth of the video or luminance amplifier in black and white or color TV as well as the resolution of monitors and video recorders.



VCR is a specially-designed test pattern to check the bandwidth, linearity, sensitivity and AGC of the chroma amplifiers in color video recorders.

This combined test pattern is divided into 4 horizontal segments:

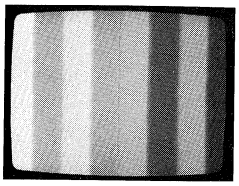
- 24 lines of 100% white to clip and to level.
- Eight bars of resolution of which 2.8 - 3.0 - 3.2 - 3.4 MHz are used to align the high-pass filter for a maximum resolution in VCR bandwidth.
- Eight steps of decreasing linear levels of saturation from 100 to 0% to check the chroma amplifier linearity and color AGC circuitry.
- A black horizontal bar with a moving white field to check moving pictures on video recorders.



Purity with a choice of the three primary colors clearly indicated by LEDs. The red pattern is used for checking color purity. The green pattern provides a purity check for three-in-line tubes. Blue is also available to check color performance. The three complementary colors, magenta, yellow and cyan can also be displayed by selection, as can white and black.

Combinations with circle and/or center cross are easy to select.

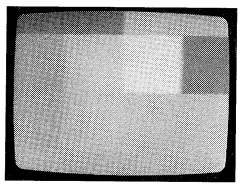
PM 5515, PM 5516 & PM 5518



Color bar standard bar pattern. The vertical bars are white D, yellow, cyan, green, magenta, red, blue and black.

Since it is dependent on the TV system selected, the luminance content is automatically corrected for each setting.

The color bar pattern therefore provides sufficient information for a good overall check of color performance, including checks on burst keying, subcarrier regeneration, RGB amplifiers, the delay color versus B/W signal and saturation.



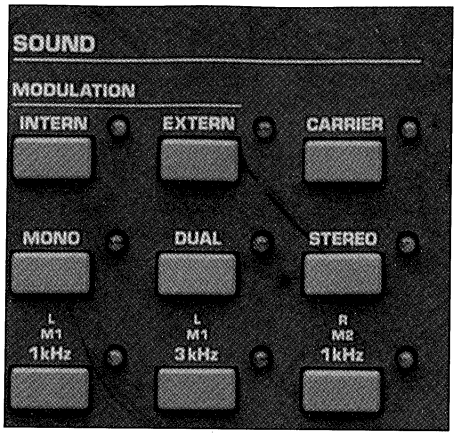
Examples of PAL coded DEM pattern. For NTSC this DEM pattern contains different color coding.

G - Y = 0		Y = 50%	
Δ + (R - Y)	Δ - (R - Y)	◊ + (B - Y)	◊* - (B - Y)
Δ ± (R - Y)	Δ ± (R - Y)	◊ ± (B - Y)	◊** ± (B - Y)
Reference Y = 50%			

Δ (B - Y) = 0 ◊ (R - Y) = 0

** PAL coded*
*** Anti-PAL coded*

DEM pattern. Demodulator is a combined test pattern which, divided in 4 sections, contains information to make on-screen checks and alignments of the color demodulators and sub-carrier frequency. For PAL it is used to check the chroma delay line for amplitude and phase (venetian blinds). For the NTSC system, the pattern is according to the NTSC requirements and contains 7 color bars, -I and +Q signals and a black and white reference field.



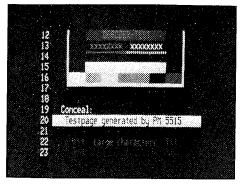
Stereo and Second Sound Channel

For use in standard CCIR, PAL G systems, the PM 5515/16/18 have a selection of optional -X, -TX, and TXS configuarations with two sound carriers — for use in one- and two-channel mode, or right and left channel of a stereo signal. They are therefore appropriate for European systems (and are not compatible with MTS (NTSC) stereo systems).

CTV transmission with stereo sound or alternative second sound channel (e.g. to choose between synchronized or original voice tracks) is becoming more common. The special CTV receivers with stereo decoders needed to reproduce these broadcasts can be expected to be increasingly popular. The -X, -TX and -TXS meet the need for a portable color pattern generator for test and realignment of these receivers.

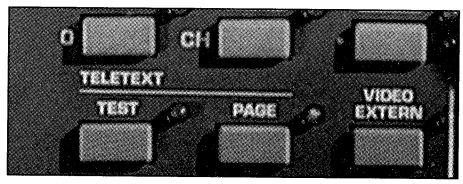
The instrument allows external modulation from a full stereo tuner/amplifier, tape or cassette recorder, with PM 5515/5518 as the RF modulator.

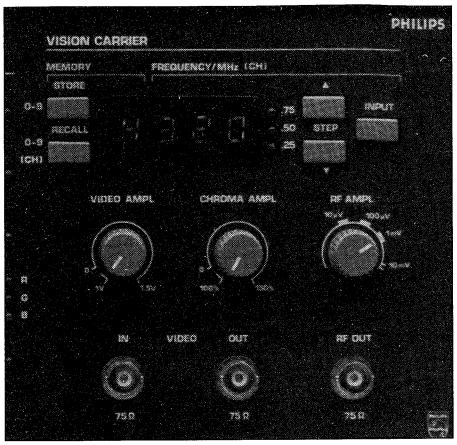
- Sound carriers according to standard at 5.5 MHz and 5.742 187 5 MHz $\pm 3 \times 10^{-5}$
- Sound/vision separation at 13 and 20 dB, respectively
- Internal FM of 1 kHz and 3 kHz with 30 kHz deviation
- Full external stereo modulation facility for all types of stereo equipment (recorders, CDs, tuners, etc.)
- Pilot tone according to standard at 54.687 5 kHz $\pm 3 \times 10^{-5}$, with recognition frequencies at f_H/133+117.5 Hz (stereo) and f_H/57+274.1 Hz (second sound channel)



Teletext

The growth of electronic communications has seen a rapid increase in the introduction of text transmission. To meet the highly specialized requirements for the checking and alignment of teletext receivers and decoders in PAL G and I systems the -T, -TX, and -TXS configurations have been specially developed. Both instruments offer the facility of a selection of five teletext pages with special contents for decoder testing as well as a wallpaper test pattern.





RF Selection

All models cover the full frequency range from 32...900 MHz, including IF and TV transmissions in frequency bands I, III, IV and V. Full coverage of cable TV and S-channels is provided in frequency bands 104...175 MHz (S1...S10) and 230...300 MHz (S11...S20); and hyperband coverage is provided in the frequency range 300...470 MHz. Selection of the synthesized RF frequency within these bands is electronic, via the keyboard.

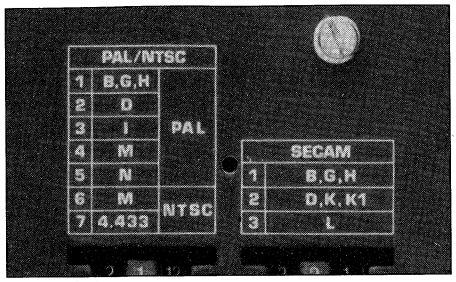
Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.

The first digit shows the memory place. The other three digits indicate the selected freq uency or TV channel. The RF carrier output of >10 mV into 75Ω is ample for 3 or 4 receivers in parallel during workshop repairs, and the carrier can be continuously attenuated by more than 60 dB, with output indications at 1 mV, 100 µV and 10 µV levels. The ability to smoothly vary the RF level is of particular value when checking the overall RF sensitivity or AGC circuits.

Up to ten memory places can be used either to store the selected RF frequency or TV channel number. Having stored, e.g. the local TV stations, any one of them can be recalled at the touch of a button without time consuming dial tuning.

RF Carrier and Frequency Spectrum

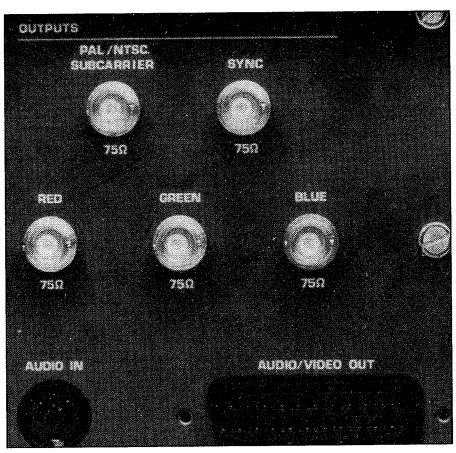
Although double sideband, the RF envelope of the PM 5515/16/18 is very similar to that transmitted by professional TV broadcast companies, such as, e.g., 13 dB for TV standard G between the sound and vision channels. (Most other generators have 25 dB or more separation, leading to false impressions when aligning tuners and RF amplifiers.)



The System Switch

The rear of the instrument offers additional facilities which add to the uniqueness of the PM 5515/16/18 range. A selection switch is used to choose the TV system required. Line frequency is automatically selected, either 15 625 Hz for CCIR or 15 734 Hz for RTMA with less than 0.4 Hz frequency tolerance.

The correct crystal for color and subcarrier, determining line- and frame-frequencies, is selected automatically.



The Euro/SCART connector for audio/video out as well as the DIN connector for external audio modulation are standard for all models.

Outputs

On the rear panel, video output is via a Euro Scart connector an external sound modulation via a standard DIN plug. Color subcarrier and sync signal are supplied as standard, with RGB optionally available.

RGB Option

RGB signals and a SYNC and subcarrier facility are available to meet the rapid advance in computer graphics techniques and servicing of color video monitors. There are many monitors which only accept RGB signals and for testing these the RGB option is essential.

Y/C plus RGB options

This optional module provides test signals for checking either S-VHS video recorders or Y/C monitors.

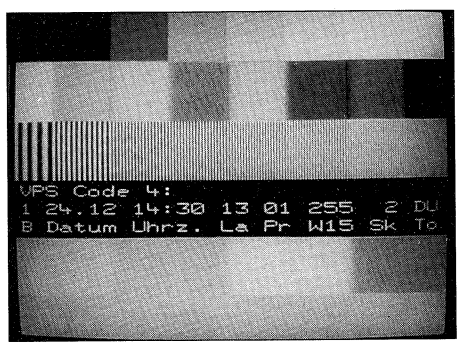
IEEE-488 version

For use in systems applications, one of the PM 5518 models is configured with an IEEE/IEC interface. All the available TV and sound modulation standards can be selected remotely, and "bus learn mode" and "identification mode" are included.

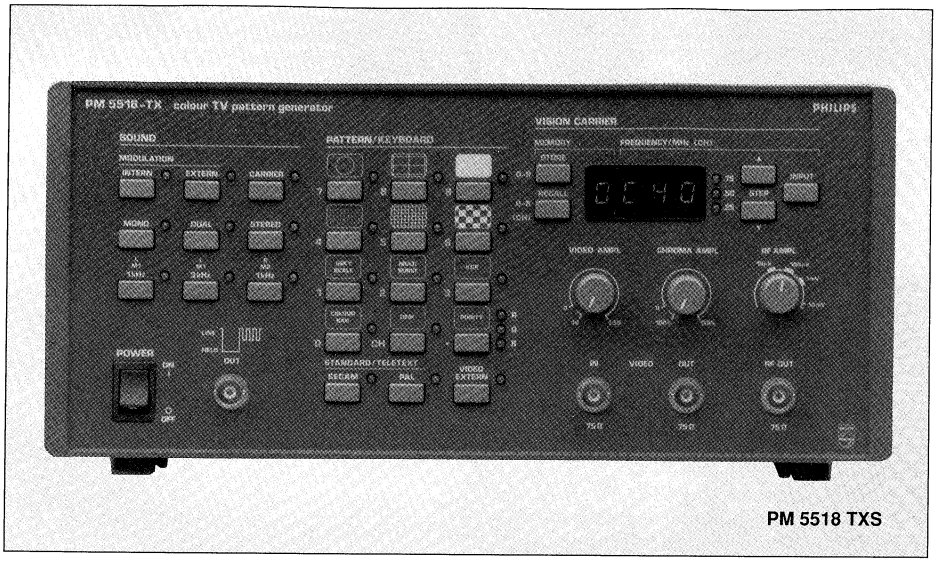
VPS Test Facilities

PM 5515-TXS and PM 5518-TXS models offer complete testing of video cassette recorders equipped with VPS, under the PAL B/G/H, D and I/N standards. A maximum of 9 coded VPS signals are available including date, transmission time, country indication, TV channel, stereo/dual/mono sound and adult/general suitability.

Special signals such as LEER code, program interrupt and system status can also be selected. VPS data is shown in a 1/6 screen height horizontal bar which can be combined with any test pattern and displayed in six positions, either on- or off-screen. Unique to VPS instruments is on-screen display of codes and programming the generator to set codes locally if required.



PM 5515, PM 5516 & PM 5518



PM 5518 TXS

A Range for Today and Tomorrow

The versatility of the Philips color pattern generator family not only ensures that today's requirements are expertly met but the developments of tomorrow are anticipated.

PM 5515 Generator For PAL/NTSC

The standard PM 5515 generator with its advanced features, unrivalled in the market place, is complemented by four enhanced models:

PM 5515-T has 5 Teletext pages plus a wallpaper test pattern for aligning and testing teletext receivers and decoders.

PM 5515-X features full additional FM stereo and dual sound channel facilities according to system G.

PM 5515-TX offers, in addition to all the facilities of the basic model, all those features provided by the other two models.

PM 5515-TXS further expands on the -TX version by adding VPS for PAL system G.

PM 5516 Generator For SECAM

The PM 5516 offers the same features as the standard PM 5515 above, except it operates according to the French SECAM TV system L with positive video modulation and AM sound. It also operates to the TV standards D, K1, B, G and H corresponding to OIRT TV system with negative video modulation and FM sound. The desired TV standard is simply selected at the rear of the instrument.

PM 5516 is the standard SECAM COLOR generator.

PM 5516-T is as PM 5516 but extended with ANTIOPE.

PM 5518 Generator For SECAM/PAL/NTSC

The PM 5518 expands on the basic PM 5515 by supporting not only the NTSC and PAL TV standards, but also SECAM. In addition, it adds IEEE-488 compatibility as an optional configuration for systems application. As such, it is Philips' most advanced color pattern generator.

A push-button on the front panel selects PAL or SECAM, with a rear panel switch to select NTSC.

In addition to the standard PM 5518, enhanced versions include:

PM 5518-TX operates according to TV standard G, STEREO FM, DUAL SOUND and five pages of teletext and — according to system SECAM L — seven pages of ANTIOPE.

PM 5518-TXS further expands on the -TX by adding VPS for TV standard G.

The PM 5581 TXI is the most advanced color pattern generator in Philips' range. It is functionally equivalent to a PM 5518 TXS, except that it is designed specifically for systems use and comes with an GPIB/IEEE-488 interface as standard. It is the most versatile general purpose instrument for testing and adjustment of TV sets, monitors and video recorders, in virtually any systems (or stand-alone) application in development, production and service.

The IEEE interface allows remote selection and control of all the functions and allows operation in automatic test environments. "Identification mode" and bus "learn mode" are implemented in the PM 5518 TXI.

This unit supports all PAL/SECAM/NTSC TV standards, including PAL M & N. Also included are teletext, antiope, composite video outputs and sound modulation in stereo, dual channel and mono. In addition, it has included as standard the universal chroma and RGB facilities available only as options on other instruments.

These systems-oriented instruments are often used continuously in factory set-ups, so the crystal oscillators have a higher stability than standard models.

PAL and NTSC TV Systems Specifications for PM 5515 and PM 5518

Series	M	B,G &H	D	I	N	M
TV and chroma standard	NTSC, RTMA	CCIR, PAL	CCIR, PAL	CCIR, PAL	CCIR, PAL	RTMA, PAL
No. of lines per picture frame	525	625	625	625	625	525
Field frequency (Hz)	60	50	50	50	50	60
Line frequency (lines/second)	15734	15625	15625	15725	15625	15734
Chrominance subcarrier (MHz)	3.579545	4.433619	4.433619	4.433619	3.582056	3.575611
Sound carrier to vision carrier (MHz)	4.5	5.5	6.5	6	4.5	4.5
Sound modulation	FM	FM	FM	FM	FM	FM
Pre-emphasis (µs)	75	50	50	50	75	75

SECAM TV System Specifications For PM 5516 and PM 5518

TV systems	SECAM B, G, H	SECAM D, K, K1	SECAM L
Sound carrier relative to vision carrier (Hz)	5500000	6500000	6500000
Type and polarity of video modulation	A3F neg.	A3F neg.	A3F pos.
Type of sound modulation	FM	FM	FM
Chrominance subcarrier (Hz)	F_{OB} = 4250000 F_{OR} = 4406250		
Type of chrominance subcarrier modulation	Frequency modulation		
Transmitted chrominance information	Line sequential D'R and D'B		
Line frequency (lines/second)	15625		
Field frequency (Hz) (fields/second)	50 (50)		

Specifications

Technical Specifications

Video Carrier

Frequency
Range: 32...900 MHz
IF = Band I: 32...90 MHz
S-Band S1-S10: 104...174 MHz
Band III: 174...230 MHz
S-Band S11-S20: 230...300 MHz
Hyperband H21-H40: 300...470 MHz
Band IV-V: 470...900 MHz
Frequency Selection: Keyboard
Fine Tuning: 250 kHz steps for TV frequencies 100 kHz steps for IF frequencies (32...44.9 MHz) Frequency Tuning: In positive or negative direction.Tuning speed increase by holding step button
Storage:
a) Possibility for 10 different RF frequencies
b) As a), indicated as TV channel numbers
Indication: 4-digit 7-segment LED display
a) First digit: memory, store and recall position 0...9
b) 2nd, 3rd and 4th digits: 3-digit indication of frequency in MHz. Separate indication for 250 kHz, 500 kHz and 750 kHz steps
c) Keyboard-selectable TV channel numbers (e.g. C21 or C70)

RF Output

RF Output: BNC connector (front panel)
Impedance: 75Ω
Output Voltage: <10 mV
Attenuation: 60 dB, continuous

Video

Video Modulation
Modulation: AM internal-external switchable
Polarity: Negative/positive for SECAM L

Video Input
Video Input: BNC connector (front panel)
Input Voltage (PP): 1V
Max. permissible Input Voltage: ±5V
Impedance: 75Ω
Polarity: White level positive
Coupling: DC (clamping on sync.)

Outputs
a) BNC connector
b) SCART connector (Euro-AV connector), pin 19 (rear)
Impedance: 75Ω
Voltage (PP):
a) 1V fixed
b) Variable between 0...1.5V/75Ω
Polarity: Negative
Coupling: DC

Chroma (NTSC/PAL)

Chroma Standards: NTSC according to system M (switchable)
PAL according to system B, D, G, H, I, (M, N)
Selection: Rear panel thumbwheel system switch
Sub-Carrier Frequency:
3.579545 MHz for NTSC
4.433619 MHz for PAL B, D, G, H, I;
3.575611 MHz for PAL M;
3.582056 MHz for PAL N;
Sub-carrier frequencies coupled to line frequency according to selected standard
Tolerance: ≤3 x 10-5 (+5...+40°C)
Burst: Position, number of cycles and phase according to selected standard
Amplitude: Chroma with burst
a) Fixed (100%)
b) Continuously variable from 0...150%
Chroma Vectors Inaccuracy: Phase ≤3°, amplitude ≤5% relative to luminance amplitude

Chroma PM 5518TXI

as above but with PAL M,N as standard

Chroma (SECAM)

Chroma standards: SECAM B, G, H, D, K, K1 and L
Selection: Two rear panel thumbwheel system switches
Sound Carrier Rel. to Vision Carrier (Hz): B, G, H-5,500,000; D, K, K1, L-6,500,000
Type/Polarity of Video Modulation: A3 F/neg. (L pos.)
Type of Sound Modulation: FM (except L)
Chrominance Sub-Carrier (Hz): fOB = 4,250,000 fOR = 4,406,250
Tolerance: <2 kHz
Type of Chrominance Sub-Carrier Modulation: Frequency modulation
Transmitted Chrominance Information: Line-sequential D'R and D'B
Line Frequency: 15,625 lines/s
Field Frequency: 50 Hz (50 fields/s)
Signals: D'R = -1.9 (E'R - E'Y)
D'B = 1.5 (E'B - E'Y)
Identification: According to TV system in line and frame
Frame Identification: Position in lines 7 to 15; in 1st, 3rd and 5th field etc.: in lines 320 to 328; in 2nd, 4th and 6th field etc.
Line Identification: By burst (chrominance subcarrier reference signal) on the back porch according to TV standard (B, D, G, H, K, K1, L/SECAM)
Amplitude: Line and frame identification according to TV standard, but also variable between 0...150% together with chroma information
Chrominance Signal: According to standard, but also variable
Amplitude: Between 0...150% of the nominal value
Frequency Deviation: Of chrominance subcarrier according to TV standard
Video Pre-Emphasis: Low frequency pre-correction and high-frequency bell filter according to TV standard
Bell Center Frequency: 4.286 MHz
Tolerances: ≤20 kHz

Chroma (SECAM); PM 5518TXI

as above except:
Tolerance: $<10^{-6}$
Temperature Coefficient: 2×10^{-6}/K
Ageing: 2×10^{-6}/year

Synchronization

Line Frequency: 15,734 Hz (RTMA),15,625 Hz (CCIR),
Frequency Tolerance: 0.4 Hz (+5 ... +40°C)
Number of Lines: 525 (RTMA), 625 (CCIR),
Field Frequency: 60 Hz (RTMA), 50 Hz (CCIR),
Line and Frame Sync.: According to TV standard, interlacing
Output: BNC connector (front panel)
Sync.Signal: Combined signal with line and field synchronization pulses with amplitude difference
Voltage (open-circuit): 2.6V for line pulse,5.0V for field pulse
Impedance: 6 kΩ
Polarity: Negative

Sound Carrier and Modulation

Sound Carrier (mono): On/off switchable
Frequency: 4.5 MHz, standard M, N;
5.5 MHz, standard B, G, H;
6.0 MHz, standard I;
6.5 MHz, standard D, SECAM L
Tolerance: ≤3 x 10^{-5} (+5...+40°C)
Vision/Sound Carrier Ratio: 13 dB, standard B, G, H;
11 dB, standard D, K, K1, L;
13 dB, standard M, N;
12 dB, standard I
Sound Modulation: FM, internal and external on/off switchable, AM for SECAM L
Pre-Emphasis: 50 µs, standard B, D, G, H, I, K, K1; 75 µs, standard M, N

Internal FM
Frequency Deviation:
±30 kHz, standard B, G, H;
±15 kHz, standard M, N;
±27.5 kHz, standard I;
±24 kHz, standard D, K, K1
Modulation Depth: 50%, standard SECAM L

External FM
0.4V will give the same deviation or modulation depth as with internal modulation
Input: DIN connector, pin 3 + 5 (rear panel)
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max Input Voltage: ±40V
Output: SCART connector (Euro-AV connec-

PM 5515, PM 5516 & PM 5518

tor), pin 3 (rear panel)
Impedance: 1 kΩ
Voltage: 0.4V

Teletext for T and TX Versions

Data Synchronization Frequency: PAL BGI-6.9375 MHz, ~444 x f^H; SECAM L-6.203125 MHz, ~397 x f^H
Data Coding: Acc. to standards as PAL
Signal Levels: '1' + 66% level, 0+black level;as PAL, '1' + 100% White level as SECAM
Signal Shaping: Cos^2 filter

Text Data
Decoder Alignment: No combination possible with test alignment patterns only PM 5515T and PM 5516T
Data Contents: Clock run-in standard, framing code standard, full field, remaining pattern pseudo-random (not PM 5518)
Normal Working Mode: Combinations possible with all test patterns
Data Lines: 22; 335
Data Contents: ≥5 text pages with special contents for decoder testing for each standard

Signal Output
Teletext Signal Combined with Video Signal: Video output
Modulated RF Signal: RF output, RF from basic unit

Sound Section for Stereo and Second Sound Channel Transmission for X and TX Versions

Standards: B, G
Sound Carriers: Carrier 1: 5.5 MHz; Carrier 2: 5.7421875 MHz
Vision Sound Carrier Ratio: Carrier 1: 13 dB; Carrier 2: 20 dB
Frequency Tolerance: <3 x 10^{-5} (+5...+40°C)

Modulation
FM, internal and external on/off switchable
Pre-Emphasis: 50 µs

Internal FM
Sound Channel 1: 1 kHz on/off switchable; 3 kHz on/off switchable
Deviation: ±30 kHz in mono/dual-channel ±15 kHz in stereo, right channel switched off ±30 kHz in stereo, left and right channels switched on with 1 kHz internal signal
Sound Channel 2: 1 kHz, on/off switchable
Deviation: ±30 kHz

External FM
Sound Channels 1 & 2 Input Voltage: 0.4V will give the same deviation as the internal signal
Inputs
DIN connector (rear panel)
Contacts: Pin 2 (ground), pin 3 sound channel 1, pin 5 sound channel 2
Impedance: 0.5 MΩ
Bandwidth: 40 Hz...15 kHz
Max. Permissible Voltage: ±40V

Outputs
SCART connector (Euro-AV connector)
Contacts: Pin 3 sound channel 1, pin 1 sound channel 2
Impedance: 1 kΩ
Voltage: 0.4V

Operating Mode Detection
Pilot Frequency: 54.6875 kHz (3.5 x f.line)
Tolerance: <3 x 10^{-5} (+5...+40°C)
Modulation: AM
Modulation Depth: 50%
Identification Frequencies: 117.5 Hz (f.line/133) stereo mode; 274.1 Hz (f.line/57) dual-channel mode
Deviation of 2nd Sound Carrier: ±2.5 kHz by modulation of carrier with unmodulated pilot
For standards D, I, M, N the stereo versions X and TX also offer all mono facilities.

VPS forTXS Versions

VPS Video Programming System for pre-programmed recording with home video recorders according to German broadcasting organizations ARD, ZDF and ZVEI
Data Synchronization Frequency: 5 MHz
Bit Length: 400 ns
Modulation: Bi-phase modulation
Data Coding: According to the guideline issued by ARD, ZDF and ZVEI
Signal Levels: '0' = black level, '1' = 71.4% of white level
Signal Shaping: Cos^2 filter
Location of Data: Line 16
Data Contents: 9 different freely programmable non-volatile sets of VPS data preset at factory; each with 15 words (8 bits), including clock run-in, special identification and date of transmission
Normal Operating Mode: Combination possible with all test patterns and teletext; on/off switchable
Programming: Via keyboard and text strip inserted in the test pattern
Text Strip: 6 different positions, or not visible

IEEE-488 Interface

(PM 5518TXI only)
Allows selection and control of all functions

RGB Option

RGB Outputs
BNC connectors (rear panel)
Output Voltage (PP): 0.7V/75Ω
Impedance: 75Ω
Sub-Carrier Output
BNC connector (rear panel)
Output Voltage (PP): 1V/75Ω
Impedance: 75Ω
Sync. Output
BNC connector (rear panel)
Output Voltage (PP): 2V/75Ω
Impedance: 75Ω

Universal PAL/NTSC Chroma Molule

NTSC Systems: M
PAL Systems: B, D, G, H, I, M, N

General Specifications

Voltage: 100, 120, 220, 240 V -12/+10%
Frequency: 50/60 Hz ±5%
Power Consumption: Depends on version
Dimensions: 300mm W x 140mm H x 395mm L
Weight: Approx. 10 kg depending on version

Included with instrument:
PM 9538 RF cable, BNC TV connector 758, mains cable, operating manual

Ordering Information

Models

PM 5515 + NTSC/PAL Pattern Generator
PM 5516 SECAM Pattern Generator
PM 5518 NTSC/PAL/SECAM Pattern Generator

Optional Configurations

PM 5515+RGB Standard PM 5515 plus RGB; PAL/NTSC
PM 5515+GX Standard PM 5515 plus PAL G stereo
PM 5515X+RGB Same, plus RGB
PM 5515+GT Standard PM 5515 plus PAL G teletext
PM 5515GT+RGB Same, plus RGB
PM 5515+GTX Standard PM 5515 plus PAL G stereo and teletext
PM 5515GTX+RGB Same, plus RGB
PM 5515+TXS Standard PM 5515 plus PAL G stereo, teletext, and VPS
PM 5515TXS+RGB Same, plus RGB
PM 5516T Standard PM 5516 + Antiope
PM 5518+RGB Standard PM 5518, plus RGB
PM 5518TX Standard PM 5518 plus PAL G stereo, PAL G/I teletext, and SECAM L antiope
PM 5518TX+RGB Same, plus RGB
PM 5518TXS Standard PM 5518 plus PAL G stereo and VPS, PAL G/I teletext, and SECAM L antiope
PM 5518TXS+RGB Same, plus RGB
PM 5518TXI/RGB Standard PM 5518 plus PAL G stereo, PAL G/I teletext SECAM L antiope, Universal Chroma RGB and IEEE-488

Accessories

PM 9539/01 RF cable and 300Ω trafo
PM 9075 75Ω BNC-BNC Cable
PM 9561 19-inch Rackmount Unit

Options

PM 9546 Universal Chroma Unit
PM 9545* Hyperband Module
PM 9544** VPS Module
PM 9543 RGB Output
** Replacement unit only for older models; hyperband is now standard on all current models*
*** See VPS for TXS for specifications*
Note:all options must be installed by the Philips service department

Performance Table PM 5515

Type Number	Stereo (Europe)	Teletext	VPS	PAL					NTSC	RGB
				D	G	I	M	N	M	Option
PM 5515				X	X	X	(X)	(X)	X	#
PM 5515-X	O			X	O X	X			X	#
PM 5515-T		+		X	+ X	+ X			X	#
PM 5515-TX	O	+		X	O + X	+ X			X	#
PM 5515-TXS	O	+	*	X	O X + *	+ X			X	#

X = mono sound O = stereo sound + = teletext # = RGB option $ = antiope-teletext *vps
• If the generator should also operate with M & N PAL system, add M or N to the order number

Optional Configuration Performance Table

Model Number	TV System												RGB	Y/C+ RGB***	IEEE 488
	NTSC	PAL					SECAM								
	M	D	G	I	M**	N**	L	B	D	G	H	K1			
PM 5515	a	a	a	a	a, opt.	a, opt.							opt.	opt.	
PM 5515X	a	a	a, b	a	a, opt.	a, opt.							opt.	opt.	
PM 5515-T	a	a	a, c	a, c	a, opt.	a, opt.							opt.	opt.	
PM 5515-TX	a	a	a, b, c	a	a, opt.	a, opt.							opt.	opt.	
PM 5515-TXS		a	a, b c, d	a, c	a, opt.	a, opt.							opt.	opt.	
PM 5516					a, opt.	a, opt.	a	a	a	a	a	a	opt.		
PM 5516-T							a, e	a	a	a	a	a	opt.		
PM 5518	a	a	a	a	a, opt.	a, opt.	a	a	a	a	a	a	opt.	opt.	
PM 5518-TX	a	a	a, b, c	a, c	a, opt.	a, opt.	a, e	a	a	a	a	a	opt.	opt.	
PM 5518-TXS	a	a	a, b c, d	a, c	a, opt.	a, opt.	a, e	a	a	a	a	a	opt.	opt.	
PM 5518-TXI	a	a	a, b, c d, opt.	a, c	a	a	a, e	a	a	a	a	a	std.	opt.	std.

*a. Mono sound b. Stereo sound c. Teletext d. VPS e. antiope-teletext **Via PM 9546 Universal Chroma Module ***Y/C + RGB*

PM 6303

T&M EXPRESS LINE



PM 6303

PM 6303 Automatic RCL Meter

- Easy-to-read LCD display
- Extremely fast automatic operation
- Displays component value, measurement units and equivalent circuit
- All displays appear simultaneously
- Push-button selection of nine different parameters
- Two- or four-wire connection
- SMD Testing via optional Test Adapter

Fast Operation, Clear Display

The PM 6303 automatic RCL meter will rapidly determine the value, electric dimension and equivalent circuit of passive components to a very high order of accuracy, and over a wide range. The measured value, together with the appropriate unit of measurement and the equivalent circuit-graphics, are easily read on a large 4-digit liquid crystal display.

Rapid Connection

Connection of a component to be tested is quick and simple, using either a two- or four-wire connector or an optional test attachment. Less than one second after connection, the dominant component's measured value, its effective dimension and its equivalent circuit will be clearly displayed. For example: when measuring a coil having a Q-factor of 1, both the series inductance and resistance and the equivalent circuit-graphics will be displayed almost instantly. Apart from using the auto mode of the PM 6303, it is possible to select from a maximum of nine differing parameters (D, Q, Rp, Rs, Z, Ls or Lp, Cs or Cp and Cs 2V bias), using only two push-buttons.

Universal Capability

Features like these make the PM 6303 an ideal instrument for a very wide range of applications; educational-institutes, R & D laboratories, specialized service centers, or in general-purpose workshops. Its automatic operation, coupled with a direct digital readout, also makes the PM 6303 a most attractive tool for use in research, development, and quality-control. In addition manufacturing engineers will find the PM 6303 a most useful aid in batch-sampling techniques.

Connection Facilities include:

- 2 sockets for measuring voltage (HI) Drive and Sense connection
- 2 sockets for measuring current (LO) Drive and Sense connection
- 1 socket guard connection

Parameter Selection

- 2 push-buttons for stepping from item to item in the parameter menu.
- 1 push-button to reset to RCL AUTO mode in which the dominant component is measured.

Parameters

- Dominating component R, C or L (autoselection)
- Q
- D
- Rp
- Rs
- Z
- Cp, Lp
- Cs, Ls
- Cp Biased (internally generated DC voltage)

Optional Accessories

When making measurements of already mounted components, connection between the PM 6303 and the component to be tested can be difficult. The problem is easily overcome by the use of the 4-wire test cable PM 9541. This consists of a cable fitted at one end with Kelvin clips, the other end fitted with a Kelvin connector which plugs into the front panel socket on the PM 6303.

In addition, and especially useful for testing batches of individual components of all different physical sizes, there is the 4-wire RCL adapter, PM 9542. This is a box-mounted set of 'slide-in' connectors having a similar cable end to the PM 9541.

Also available is a fixture for all types of SMDs (Surface Mounted Devices). Designated the PM 9542 SMD, it plugs into the PM 9542 and allows measurment on and testing of all shapes and sizes of SMDs. A direct readout of the component type and value is displayed on the PM 6303, together with a display of the equivalent-circuit symbol for the component. As for other components, a 4-wire technique is used for measurment, ensuring high accuracy even for low-impedance components.

All three accessories may be seen on the following page.

Specifications

Technical Specifications

General

Display: Large 18mm, 4-digits LCD
Dimension Indications: Ω, kΩ, MΩ, pF, nF, µF, mF, µH, mH, H, kH
Out of Range Indication: 4 middle digit segments flashing

Measuring Ranges

Resistance: Rp, Rs, Z 0.000Ω...200 MΩ
Capacitance: Cp, Cs 0.0 pF...100 mF
Inductance: Lp, Ls 0.0 µH...32 kH
Quality Factor: Q 0.002...500
Dissipation Factor: D 0.002...500

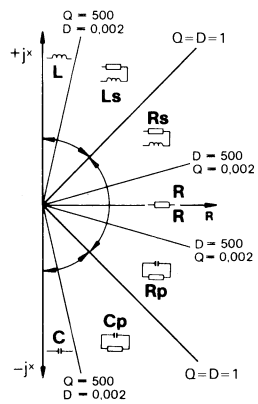
Equivalent circuits
– 7 Equivalent circuits

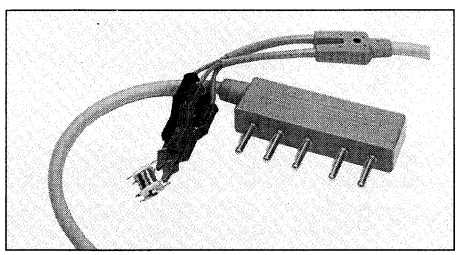
D > 500

D < 0.002, Q > 500

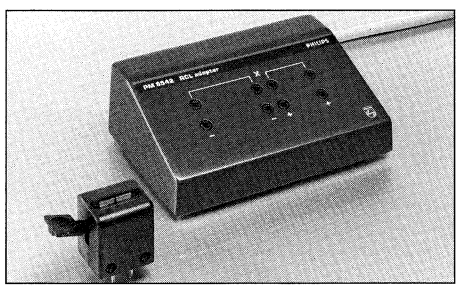
Q > 500, no display of the secondary parameter

D or Q Q=D=1	parameter selection
≤ 500	RCL AUTO, Cp, Rp, D, Z
≤ 500	Cs, Rs
≤ 500	RCL AUTO, Ls, Rs, Q, D, Z
≤ 500	Lp, Rp





4-wire test cable PM 9541 (optional)



4-wire RCL adapter PM 9542 with SMD adapter PM 9542SMD (optional)



PM 6303 is extremely versatile making it a valuable measurement tool in industry, service workshop or education.

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	PM 9541	PM 9542*
Performance characteristics:		
DUT-connection	by two Kelvin clips	by Kelvin contacts in the test pods
Short-circuit inductance	0.1 µH typical 0.3 µH max.	<0.1 µH max.
Mechanical specifications:		
Cable length	600 mm	600 mm
Case dimension	—	50 x 145 x 95 mm
Weight	0.2 kg	0.6 kg

** Alone or combined with 9542SMD*

Resolution per Range

Resistance: 1 mΩ
Capacitance: 0.1 pF
Inductance: 0.1 µH
Quality/Dissipation Factor: 0.001
Measuring Accuracy: Basic Error ±0.25%
±1 digit
Measuring Frequency: 1 kHz ±0.025%
DUT Stress: ≤5 mA, ≤2V
(linked to a 2 V_{RMS} source with an internal resistance of 400Ω)
Measurement Update Rate: Approx. 2 measurements per second
Zero Capacitance Adjustment:
Co-trim by means of screwdriver adjustment on front panel.
Maximum Adjustable Capacitance: 5 pF
Type of Connectors: 4 mm sockets
2 sockets for measuring voltage (HI)
Drive and Sense connection
2 sockets for measuring current (LO)
Drive and Sense connection
1 socket guard connection

Power Requirements

Voltage: 110, 128, 220, 238V ±10%
Frequency: 50...100 Hz ±5%
Power Consumption: 13W

Environmental Capabilities

Ambient Temperatures
Reference Value: +23°C ±1°C
Operation: +5°C + 40°C
Storage and Transport: -40°C...+70°C
Dimensions: 310 mm W x 140 mm H x 310 mm L (12.2 in W x 5.15 in H x 12.2 in L)
Weight: 4.8 kg (10.6 lb)
Included with instrument: Two-terminal fixture and operating manual

Ordering Information

Model

PM 6303/008 Automatic RCL Meter

Accessories

PM 9541/00 Four-wire test cable
PM 9542 RCL test adapter
PM 9542SMD SMD adapter for PM 9542

PM 6307



PM 6307

PM 6307 Wow & Flutter Meter

- Crystal controlled oscillator
- High accuracy and frequency stability
- 3150 Hz and 3000 Hz selectable
- Separate 'Drift' and 'Flutter' indication
- In/Output connector to DIN 41 524
- Easy to operate

Previously reserved as a special tool for the audio design laboratory, the wow and flutter meter has today become a must for every audio and video service workshop. The easy-to-operate PM 6307 is designed to identify and quantify unwanted speed variations in audio and video tape recorders, record players and movie projectors. This crystal controlled oscillator giving the choice of 3.15 kHz (DIN) or 3 kHz frequencies, it is possible to make very accurate wow and flutter checks and alignments.

Readout of speed fluctuations of, for example, a recorder, is indicated on two separate analog meters, one for drift and one for wow and flutter. Calibration of the drift indicator is simple, being achieved by depressing the ZERO button, while the SET ZERO control is adjusted for zero indication. The use of the X-tal oscillator eliminates the long warm-up time associated with normal RC types with the advantage that the instrument can be used immediately after switch-on. The measuring ranges for drift and flutter are separately selectable by push-buttons. There is also a convenient choice of three positions for wow and flutter measurements. With the filter switched ON, the frequency response is 'weighted', according to DIN Standard 45 507.

In the filter OFF position a linear frequency response of 0.5 Hz to >500 Hz, (-3 dB) is available and the 'unweighted' flutter is indicated.

For special measurements beyond the normal everyday usage there is a connector on the rear panel to apply any desired external filter.

Ideal for fast checks and alignment procedures, the PM 6307 is especially favored in servicing applications, because it will differentiate between mechanical and electrical problems.

Generally, the wow/flutter meter indicates a mechanical failure while the drift meter is associated with electronically sourced faults.

Small in size, light in weight and extremely easy to operate thanks to good ergonomic design, this instrument is a real asset for today's audio and video service requirements.

To detect extremely slow speed variations, the SLOW RESPONSE setting is selected. A range of input and output connectors is available which will meet the requirements of service workshops and development laboratories alike. Because the majority of wow and flutter measurements are made on consumer HiFi, record players, tape and cassette recorders, the in/output standard DIN connector is conveniently located on the front panel.

Specifications

Technical Specifications

Oscillator

Frequency: 3150 Hz and 3000 Hz. Selectable (X-tal controlled)
Accuracy: $<10^{-4}$ (ref. 23°C)
Stability: 1×10^{-5}
Output 1:
DIN connector at front panel (DIN 41 524)
Signal Voltage: 400 mV_{p-p} Open circuit; 100 mV_{p-p} at 47 kΩ load; 20 mV_{p-p} at 10 kΩ load
Internal Resistance: 430 kΩ
Output 2:
BNC connector at rear panel
Signal Voltage: $1V_{pp}$
Output Impedance: 600Ω

Measurement Section

Input 1: Same as output 1 at front panel
Input 2: BNC connector at rear panel
Input Voltage: 2 mV...10V
Input Impedance: 10 kΩ
Test Frequencies: 3150 Hz or 3000 Hz selectable
Calibration: With zero set push-button and control on front panel
Drift-Measuring Range: ±0.3%, ±1%, ±3%
Indication: Analog meter, with zero at midpoint
Flutter-Measurement Range: 0.1%, 0.3%, 1%, 3%
Indication: Analog meter

Frequency Response Flutter Indication

Selectable
A. weighted: according to DIN Standard 45 545 (filter on)
B. unweighted: 0.5 Hz...500 Hz (-3 dB) bandpass (filter off)
C. external: connector at rear panel for use of an external filter (filter ext.)

Reading Speed

Normal: According to DIN 45 507
Slow: Slow response (e.g. to measure the average value to fast speed variations)
Output 3:
BNC connector (on rear panel)
Bandwidth: 0.5 Hz...500 Hz (-3 dB)
(For fast recording on oscilloscope display)
Output Impedance: 10 kΩ
Frequency Variation Coefficient: For 'Drift' 1V corresponds with 1%

Power Requirements

Line Voltage: 115, 230V
Power Consumption: 2W
Line Frequency: 50/60 Hz
Dimensions: 230 mm W x 110 mm H x 200 mm L (9 in W x 4.3 in H x 8.3 in L)
Weight: 2 kg (4.4 lb)
Included: Mains cable, instruction manual

Ordering Information

Models

PM 6307 Wow and flutter meter

Accessories

Test Cassette 3150 Hz
Record 3150 Hz ($33^{1}/_{3}$ rpm)
Both items are to DIN 45 545

PM 6309



PM 6309

PM 6309 Distortion Meter

- Accurate, fast and automatic measurements to DIN standards
- Total and third harmonic measurements 0.01 to 19.9%
- Direct readout on $3^1/_2$-digit LED display plus analog trend indicator
- Integral oscillator with adjustable output from 1 mV to 1V
- Four selectable test frequencies: 40, 333, 1000 and 5000 Hz
- Built-in volts $_{RMS}$ meter
- Easy DIN connection to device under test

The PM 6309 has been specially designed to provide appropriate signal generation plus an accurate distortion measuring capability within a single instrument. It is capable of very fast automatic measurements to DIN specifications.

PM 6309 thus has a very wide application potential in audio and HiFi servicing since it can be used to check cassette and tape recorders, amplifiers and record players.

The instrument provides either third harmonic or total harmonic distortion readings on an integral $3^1/_2$-digit LED display or simple analog trend meter. The test signal is generated by a built-in very low distortion oscillator.

Four fixed test frequencies are provided; DIN standard 40, 333, 1000 and 5000 Hz to meet all basic service applications. Output is provided on a front panel connector, with output voltage continuously adjustable from 1 mV to 1V.

There is a choice of BNC or DIN connectors — the latter particularly for recorders — on the front panel for signal measurements. Input range can be selected from 200 mVto 20V; input LEDs indicate the need to change range. With the DIN input, DIN levels 0.2 to 2V are selected and it is possible to check either right or left channels.

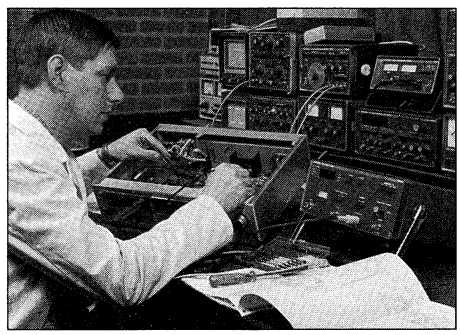
Input Filtering

The incoming signal is filtered to remove the first harmonic (the original signal) and distortion is indicated as a percentage of this harmonic. The measurement can either be the total harmonic distortion, normally with 40, 1000 or 5000 Hz, or only the third harmonic distortion, particularly at 333 Hz used for cassette and tape recorder testing.

Moreover, the input range having been selected, the instrument automatically maintains the input signal to a fixed level. Thus, fluctuating inputs cannot influence a measurement.

Resolution with the LED display is 0.01 percent up to 19.99 percent distortion. The separate analog meter allows adjustments such as setting minimum levels. The LED display can also function as an RMS voltage meter, ideal, for example, to set the gain of an amplifier to a required value.

A separate output on the rear of the instrument provides the distortion signal; that is, the incoming signal minus the first harmonic, for any further analysis.



PM 6309 in service workshops: professional equipment for professional service

Simple to Use

Practically complete automation of operation makes the PM 6309 particularly easy to use. It is virtually impossible to make mistakes when using the instrument.

Specifications

Technical Specifications

Measuring Modes

Distortion and Voltage measurement

Distortion Mode

Nominal Test Frequencies: 40,333,1000 and 5000 Hz (selectable with push-buttons)
Tolerance: ±1.5%
(admissable difference between input frequency and selected nominal test frequency)
Measured Quantities: Total harmonic distortion (THD) at 40,1000 and 5000 Hz
Third harmonic distortion (3rd HD) at 333 Hz
Input
1. BNC connector on front side,
2. DIN connector on front side, (Left and right channel selectable with push-buttons)
Input Impedance: 1 MΩ (for both inputs)
Input Capacitance: 30 pF for input 1;
25 pF for input 2

Digital Display: 3 digit 7-segment LED display
Maximum Indicated Value: 19.99%
Resolution: 0.01%
Max. Measuring Error: ±5% ±1 digit of display value
Hum Attenuation (50...180 Hz): >20 dB (at 1 and 5 kHz)
Analog Indication: 0...20%
Characteristic: 0...0.2% linear
0.2...20% approx logarithmic
Distortion: BNC connector ar rear side
Output Voltage: 0.1 V_{RMS}/% distortion
Output Impedance: 1 kΩ
Oscillator Output: BNC connector or DIN connector on front panel
Voltage Range: 1 mV...1V
Frequency: Determined by test frequency selection
Maximum Frequency Error: ±0.5%
Temperature Coefficient: <300 ppm/K
Distortion: <0.01% for 333/1,000/5,000 Hz
<0.015% for 40 Hz
Output Impedance: 600Ω for BNC connector
47Ω for DIN connector

Voltage Mode

Input: As distortion input, if plug is inserted into INPUT/OUTPUT socket this input is automatically selected
Measuring Ranges: 0...2V; 0...20V
(selectable with push-buttons)
Input Impedance: 1 MΩ
Digital Display: $3^1/_2$ digits 7-segment LED display
Maximum Value: 19.99V
Resolution: 0.01V in 20V range
0.001V in 2V range
Frequency Range: 10 Hz...100 kHz
Error (for sinewaves with THD<2%):
±5% ±1 digit (10 Hz...20 kHz)
±10% ±1 digit (10 Hz...100 kHz)
for voltages >5% of range

Environmental Capabilities

Ambient Temperatures
Range of Use: +5°C...+40°C
Storage and Transport: -40°C...+70°C
Humidity: Relative humidity 20%...80%
Max. Altitude for Operation: 2200m
Vibration: 5g (10...150 Hz) 0.35 mm
Shock: 10g
Dimensions: 310 mm W x 140 mm H x 333 mm L
(13.1 in W x 5.5 in H x 13.1 in L)
Weight: 5 kg (11 lb)

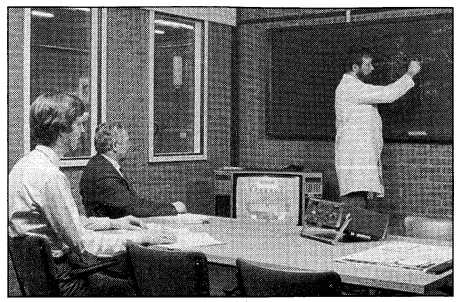
Power

Line Voltage: 110,128,220 or 238V ±10%
Frequency: 50...100 Hz
Included: instruction manual

Ordering Information

Models

PM 6309 Distortion meter



PM 6309 in education: training with the same equipment as used in professional service.

PM 5171



PM 5171

PM 5171 Amplifier, AC/DC and Linear/Log Converter

Three instruments in one: amplifier, AC/DC converter and linear-logarithmic converter

AC/DC Converter: dynamic range 60 dB, response time 0.35s, error ±0.5 dB (1 kHz)

Log Converter: dynamic range 80 dB, slewing speed 80 dB/s, error 1 dB at 60 dB

Amplifier: gain 60 dB, rise/fall time 100 ns, distortion 0.2% (60 dB)

This versatile laboratory instrument combines the three distinct functions wideband amplifier, AC-to-DC converter and linear-to-logarithmic converter, in a single instrument.

Measuring Amplifier

The measuring amplifier covers the range from DC to 1 MHz and will accept an AC- or DC-coupled input. Maximum permissible input voltage is 100V p-p and the output is between 0 and 10V rms. Gain is adjustable in switchable 10 dB steps, between 0 and 60 dB, with an accuracy of 0.1 dB at 1 kHz. It can also function as an impedance converter, as Z_{in} is high and Z_{out} is low.

AC-to-DC Converter

The DC output for a 10V rms input is 10V. With a dynamic range of 80 dB, the conversion error is only 0.5 dB at 1 kHz. A good response time of 0.35 seconds has been achieved and the frequency range is between 10 Hz and 100 kHz for an output of 10V rms and between 10 Hz and 20 kHz for an output of 1V rms.

Linear-to-Logarithmic Converter

This has a dynamic range of 80 dB, with a slewing speed of 100 dB/second. Output voltage is, typically, 2V for a 10V rms amplifier output. A continuously adjustable DC shift from 0 to 2V is provided. Conversion factor is 1V/20 dB and frequency ranges are as for the AC-to- DC converter.

Specifications

Technical Specifications

Measuring Amplifier

Input: ac or dc coupled (switchable)
Input Impedance: 1 MΩ//20 pF
Maximum Operating: 30V pp
Maximum Permissible Input Voltage: 100V pp
Output Voltage: 0...10V rms (open circuit)
Internal Resistance: 50Ω
Gain: 0, 10, 20, 30, 40, 50 or 60 dB (switchable)
Inaccuracy: ±0.1 dB at 1 kHz (<40 dB gain)
Bandwidth: R load = 600Ω, f_{ref} = 1 kHz
DC Coupling: 0...1 MHz at G ≤20 dB (-0.5 dB);
0...3 MHz at G ≤20 dB (-3 dB);
0...15 kHz at G = 60 dB (-0.5 dB);
0...40 kHz at G = 60 dB (-3 dB)
AC Coupling: Lower frequency limit
≤5 Hz (-0.5 dB)
≤2 Hz (-3 dB)
Rise and Fall Time: 100 ns at R load 600Ω and a gain of 20 dB
Distortion: 0.1%, gain 40 dB (f = 15 kHz)
0.2%, gain 60 dB (f = 15 kHz)
Drift: 50 µV/°C
Input Noise: 15 µV (gain 10...60 dB; B = 350 kHz)

AC-to-DC Converter

DC Output Voltage: 10V at 10V rms at amplifier output (load resistor 19 kΩ)
Internal Resistance: 10Ω
Conversion Error: ±0.5 dB ;at 1 kHz
Dynamic Range: 80 dB
Response Time: 0.35s
Frequency Range:
10 Hz...100 kHz at 10V rms at amplifier output
10 Hz...20 kHz at 1 mV rms at amplifier output

DC to Log Converter

Output Voltage:
+2V at 10V rms at amplifier output
-1V at 10 mV rms at amplifier output
DC Shift: 0...-2V continuously adjustable
Conversion Factor: 1V/20 dB
Conversion Error: 1 dB (at 1 kHz from 0 to 60 dB)
Dynamic Range: 80 dB
Slewing Speed: 80 dB/s (from 0 to -60 dB)
Frequency Range:
10 Hz...100 kHz at 10V rms at amplifier output.
10 Hz...20 kHz at 1 mV rms at amplifier output

Operating Conditions

Reference Temperature: 23°C ±1°C
Operating Temperature: 5°C...40°C
Dimensions: 230 mm W x 110 mm H x 200 mm L (9 in W x 4.3 in H x 7.9 in L)
Weight: 1.6 kg (3.5 lb)

Power Supply

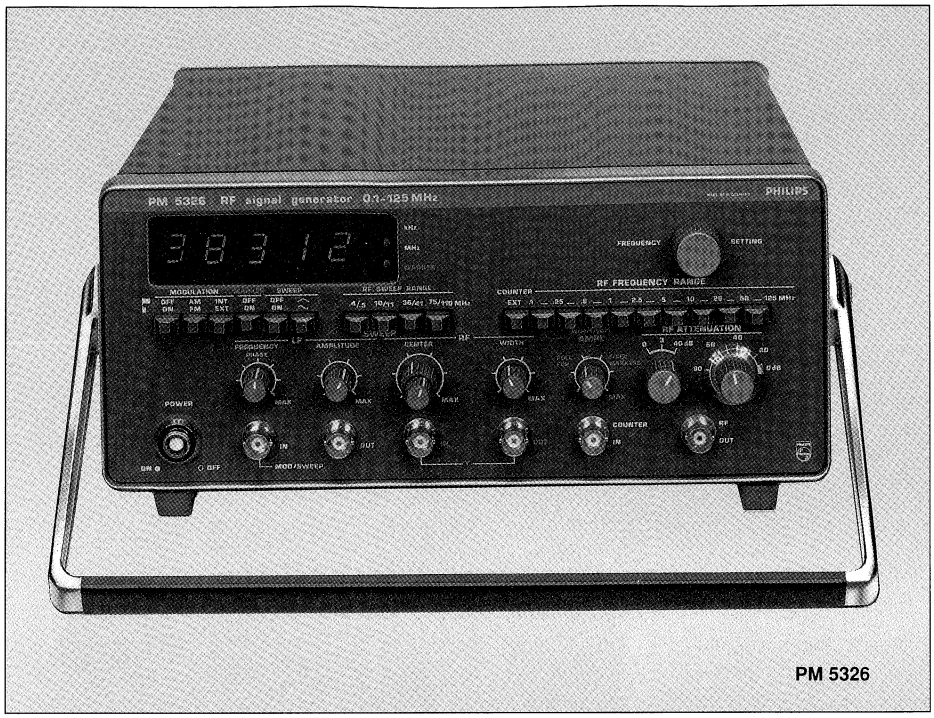
Line Voltage: 115/230V ±15%
Line Frequency: 50...100 Hz
Consumption: 8W
Included: Operating/service manual

Ordering Information

Models

PM 5171 Amplifier, AC/DC and linear/log converter

PM 5326



PM 5326

PM 5326 RF Signal Generator

- 100 kHz to 125 MHz in 9 overlapping ranges
- 5-digit counter displays, RF-carrier marker and external frequencies to 10^{-4} ±1 digit
- 50 mV RF output at 75Ω can be attenuated to over 100 dB
- Output level electronically stabilized
- Sweep facility for IF amplifiers AM/FM, radio and TV receivers

The RF signal generator PM 5326 has been specially designed for radio and television development laboratories and those involved with receiver sensitivity and selectivity measurements. For service workshops and education the generator also provides four sweep ranges for the alignment of IF amplifiers and FM receivers.

Color Coded Controls

The generator is divided into three functions: main RF oscillator; sweeper; and marker generator. Controls for each function are color-coded, and grouped for operator convenience.

Main RF Oscillator

The output frequency extends from 100 kHz to 125 MHz in 9 push-button selected ranges covering the AM/FM radio spectrum. A built-in 5-digit display enables frequencies to be easily set to 1 part in 10000, essential for precise alignment procedures, selectivity and filter tests. The counter function can also measure frequencies from external oscillators to 1 MHz, extendable up to 100 MHz using the model PM 5326X. Typical uses for the counter include alignment of TV remote control units and checking line and frame time base frequencies.

The output level is electronically stabilized for all ranges eliminating resetting and the need for meter reading and can be continuously attenuated to over 80 dB from the maximum of 50 mV into 75Ω. This may be set to levels calibrated at -3 dB and -40 dB with a separate attenuator. An additional unique feature of the generator is the special attention given to spurious RF radiation. A 'double-box' construction gives a high degree of screening, keeping RF radiation very low and ensuring that low level outputs in the region of 0.5 µV can be used with full confidence.

AM/FM Modulation

A choice of CW or MCW output AM or FM and internal or external modulation signals are quickly selected by push-buttons. All AM signals can be internally modulated by a 1 kHz tone to a depth of 30% which is adequate for most applications. This can be increased to 100% over the range 20 Hz to 20 kHz (3 dB) by an external source. Frequency modulation may be applied to the 10/11 MHz and 75-110 MHz ranges allowing complete alignment checks to be made on FM receivers. Internal frequency modulation at 1 kHz is equivalent to a 22.5 kHz deviation. External signals can be applied to a maximum deviation of 75 kHz over the frequency range 20 Hz to 60 kHz (3 dB).

A swept frequency oscillator output is available to measure the dynamic response of intermediate frequency amplifiers in AM/FM and TV receivers. Four frequency ranges are selectable by push-buttons. The maximum sweep widths are 50 kHz for AM/IF, 1.2 MHz for FM/IF and Band II and up to 10 MHz for the video IF ranges. Sweep rate is either by a linear sawtooth between 3-30 Hz or at a line frequency sinewave with phase adjustment.

Marker Generator

Markers are available in each RF sweep range to indicate a precise frequency value and provide a calibrated frequency scale over the complete spectrum. The position of the variable marker is controlled by the main frequency control and the setting is displayed on the internal counter. Fixed markers at regular intervals may be added to the output signal by pulling the marker amplitude switch.

Specifications

Technical Specifications

Frequency

Range: 100 kHz...125 MHz
(9 subranges, selectable with push-buttons)
Subranges:
1. 100 kHz...250 kHz
2. 250 kHz...500 kHz
3. 500 kHz...1000 kHz
4. 1 MHz...2.5 MHz
5. 2.5 MHz...5 MHz
6. 5 MHz...10 MHz
7. 10 MHz...25 MHz
8. 25 MHz...50 MHz
9. 50 MHz...125 MHz

Display: 5-digits, 7-segment 11 mm LED, 2-dimension LEDs kHz, MHz
Setting Error: $<10^{-4}$ ±1 digit (typical)
Temperature Coefficient: $<10^{-5}$/K
Short Term Drift: 1×10^{-6}

RF Output

Voltage: 50 mV at 75Ω
Impedance: 75Ω
Frequency Response: <2 dB in each RF range (1 dB typical)
Attenuation:
80 dB continuous with indication
40 dB and 3 dB calibrated and switchable

PM 5326

Modulation

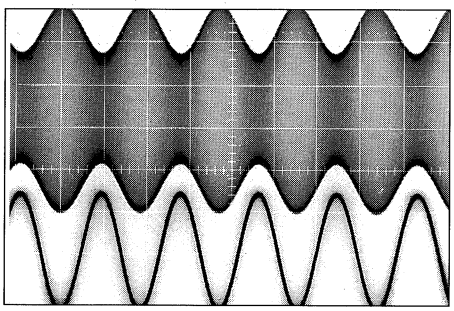
Modulation modes:
Unmodulated
Amplitude modulated AM
Frequency modulated FM
Modulation Output MOD OUT:
1 kHz sine, 2V resp. external modulating signal at MOD IN

Amplitude Modulation:
Unmodulated
AM, Internal:
All RF and sweep ranges
Modulation frequency: 1 kHz sine
Modulation depth: 30%
AM, External:
Modulation depth: 0 - 100%
Modulation coefficient: 200 mV/10%
3 dB Bandwidth: 20 Hz - 20 kHz
Input impedance: >10 kΩ

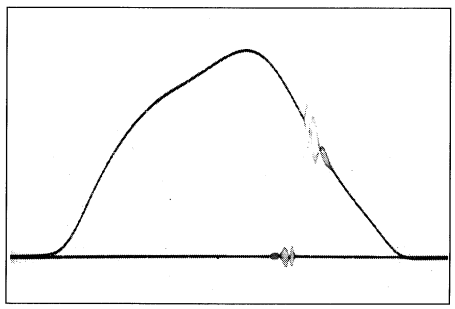
Frequency Modulation
FM, Internal:
10/11 and 75/110 MHz ranges
Modulation frequency: 1 kHz sine
Deviation (Δf): 22.5 kHz

FM External:
3 dB Bandwidth: 20 Hz - 60 kHz
Deviation (Δf): 0 - 75 kHz
Modulation coefficient: 200 mV/7.5 kHz
3 dB Bandwidth: 20 Hz - 60 kHz
Input impedance: >10 kΩ

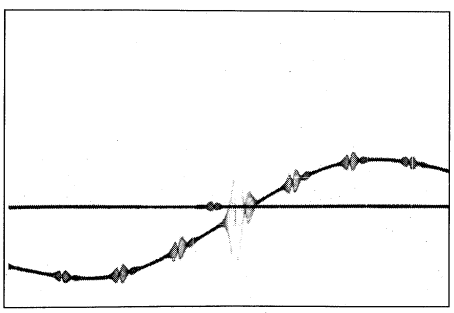
RF Sweep Ranges:
400 kHz...500 kHz
10 MHz...11 MHz
75 MHz...110 MHz
36 MHz...41 MHz
Frequency Response: >0.2 dB in sweep ranges
36...41 MHz and 75...110 MHz
>2 dB in sweep ranges
400 kHz...500 kHz
10 MHz...11 MHz
Sweep Frequency: 3...30 Hz continuously variable; 50 Hz or 60 Hz mains, phase variable
Sweep Widths: (fully variable)
0...50 kHz in range 400 kHz...500 kHz
0...>1 MHz in range 10 MHz...11 MHz
0...1 MHz in range 75 MHz...110 MHz
0...10 MHz in range 36 MHz...41 MHz
Linearity: >95%
Center Frequency: Fully adjustable between minimum and maximum



Internal AM signal, 1 kHz and 30% modulation depth at a carrier frequency of 27 MHz.



The luminance IF curve is aligned at its frequency of 38.9 MHz.



S curve with variable marker at 10.7 MHz and fixed markers at regular intervals of 100 kHz.

Output: BNC connector Sweep out
Voltage: 2.5V to 10.5 Vp-p (varied by internal sweep)
Impedance: 1 kΩ

Marker Generator

Fully variable over all four RF sweep ranges and indicated by LED display.
Marker: Marker mixing, AF beat frequency markers
Amplitude: Adjustable to 2 Vp-p
Output: Marker addition via loop through BNC connections Y_{in}- Y_{out}
Impedance: >500 kΩ

Fixed Markers

Obtained by pulling marker amplitude switch. Distance between the fixed markers dependent on selected range.

Counter

Selected by COUNTER EXT push-button
Input: BNC-connector
Frequency Range: 1 kHz - 999.99 kHz or 1 kHz - 99.99 MHz (PM 5326X)
Input Voltage: 30 mV...50V (PM 5326X)
50 mV...50V (PM 5326)
Input Impedance: 1 MΩ

General Specifications

Power Requirements

Voltage: 115, 230V
Power Consumption: 18W
Frequency: 48...63 Hz

Mechanical Specifications

Size: 310 mm W x 140 mm H x 330 mm L (12.6 in W x 5.5 in H x 13 in L)
Weight: 6.5 kg (14.3 lb)
Included: PM 9537 Cable with impedance transformer 75/300Ω, operating/service manual, line cord.

Ordering Information

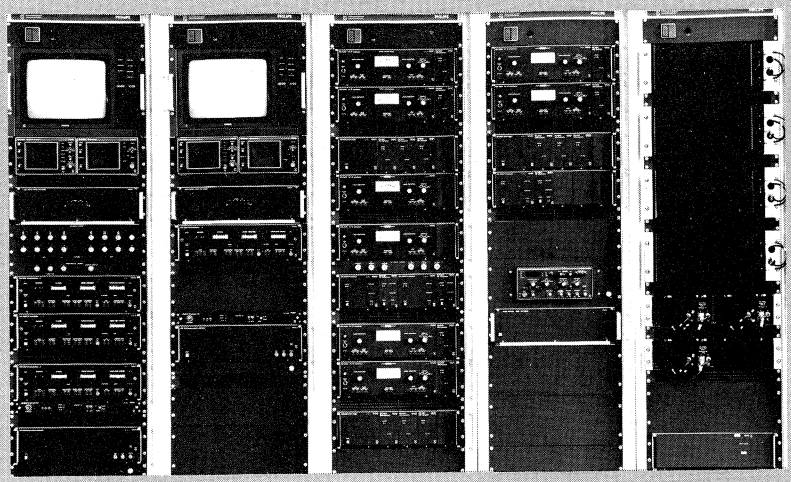
Models

PM 5326 RF Signal Generator
PM 5326X As PM 5326 with a counter facility up to 100 MHz

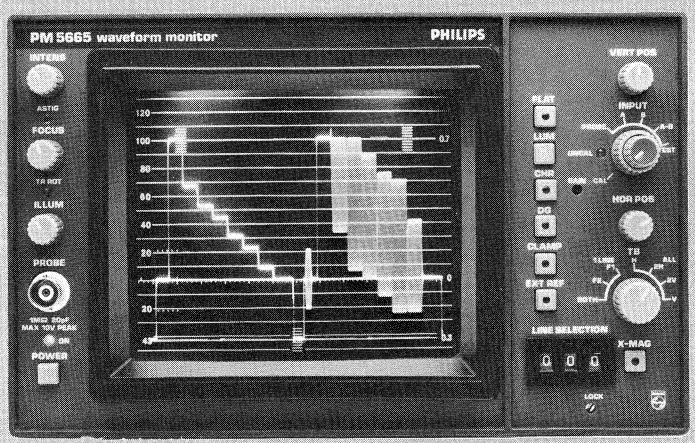
Accessories

PM 9072 Cable BNC 4 mm
PM 9075 Cable BNC-BNC
PM 9560 19-in Rackmount Adapter

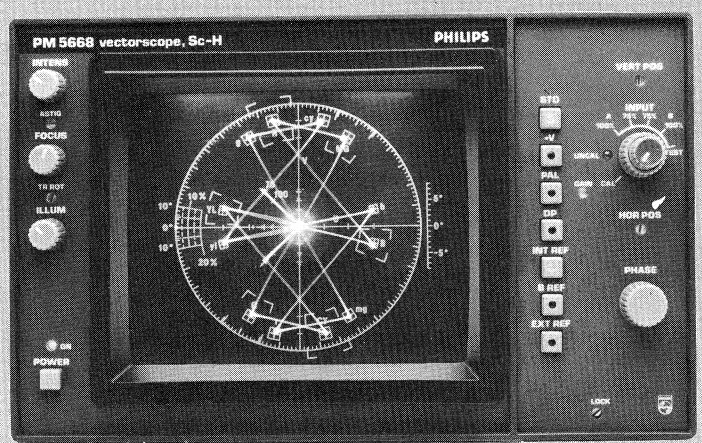
Professional Television



Transmitter system Page 514



PM 5665 Page 515



PM 5668 Page 515

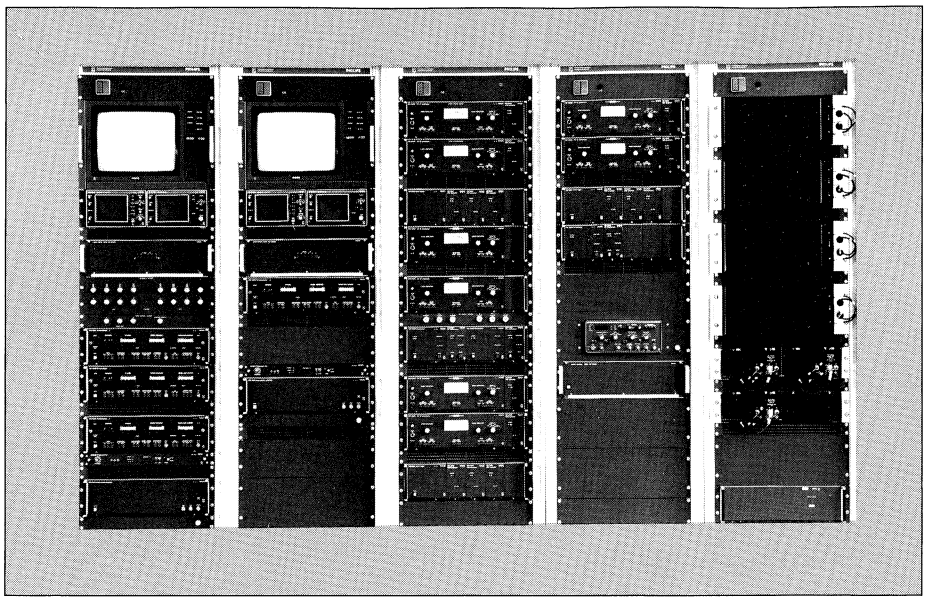
Philips Professional Television (PTV) measuring equipment is among the largest television test and measuring equipment suppliers in the world. PTV test equipment is used in TV broadcasting, cable TV, closed-circuit TV, engineering, manufacturing and repair of consumer and professional TV products.

Philips PTV test equipment is found in broadcasting studios, telecine and video tape recorder centers, main terminals, microwave and satellite link stations, and in transmitting stations. Large cable TV and closed-circuit TV systems use PTV equipment for testing and monitoring system performance, and for signal distribution.

Most of the world's TV receivers are produced with some Philips test gear. The same is true for manufacturing video tape recorders, video cassette recorders, television transmitters, television cameras, mixers, color monitors and other television test gear.

The total range of PTV equipment has a reputation for extremely high quality and excellent reliability.

Introduction	Page 514
Video Analysers	Page 515
Test Signal Generators	Page 517
VITS Generators & Analyzers	Page 518
Sync & Pattern Generators	Page 519
Modulators & Demodulators, etc.	Page 519



Complete transmitter system for testing TV sets in TV manufacturing complex

Professional TV Test & Measuring Equipment Introduction

This section of the catalog describes only part of the extensive Philips Professional Television (PTV) measuring equipment. More details are available in the comprehensive PTV catalog and separate data sheets for each instrument.

Philips PTV is among the largest television test and measuring equipment suppliers in the world. PTV test equipment is used in test broadcasting, cable TV, closed-circuit TV, engineering, manufacturing and repair of consumer and professional TV products.

Philips PTV test equipment is found in broadcasting studios, telecine and video tape recorder centres, main terminals, microwave and satellite link stations, and in transmitting stations. Large cable TV and closed-circuit TV systems use PTV equipment for testing and monitoring system performance, and for signal distribution.

Most of the world's TV receivers are produced with some Philips test gear. The same is true for manufacturing video tape recorders, video cassette recorders, television transmitters, television cameras, mixers, color monitors and other television test gear.

The total range of PTV equipment has a reputation for extremely high quality and excellent reliability. These are key factors when the failure of a single piece of equipment can shut down an entire operation.

Systems

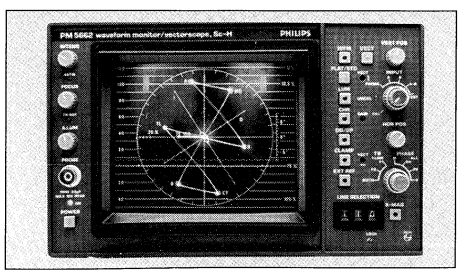
The PTV factory also supplies systems and special customer modifications of standard products. The increasing complexity of television systems and the demand for special know-how and test equipment forces many TV test equipment users to seek professional assistance in planning and installing systems. The ordering of a complete system rather than individual units offers the user the following advantages:

- Guaranteed system performance
- Design and planning by experienced PTV specialists
- Only a single supplier to negotiate with.

The Philips PTV systems group derives its expertise from many years of successful system design, in particular for TV set and video cassette recorder factories. For further information, please contact the Test & Measurement sales office of your local Philips sales organisation. You may contact Philips PTV, Philips Elektronik Industri, Jenagade 22, DK 2300 Copenhagen, Denmark.

Telephone +45-31-572222
Telex 31201 PHIL DK
Telefax =45-31-570044

Waveform Monitor/Vectorscope PM 5661 and PM 5662, Sc-H



- **Two instruments combined in one unit.**
- **PM 5662 features Sc - H phase display.**
- **Input signal subtraction (A-B) for easy colour frame correction.**
- **All lines (525/625) selectable from front panel.**
- **Available in NTSC & PAL versions.**
- **Familiar control panels for fast and simple operation**

This two-in-one instrument, PM 5661 Waveform Monitor/Vectorscope and PM 5662 Waveform Monitor/Vectorscope with Sc - H phase display, delivers all essential waveform monitor and vectorscope capabilities. Its compact size (only a half-rack wide) makes these instruments ideal for applications with limited space and restricted power. PM 5661 and PM 5662 offer the wide range of measuring facilities required in TV broadcast studios, OBVs, ENGs, CATV head ends, and production studios. Both instruments are suitable for integration with video tape recorders.

When Sc - H phase measurement is needed, PM 5662 is ideal. It provides horizontal sync timing, relative to the reference subcarrier (burst), to verify colour framing and signal format. PM 5662 Sc - H phase display greatly simplifies a previously complex monitoring and analysing task.

Every instrument in the Philips range of waveform monitors and vectorscopes delivers the brightest, crispest displays available - even VITS (ITS) are now brighter and crisper than previously in all measuring modes.

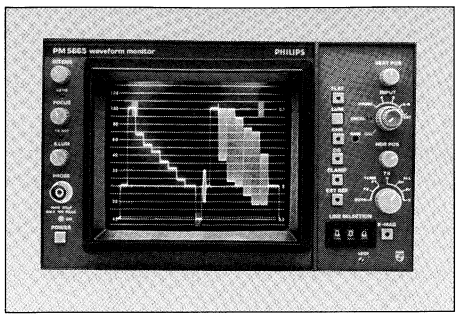
Ordering Information

PM 5661M (M-version, 525- line NTSC, 3.579 MHz)
PM 5661G (G-version, 625-line PAL, 4.433 MHz)
PM 5661N (N-version, 625-line PAL, 3.582 MHz)
PM 5661P (M-version, 525-line PAL, 3.575 MHz)
PM 5662M (M-version, 525-line NTSC, 3.579MHz)
PM 5662G (G-version, 625-line PAL, 4.433 MHz)
PM 5661M/20 (M-version, 525-line NTSC, 3.579 MHz, non lin.)
PM 5661G/20 (G-version, 625-line PAL, 4.433 MHz, non lin.)
PM 5661N/20 (N-version, 625-line PAL, 3.582 MHz, non lin.)
PM 5661P/20 (M-version, 525-line PAL, 3.575MHz, non lin.)

Options

PM 8539 19" Rack Cabinet
PM 8540 Blind Plate for PM 8539
PM 8541 Carrying Case
PM 8543 Cabinet, Plain

Waveform Monitor PM 5665



- **Input signal subtraction (A-B) for easy colour framing correction.**
- **All lines (525/625) selectable from front panel line selector.**
- **Available in NTSC & PAL versions.**
- **Standard control panels for fast, simple operation.**
- **Front panel probe input for quick fault finding.**
- **Higher resolution, even for differential gain.**

The PM 5665 Waveform Monitor offers all essential waveform monitoring capabilities. It has the wide range of measuring facilities required in TV broadcast studios, transmitters, OBVs, ENGs, CATV heat ends and production studios. The instrument is ideal for integration with video tape recorders.

The capability to subtract inputs allows easy timing and phasing of two genlocked signals. The user can select inputs A, B and A-B directly from the front panel.

- Input impedance: high ohmic, 75Ω looped through.
- Return loss: <-40dB up to 15MHz.
- Max. input level: 2V peak-to-peak AC; <±2V DC.
- Gain differential between inputs A and B: <1% at 0.5MHz & f-sc.
- Phase differential between inputs A and B: <0.5 at f-sc.
- Crosstalk between inputs A and B: <-60dB at f-sc; <-50dB at 7MHz.
- Connector type: BNC.

The user can select a front panel probe input via the input selector switch:

- Input impedance: 1MΩ, 20pF.
- Max. input level: 10V DC± peak AC.

The user can select filters directly from the PM 5665 front panel:

- Flat: 50kHz to 10MHz, within 2%.
- Luminance attenuation: <3dB at 1MHz; >40dB at f-sc.
- Chrominance, -3dB bandwidth:
  f-sc -800kHz ± 100kHz;
  f-sc +800kHz ± 100kHz.

With an internal jumper, the user can select alternate displays of flat and luminance response in LUM mode.

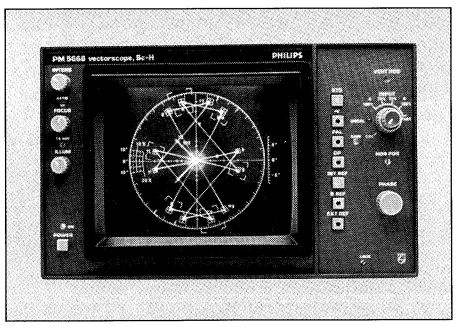
Ordering Information

Waveform Monitor
PM 5665 (M-version,525-lineNTSC, 3.579MHz)
PM 5665G (G-version, 625-line PAL, 4.433MHz)
PM 5665N (N-version, 625-line PAL, 3.582MHz)
PM 5665P (M-version, 525-line PAL, 3.575MHz)
PM 5665M/20 (M-version, 525-line NTSC, 3.579MHz,non-lin.)
PM 5665G/20 (G-version, 625-line PAL, 4.433MHz, non-lin.)
PM 5665N/20 (N-version, 625-line PAL, 3.582MHz, non-lin.)
PM 5665P/20 (M-version, 525-line PAL, 3.575MHz, non-lin.)

Options

PM 8539 19" Rack Cabinet
PM 8540 Blind Plate for PM 8539
PM 8541 Carrying Case
PM 8543 Cabinet, plain

Vectorscope PM 5667 & PM 5668 Sc-H



- **PM 5668 features Sc - H phase display.**
- **Available in NTSC & PAL versions.**
- **Higher resolution, even for differential phase up to 0.2 deg.**
- **Easy access for adjusting astigmatism.**

The PM 5667 Vectorscope and PM 5668 Vectorscope with SC - H phase display have all essential vectorscope capabilities. They offer the whole range of measuring facilities required in TV broadcast studios, transmitters, CATV head ends and production studios. Both instruments are ideal for integration with video tape recorders.

When Sc - H phase measurement is needed, the PM 5668 is ideal. The PM 5668 provides correct phasing relative to the reference subcarrier (burst). PM 5668 Sc - H phase display greatly simplifies a previously complex monitoring and analysing task. The user can select inputs A and B directly from the front panel.

- Input impedance: high ohmic, 75Ω looped through.
- Return loss: <-40 dB up to 15 MHz.
- Max. input level: 2V peak-to-peak AC; <±2V DC
- Crosstalk between inputs A and B: <-60 dB at 2 f-sc.
- Connector type: BNC.

Sc-H phase display:

- Signal requirements: (applied to A, B or EXT REF):
  – signal type: composite video or black burst.
  – sync and burst amplitude; 300 mV (PAL). 286 mV (NTSC) ±3 dB.
  – timing between EXT REF and displayed signal, <±15 µs
- Electrical characteristics
  – Display range internal interference ±80° (with field ref. pulse 360) EXT REF: 360°.
- Accuracy
  – Absolute: ±5° phase at 25°C.
  – Relative: ±2° (0 - 45°C).
- Matching
  – Internal reference to EXT REF match: ±0.5°.
  – Input A to input B match: ±0.5°.

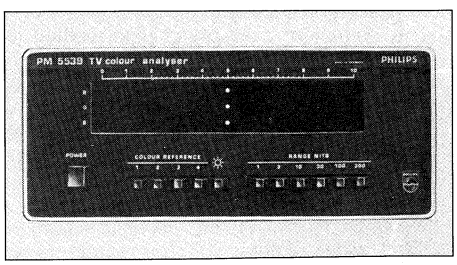
Ordering Information

Vectorscope
PM 5667M (M-version, 525-line NTSC, 3.579 MHz)
PM 5667G (G-version, 625-line PAL, 4.433 MHz)
PM 5667N (N-version, 625-line PAL, 3.582 MHz)
PM 5667P (M-version, 525-line PAL, 3.575 MHz)
PM 5668M (M-version, 525-line NTSC, 3.579 MHz)
PM 5667G (G-version, 525-line NTSC, 4.433 MHz)

Options

PM 8539 19" rack cabinet
PM 8540 Blind Plate for PM 8539
PM 8541 Carrying Case
PM 8542 Interface Cable
PM 8543 Cabinet, Plain

TV Colour Analyser PM 5539



- **First practical solution to the problem 'objective setting' of color monitors.**
- **The three LED bars mounted over each other ensure quick and accurate reading of color levels and balance.**
- **High sensitivity allows accurate setting of the colour white at low luminance levels.**

The Philips TV Color Analyser PM 5539 meets the growing demand for measure and adjusting the 'color' white of TV sets and color monitors.

The light emitted by a color picture tube consists of the primary colors: red, green and blue. White is obtained by additive mixing of these colours in the appropriate proportions. The PM 5539 has three independent LED displays, so that the intensities of the primary colors can be measured simultaneously.

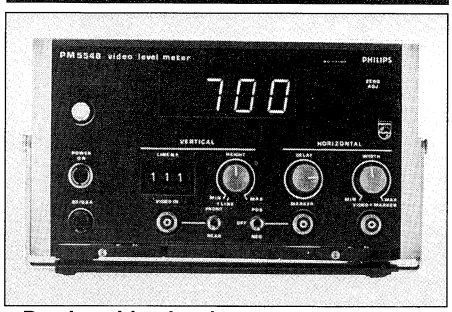
To cope with different white standards or different brands of picture tubes, the PM 5539 has four matrix circuits which can be adjusted to give correct readings.

The white level is normally adjusted at both high and low brightness levels, but the ratio of the three primary colours should also stay the same at 'grey' levels. To permit this 'grey scale tracking', the PM 5539 has a wide sensitivity range (1 to 300 NIT full scale).

Ordering information

PM 5539

Video Level Meter PM 5548



- **Precise video level measurement.**
- **Controls for line selection and position on the selected line(s) allow measurement at any place of the video level of a TV signal or pattern including insertion signals.**
- **Optional BCD output.**

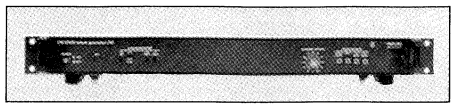
The digital video level meter is specially designed for aligning and checking all video equipment, such as pattern and test signal generators, encoders, decoders, mixers.

The instrument uses a sampling method to measure levels at any point of the television signal. The position of the sampling pulse is determined by four frontplate controls: - thumbwheel switches, directly indicating the line number for the sampling to start, - control height, determining how many lines will be sampled, - multiturn potentiometer delay, giving the sampled point on the selected line(s), - control width, determining the width of the sampling pulse.

Ordering Information

Video Level Meter
PM 5548G (G-version, 4.43 MHz color subcarrier, mV readings)
PM 5548M/00 (M-version, 3.58 MHz color subcarrier, mV readings)
PM 5548M/10 (M-version, IRE readings)

Color Generator PM 5630, PO



- **Generates six video signals on parallel outputs.**
- **All video signals generated digitally.**
- **Provides all synchronisation signals for TV studios and OB vans.**
- **High stability through TCXO as reference oscillator.**

The color generator, PO (Parallel Outputs), type PM 5630, is a combined color sync pulse generator and colour test signal generator. PO indicates that all test signals are available simultaneously at separate outputs. The sync pulse generator conforms with the latest EBU and RS-170A standards for broadcasting, and supplies all necessary synchronisation signals for driving television studios and other television systems. Special custom-made integrated circuits and carefully selected crystal oscillators ensure unsurpassed accuracy and stability.

The signal generator works digitally, i.e. all test signals are stored in programmable read-only memories as digital information. This information feeds digital-to-analog convertors so that the required analog waveforms are obtained. This principle guarantees highly accurate and stable output signals.

The signals comprise the following important studio alignment signals:

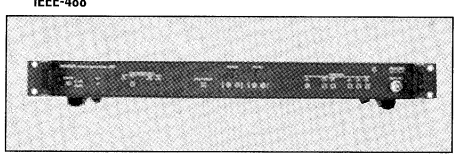
- Color bars (several versions)
- PLUGE with grey scale
- Convergence pattern (grid-dots-checker board, several versions available)
- Red pattern
- Grey scale (5 or 10 riser)
- Window (10% - 100% white) in steps of 10%
- Black burst

Ordering information

Colour generator
PM 5630G (G-version, 625-line PAL)
PM 5630 P (M/PAL version, 525-line PAL)
PM 5630 N (N-version, 625-line PAL)
PM 5630M (M-version, 525-line NTSC)

Color Generator PM 5631, MP

GPIB
IEEE-488



- **Generates up to 99 video signals selectable from the front panel.**
- **Provides all necessary synchronisation signals for TV studios and OB vans.**
- **All main options remotely controllable via optional IEEE bus interface.**
- **Color field reference pulse available.**
- **Can be genlocked to other video sources.**

The color generator, type PM 5631, MP (multiple pattern), is a combined color sync pulse generator and color pattern generator.

MP indicates that a large number of signals can be selected on a single output.

The sync pulse generator conforms with the latest EBU and RS-170A standards for broadcasting, and supplies all necessary synchronisation signals for driving television studios and other television systems. Special custom-made integrated circuits and carefully selected crystal oscillators ensure unsurpassed accuracy and stability.

The signal generator works digitally, i.e. all test signals are stored in programmable read-only memories as digital information. This information feeds digital-to-analog convertors so that the required analog waveforms are obtained. This principle guarantees highly accurate and stable output signals.

The generator has a standard library of some 90 pre-programmed patterns that include:

- Color bars
- Composite color patterns
- Color test signals
- Monochrome signal.

In manual mode, pattern selection is via push-buttons (up/down counter with display). Modifications are available for testing purposes. The instrument can also be controlled remotely via an IEC/IEEE interface (optional).

The PM 5631 is recommended when a number of test signals are needed on a single output, by manual or computer control, such as in broadcast studios, CCTV and CATV studios, outside broadcast vans, factories for manufacturing high quality consumer TV products and professional color equipment.

Ordering Information

Colour Generator
PM 5631G (G-version, 625-line PAL)
PM 5631P (M-version, 525-line PAL)
PM 5631N/O (N-version, 625-line PAL)
PM 5631M (M-version, 525-line NTSC)
SECAM version: see PM 5632

Options

PM 8520 IEEE-488 Interface
PM 8530 TTL control

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Color Generator PM 5632 SECAM

GPIB IEEE-488

This generator is the SECAM version of the PM 5631. All test signals and features are essentially identical with those of the PM 5631. The output is in accordance with the SECAM color system.

Ordering information

Color generator
PM 5632L (625-line SECAM)

Options

PM 8520 IEEE-488 Interface
PM 8530 TTL Control

Component Color Coder, SPG PM 5638



- **Encodes analogue components to composite video signal (NTSC or PAL).**
- **Stand - alone SPG for timing.**
- **Multiple formats, including RGB and new SMPTE/EBU standards.**
- **Easy TTL control.**
- **Extra functions via rear connection.**
- **Only one reference needed in genlock.**
- **Optional color bar generator module.**

The Philips PM 5638 Component Color Coder, SPG is a compact, highly stable encoder and SPG for professional applications in, for example, television studios, programme production and TV laboratories. It encodes critical analogue signal sources from VTRs, cameras, etc. into composite video format.

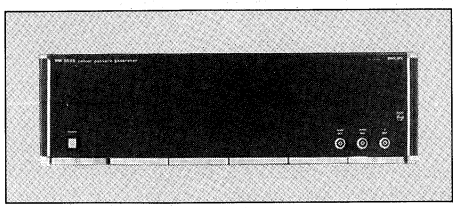
For genlock, only a sync is needed as the PM 5638 has its own built-in SPG. This special feature distinguishes the PM 5638 from other encoders which require a separate SPG for timing signals. The PM 5638 also functions as a stand-alone SPG.

The standard PM 5638 handles two formats: internal jumper selection sets the instrument to RGB (GBR), or to Y, R-Y, B-Y which also covers the SMPTE/EBU format (Y, P/B, P/R). Other formats are available on request. Most PM 5638 functions are switched by grounding the particular function pin via a 24 - pole Amphenol (R) connector on the rear panel.

Ordering Information

Component Color Coder
PM 5638G/00 (G-version, 625-line PAL, 4.433 MHz)
PM 5638N/00 (N-version, 625-line PAL, 3.582 MHz)
PM 5638P/00 (M-version, 525-line PAL, 3,575 MHz)
PM 5638M/00 (M-version, 525-line NTSC, 3.579 MHz)

Color Pattern Generators PM 5534 and PM 5535



- **Most recognised receiver test pattern in the world.**
- **Used intensively by broadcasting authorities and TV setmakers.**
- **Extended performance by optional text generator and time clock.**
- **Built-in coder and sync pulse generator for color systems (PM 5534).**
- **YRGB output (PM 5535).**

The Color Pattern Generator PM 5534 is a self-contained instrument generating the well known PHILIPS circle pattern. This pattern, recognised all over the world, allows the most important characteristics of a TV receiver to be visually checked on the screen. The PM 5534 pattern is identical with the pattern produced by its predecessor PM 5544.

This test pattern has been adopted by television authorities in more than 25 countries in all parts of the world as the test pattern to be transmitted outside programme hours. The pattern is composed so that almost all relevant parameters for a TV receiver or color monitor can be checked by observing the various signal elements of the pattern, directly from the screen of the receiver or TV monitor.

The PM 5535, with its YRGB output, will drive different coders for multi-standard applications (e.g. PAL & SECAM).

In addition, there is room for optional print cards to extend the performance of the instrument. These include a text generator, clock generator, an oven-controlled crystal oscillator and a 10MHz input card.

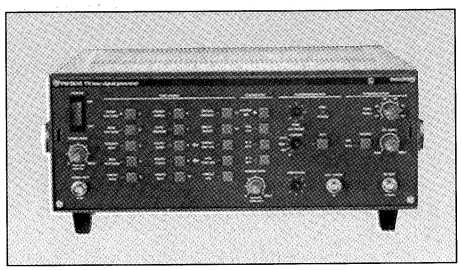
Ordering Information

Color Pattern Generator
PM 5534D (D-version, 625-line PAL)
PM 5534G (G-version, 625-line PAL)
PM 5534I (I-version, 625-line PAL)
PM 5534L (L-version, 625-line SECAM)
PM 5534P (M-version, 525-line PAL)
PM 5534M (M-version, 525-line NTSC)
PM 5534N (N-version, 625-line PAL)
PM 5535G (G-version, 625-line PAL)
PM 5535I (I-version, 625-line PAL)
PM 5535L (L-version, 625-line SECAM)
PM 5535P (M-version, 525-line PAL)
PM 5335M (M-version, 525-line NTSC)
PM 5335N (N-version, 625-line PAL)

Options

PM 8501 10 MHz Interface Card
PM 8502 Oven Controlled Crystal Oscillator
PM 8503 Text Generator
PM 8504 Time Clock
PM 8507 Calibration Board

Test Generator PM 5646



- **Low cost and light weight.**
- **Ideal for video production centres & small TV studios.**
- **Perfect for professional & consumer TV repair.**

The new PM 5646 TV Test Signal Generator is a universal test signal generator, with a built-in sync pulse generator (SPG) and auxiliary RF modulator for Band 1.

The PM 5646 delivers a variety of signals useful for lining up monitors, cameras, waveform monitors, vectorscopes and other equipment.

Moreover, the PM 5646 generates test signals for checking video tape recorders, mixers and all types of transmission equipment. For final testing, the PM 5646 provides a composite test pattern.

Since the PM 5646 has a text captioning option, it can also deliver a standby pattern.

Light in weight, the PM 5646 is perfect in situations where portability is paramount.

Ordering Information

Test Generator
PM 5646G (G-version, 625-line PAL)
PM 5646M (M-version, 525-line NTSC)

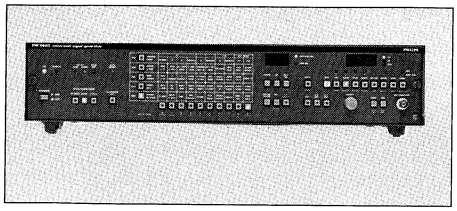
Options

PM 8526 Test Generator
PM 8527 19" Mack Mount Kit

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

Video Test Signal Generator, PM 5640

GPIB IEEE-488

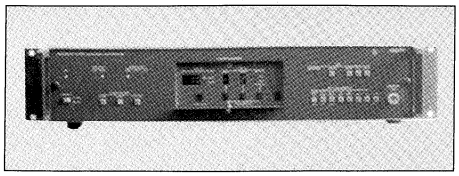


- **Most comprehensive test signal generator available.**
- **Simplest to operate.**
- **Simplest to programme.**
- **Unique: continuous amplitude control of all signal elements.**
- **Unique: sinewave frequencies of up to 20 MHz.**
- **Unique: zone plate signals up to 13.5 MHz.**
- **Unique: over 150 standard test signals & patterns.**
- **Unique: digital display of amplitudes & frequencies.**
- **Unique: emergency pushbutton for standard set-up.**
- **Unique: blanking mixer facility.**
- **Circle pattern included.**
- **Built-in full VITS generator & insertor.**
- **All synchronisation signals available as outputs.**
- **Correct Sc - H phase included.**
- **Simple - to - programme VITS insertions.**
- **User can customise signals**
- **GPIB/IEEE-488* remote control of all functions, including amplitudes.**
- **Non-volatile memory stores all settings, even if power fails.**
- **Stores up to 9 front-panel set-ups & customised signals.**

Ordering information

Video Test Signal Generator
PM 5640G (B/G-vesion, 625-line PAL,4.43 MHz)
PM 5640M (M-version, 525-line NTSC, 3.58MHz)
PM 5640I (I-version, 625-line PAL, 4.43 MHz UK ITS)

VITS Generator & Inserter PM 5654



- **Extensive full-field capabilities.**
- **Text signals digitally generated for high accuracy and stability.**
- **Built-in security features prevent unauthorised access to programming.**
- **Program protection with by-pass relay.**
- **All 4 CCIR & EBU test signals and colour bar inserted as VITS in 625-line version.**
- **Generates NTC-7 and VITS & VIRS in 525-line version.**
- **Inserts 4 (or 6) EXT. SIGNALS, e.g. teletext, data and special test signals.**
- **Remote control of main functions, insertions and full-field signals.**

The new PM 5654 VITS Generator & Inserter from Philips inserts digitally - generated test signals to guarantee high accuracy and stability.

The instrument is available in 625-line as well as 525-line versions. (Request separate data sheet for 525-line version). PM 5654 generates VITS (Vertical Interval Test Signals) as well as full - field test signals and inserts signals for TV transmitters, satellite links and terrestrial microwave links. PM 5654 also inserts teletext and data. In transmitter, as well as other applications, the instrument has automatic program signal substitution.

With built-in security measures to prevent unauthorised access to programming, the PM 5654 permits line selection directly from its front pane for storage in a non-volatile memory. The instrument has special features like Red, colorbar, 50 Hz and 250 kHz squarewaves. From the VITS panel, a substitution signal can be selected and then programmed. Without inserting VITS or colour bar, line content can still be deleted with the PM 5654. An optional Source Identification (SID) Generator can insert a special digital code in the vertical blanking interval to identify signal source (eg STUDIO 2, VTR 24, OB 4).

The PM 5654 is realistically designed for the demands of actual applications. The instrument contains no unnecessary features. This allows the PM 5654 to be priced without charges for unwanted extras.

Functional Description

As input, the PM 5654 accepts regular video signals as well as signals provided with "sound in sync". The PM 5654 VITS Generator and Insertor loops an incoming signal through its insertor/ deleter circuit, where insertions of VITS, soyrce identification signal and signals to EXT inputs occur and where other lines may be deleted. Insertions and deletions are programmable on any line from line 6 to line 22 in field 1 and line 319 to line 335 in field 2.

The VITS generated by PM 5654 are in full accord with CCIR Recommendation 473-3 and EBU spec. tech. 3209E. The PM 5654 VITS control panel is under a hinged cover in the centre of the unit's front panel. Via the control panel, insertion is enabled for the generated test signals, 4 (or 6) EXT inputs and 4 SID codes selectable via remote control. The lines used for these signals can be monitored for status from the control panel. Any of these lines can be erased via the control panel, and any missing program signal can be automatically substituted for. In testing, the program signal can be exchanged for a full - field test signal based on the unit's various test signals and duty modes. Moreover, a separate full-field test signal independent of the VITS generator mode, is also provided.

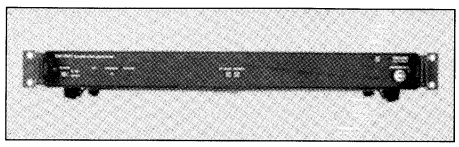
Ordering Information

VITS Generator & Inserter
PM 5654G (B/G version, 625-line, 4.43 MHz color subcarrier)
PM 5654M (M-version, 525-line, 3.58 MHz color subcarrier)
PM 5654I (I-version, 625-line UK ITS and CCIR VITS)

Options

PM 8538 Source Identification Generator & Detector/VITS Detector
• Data generator.
Generates source codes consisting of a sequence of biphase signals as outlined in EBU tech. 3217-E. Four sets selectable by remote control.
• Data Detector
When enabled, this provides automatic insertion of DATA from either the optional Source Identification Generator or from the signal from one of the EXT inputs in case of missing DATA.
• VITS Detector.
When enabled, this provides automatic insertion of VITS in case of a missing test signal on a specific line which is selectable from the PM 5654 front panel controls. The line number is stored in the non-volatile memory.

Studio VITS Generator PM 5651 & PM 5652, ED



- **Self - contained unit with insertion and generation of CCIR or NTC 7 specified VITS signals.**
- **Programme path protected via by-pass relay.**
- **Insertion of VITS signals selectable by internal matrix from line 8 to line 22 (321-335).**
- **Optional source code generator available.**

The PM 5651 is for use in broadcasting studios, video tape recording and telecine centres.

The PM 5651 offers the professional EBU and NTC 7 signals at an attractive price, so that it is

now economically feasible to introduce a VITS generator/inserter/deleter at each video source. In addition, the PM 5651 has an optional source code generator which makes the identification of signal source or programme material easy or even automatic. The EBU source code is standard in the European version; other codes on request.

The generator has extreme accuracy and stability due to its digital generation principle, whereby the signals are stored in a digital format in PROMs and turned into analogue waveforms by means of a high-speed precision D/A converter. Bypass relay protection, easy programming and serviceability are self-evident features of this type of equipment.

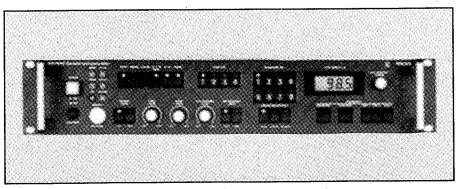
Ordering Information

Studio VITS Generator
PM 5651G (G-version, 625-line CCIR [EBU])
PM 5651 I (I-version, 625-line UK national)
PM 5651M (M-version, 525-line NTC-7)
PM 5652G (G-version, 625-line CCIR)
PM 5652 I (I-version, 625-line UK national)
PM 5652M (M-version, 525-line NTC-7)

Options

PM 8523 Source ID Generator
Specification: EBU source code or similar (Special codes on request).

Teletext Test Generator PM 5645



- **Complete 4-page teletext generator in conformity with British teletext standard.**
- **Transmission of 1, 10 or 100 pages per magazine, selectable from front panel.**
- **Adjustable eye - height of data signal with two pre-set positions.**
- **Adjustable white noise as well as co-channel sine wave interference available.**

The PM 5645 Teletext Test Generator is a precision instrument designed for testing teletext decoders, TV receivers with teletext decoder, as well as any equipment or part of a TV + teletext transmission system.

The instrument is self - contained in that it consists of a sync pulse generator (SPG), a full field video generator (cross - hatch) and a teletext generator with distortion possibilities. The teletext part has the following key facilities:

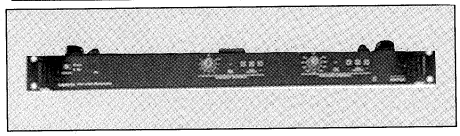
- 8 selectable magazines.
- Magazine length of 1, 10 and 100 pages.
- 4 pages
- Eye - height reduction by echoes, co-channel interference and noise.

The PM 5645 is recommended for use in production and professional repair plants for testing, calibrating and evaluating TV receivers/monitors with teletext facilities. In the transmission path, in particular at transmitter stations, the PM 5645 is very useful for testing of the degradation of the decoding margin as a result of incorrect amplitude and group delay response.

Ordering Information

Teletext Test Generator
PM 5645I (I-version, 625-line UK teletext)

Sync Test Generator PM 5634



- **Jumping line signal with offset up to ±8% from nominal line frequency.**
- **Jumping subcarrier signal with offset up to ±800 Hz from nominal subcarrier frequency.**
- **Color test signals for adjustment and control of decoders.**
- **External reference inputs for other line and subcarrier frequencies.**

The PM 5634 Sync Test Generator is an extremely versatile tool for testing and evaluating the synchronisation circuitry incorporated in most types of television equipment, such as monitors, receivers, video tape recorders and sync pulse generators.

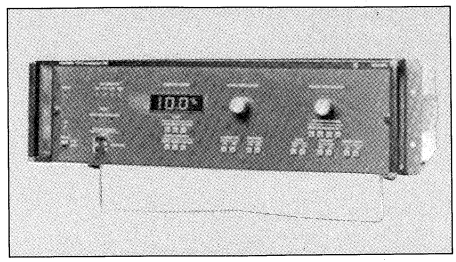
The instrument supplies two main signals and two auxiliary signals. The monochrome test signal has variable horizontal (and vertical) frequency, which can be off-set from nominal in steps or jumped automatically from plus to minus the selected offset. The color test signal has a variable subcarrier frequency, which can be offset in the same way as the horizontal frequency of the monochrome signal. The auxiliary signals (red and colortest) are used for monitor and receiver alignment.

The PM 5634 is recommended for all television production, repair and quality control. In engineering and design laboratories, the instrument offers speedy evaluation of the synchronisation characteristics of new equipment.

Ordering Information

Sync Test Generator
PM 5634G (G-version, 625-line PAL)
PM 5634P (M-version, 525-line PAL)
PM 5634M (M-version, 525-line NTSC)
PM 5634N (N-version, 625-line PAL)

TV IF Modulator PM 5680



- **Minimises incidental phase modulation.**
- **Non-linearity corrector option for tetrode transmitters.**
- **Effective RF/IF signal screening.**
- **Optional sound modulator for 2-channel stereo transmission.**
- **Optional white clipper & sync stretcher.**
- **Versions for TV systems B/G, M, L, D and I.**

The PM 5680 TV IF vision and sound modulator comes in versions designed to meet the broadcast specifications of TV systems B/G, M, L, D and I.

The PM 5680 output signals are either combined vision/sound signal or separate vision and sound carriers. The unit's high stability and tight tolerance on amplitude and group delay make the PM 5680 well suited for broadcast transmitters. The vision output level is 1 Vrms (sync). Input requirements are 1V p-p +3 dB to -6 dB video and 0 dBm + 6 dB sound. The PM 5680 is also used in TV distribution systems such as large CATV systems, TV factories and TV labs. For these applications, one or more RF converters (PM 5682 and PM 5683) bring in the signal on a VHF or UHF channel. The converter's IF inputs are looped through with directional couplers, so a single IF modulator can drive a large number of converters.

Ordering Information

TV IF Modulator
PM 5680G/00 (G-version, 38.9 MHz, LC filter, Standard Group Delay)
PM 5680G/10 (G-version, 38.9 MHz, SAW filter, Standard Group Delay)
PM 5680G/02 (G-version, 38.9 MHz, LC filter, Norwegian/Swedish Group Delay)
PM 5680G/12 (G-version, 38.9 MHz, SAW filter, Norwegian/Swedish Group Delay)
PM 5680G/04 (G-version, 38.9 MHz, LC filter, Australian Group Delay)
PM 5680G/14 (G-version, 38.9 MHz, SAW filter, Australian Group Delay)
PM 5680D/00 (D/K-version, 38.0 MHz, LC filter)
PM 5680D/01 (D/K-version, 38.9 MHz, LC filter)
PM 5680D/11 (D/K-version, 38.9 MHz, SAW filter)
PM 5680I/00 (I-version, 38.9 MHz, LC filter)
PM 5680I/01 (I-version, 39.5 MHz, LC filter)
PM 5680I/10 (I-version, 38.9 MHz, SAW filter)
PM 5680L/00 (L-version, 32.7 MHz, LC filter)

PM 5680L/01 (L-version, 38.9 MHz, LC filter)
PM 5680L/11 (L-version, 38.9 MHz, SAW filter)
PM 5680M/00 (M-version, 45.75 MHz, LC filter)
PM 5680M/01 (M-version, 38.9 MHz, LC filter)
PM 5680M/10 (M-version, 45.75 MHz, SAW filter)

Options

PM 8533G White Clipper + Sync. Stretcher, 4.43 MHz
PM 8536G Dual Sound / Stereo 33.4 / 33.16 MHz
PM 8537G Non-Linearity corrector, 32 - 39 MHz

TV Modulator, IF PM 5670

This modulator is an IF version of the PM 5671 TV modulator. The modulator allows either a composite vision/sound IF signal or vision and sound signals on separate output connectors (selected internally).

The PM 5670 is recommended when IF signals are required or sound and vision have to be converted separately into VHF or UHF channels. Recommended convertors: PM 5682; PM 5683 power supply for PM 5682.

Ordering Information

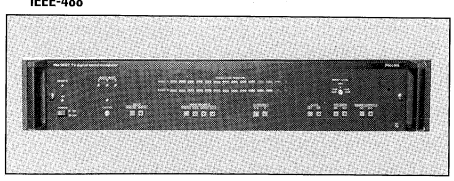
TV Modulator
PM 5670D/01 (D/K-version, 38.9 MHz IF)
PM 5670G/00 (B/G-version, 38.9 MHz IF)
PM 5670I/00 (I-version, 38.9 MHz IF)
PM 5670M/00 (M-version, 45.75 MHz IF)
PM 5670L/00 (L-version, 32.7 MHz IF)

Options

PM 8524 10 MHz TCXO

PM 5687 TV Digital Sound Modulator, PM 5685 NICAM Encoder & PM 5686 NICAM Sound Modulator

GPIB IEEE-488



PM 5687 is a multisound encoder and QPSK modulator offering high quality digital sound in stereo, two independent mono channels or one mono channel and/or one data channel for adding to a TV signal. The PM 5687 fulfils and even surpasses NICAM-728 standards.

Full compatibility with existing TV transmissions is obtained by modulating the additional information on a second sound carrier. The PM 5687 is designed for TV systems B/G and I. The instrument can be readily adapted to other TV systems on request.

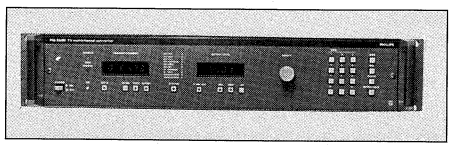
If only NICAM-728 encoding is required, two analog audio signals from inputs A and B of the PM 5685 NICAM encoder can be encoded into NICAM-728. PM 5685 also has an extra 11 - bit data channel. The audio modes (mono, stereo, dual) can be selected using the four control bits via remote control. The PM 5685 is available for all TV systems.

If only NICAM-728 sound modulation is required, then the PM 5686 NICAM sound modulator should be used. A NICAM-728 input signal can be digitally QPSK sound modulated. The NICAM clock frequency is also regenerated internally. All frequencies and timings can be derived from either an internal or external reference. The PM 5686 is designed for TV systems B/G and I.

Ordering Information

Digital TV Sound Modulator
PM 5687G/00 33.05 MHz (fv: 38.9 MHz) TTL Interface
PM 5687G/10 33.05 MHz (fv: 38.9 MHz) GPIB/ IEEE-488 Interface
PM 5871/00 32.348 MHz (fv: 38.9 MHz) TTL Interface
PM 5687I/10 32.348 MHz (fv: 38.9 MHz) GPIB/ IEEE-488 interface
PM 5871I/01 32.948 MHz (fv: 39.5 MHz) TTL Interface
PM 5687 I/11 32.948 MHz (fv: 39.5 MHz) GPIB/ IEEE-488 Interface
NICAM Encoder
PM 5685/00 TTL Interface
PM 5685/10 GPIB/IEEE-488 Interface
NICAM Sound Modulator
PM 5686G/00 IF: 38.9 MHz
PM 5686I/00 IF: 38.9 MHz
PM 5685I/01 IF: 39.5 MHz

TV Multichannel Converter PM 5690



GPIB IEEE-488

- **IF to RF signal conversion.**
- **Adjusts to any IF input frequency.**
- **Preprogrammed for 8 TV systems.**
- **User can preprogram & store two additional channel systems.**
- **Covers all known TV frequencies from 8 MHz to 950 MHz.**
- **Variable output level.**
- **RF output level adjustable from 0.01 to 500 mV. Low spurious noise &distortion.**
- **Available with 50 & 75 ohm output impedance.**

The PM 5690 TV Multichannel Converter is a highly stable RF converter with calibrated output level. It converts a complete IF TV signal, between 36 MHz - 46 MHz, to any channel between 8 MHz - 950 MHz. The PM 5690 works with the PM 5670 and PM 5680 IF modulators in an integrated measuring system.

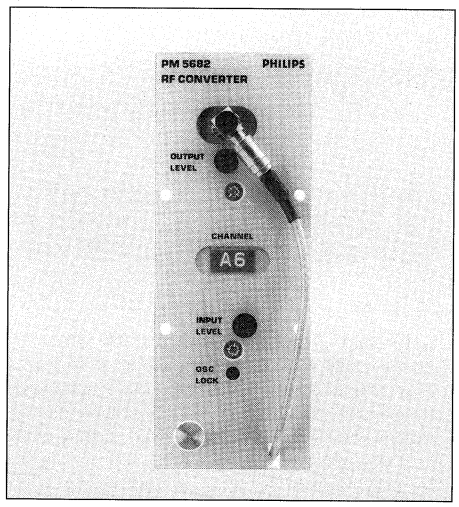
The PM 5690 has applications in manufacturing video recorders and TV receivers, including multi-standard receivers. It is easily adapted to computer-controlled test and measuring systems; in particular, the GPIB bus can be used to control levels and frequencies.

In broadcast organisations and tele-administrations, PM 5690 is ideal for laboratory applications, such as testing and repairing transposers and demodulators. In the field, PM 5690 is well suited for transmission and propagation tests.

Ordering Information

TV Multichannel Converter
PM 5690/00 (Input 50 ohm, output 50 ohm)
PM 5690/20 (Input 50 ohm, output 75 ohm)

PM 5682 RF–Converter & PM 5683 Base Unit



The channel converter PM 5682 can be easily installed and turns an IF Modulator PM 5680 into a high quality TV channel modulator with frequencies between 45 MHz and 900 MHz. The PM 5682 is designed for TV systems B/G, D/K, I, L and M.

If more TV channels are required, the base unit PM 5683 allows four channel converters PM 5682, to be connected to one PM 5680.

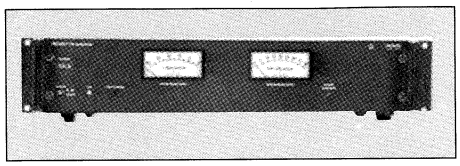
Ordering Information

Channel Converter
PM 5682G/00 38.9 MHz
PM5682D/00 38.0 MHz

**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

PM 5682D/01 38.9 MHz
PM 5682I/00 38.9 MHz
PM 5682I/01 38.9 MHz
PM 5682L/00 32.7 MHz
PM 5682L/01 38.9 MHz
PM 5682M/00 45.75 MHz
PM 5682M/01 38.9 MHz
Base Unit
PM 5683

TV Modulator PM 5671



- **Combined vision and sound modulator with output signal in VHF or UHF bands.**
- **Very high stability due to SAW filters.**
- **Pre-corrected group delay and rudimentary sideband characteristics.**
- **Very low content of harmonics and spurious signals at output.**
- **Ideal for low-power transmitters and distribution systems in TV factories.**

The TV modulator PM 5671 is a complete television modulator (transmitter) which has inputs for video and audio and output for VHF or UHF radio frequencies.

Extreme accuracy and stability are obtained with new technology, such as synthesised carrier generation and surface - acoustic wave - filter (SAW) for the amplitude response shaping. Although the PM 5671 is economically priced, it features the following broadcasting characteristics only found in more expensive modulators:

- Rudimentary side-band characteristics.
- Group delay pre-correction.
- Low distortion.
- Channel output with very low spurious and harmonic content.
- Precision meters, front mounted, for modulation control.

The PM 5671 is ideal for television distribution systems such as those used in TV and video cassette recorder factories, closed circuit and cable TV networks. The SAW filter ensures adjacent channel operation without interference. The PM 5671 is ideal as a cost effective exciter in low-power TV transmitters. The instrument is available for TV systems B/G, D/K, I, L and M.

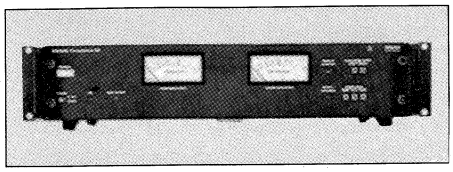
Ordering Information

TV Modulator
PM 5671D (D/K version)
PM 5671G (B/G-version)
PM 5671I (I-version)
PM 5671M (M-version)
PM 5671L (L-version)

Options

PM 8524 10 MHz TCXO

TV Modulator PM 5672, DS



- **Combined vision and dual/stereo sound modulator with RF output in the VHF range and the UHF range.**
- **Dual/stereo sound in conformity with the German system.**
- **Pre-corrected group delay and rudimentary sideband characteristics.**
- **Ideal for low - power, dual sound/stereo transmitters in CATV networks as well as central transmitter in TV factories.**

The PM 5672 DS TV modulator is a complete television modulator (transmitter) with inputs for video and two audio channels and output for VHF or UHF radio frequencies.

Extreme accuracy and stability are obtained with new technology, such as synthesised carrier generation and a surface-acoustic wave filter (SAW) for the amplitude response shaping. Although the PM 5672 is economically priced it features the following broadcast characteristics only found in more expensive modulators:

- Rudimentary side-band characteristics
- Group delay pre-correction
- Low distortion
- Channel output with very low spurious and harmonic content
- Precision meters, front mounted, for modulation control
- Stereo or two-channel sound

The PM 5672 is ideal for television distribution systems such as those used in TV and video cassette recorder factories, closed circuit and cable TV networks. The SAW filter ensures adjacent channel operation without interference. The PM 5672 is ideal as a cost effective exciter in low power TV transmitters.

Ordering Information

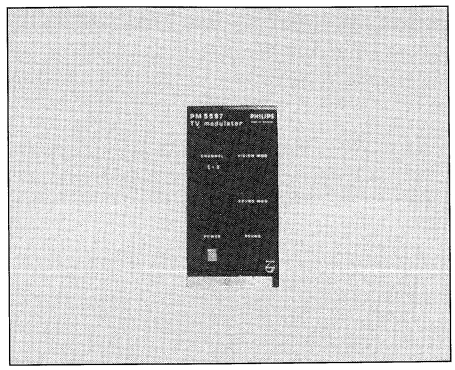
TV Modulator
PM 5672G (B/G-version, German two carrier system)
PM 5672D (D/K version, German two carrier system)

Two carrier system for other TV systems on request. The PM 5672 is supplied fully adjusted to a specific TV channel. Channel number or vision/sound frequencies as well as TV systems must be specified when ordering.

Options

PM 8524 10 MHz TCXO

TV Modulator PM 5597 & 5598



- **Self-contained TV modulator for distribution and universal purposes.**
- **Double side-band modulation with special filter that reduces partly the lower side-band and suppresses spurious and harmonic signals.**
- **Built-in indicators for overmodulation of video as well as sound carriers.**
- **Output of several modulators can be combined using simple combiners.**

The PM 5597 TV modulator is a small one-channel, combined vision/sound 'transmitter' of professional quality, well suited for colour and monochrome TV. The carrier frequency is crystal controlled, and all channels from 35 MHz to 300 MHz are available. The output signal is, in principle, a double side-band modulated RF signal; but a bandpass filter in front of the output stage partly suppresses the lower side-band and the frequency content of the higher side-band above the sound carrier. Moreover, this filter suppresses any spurious and harmonics outside the band-pass range. Thanks to wide-band output stage (75Ω output impedance over the complete frequency range), the outputs of several modulators can be connected to a single cable for distribution by means of a simple combiner without any mutual disturbance of the signals. Only every other channel has to be kept free of signal.

The modulator is a plug-in unit fitting into the PHILIPS 19-in, rack/table cabinet. The PM 5597 is a $^1/_6$ unit.

Ordering Information

TV Modulator
PM 5597D (D-version)
PM 5597G (G-version)
PM 5597I (I-version)
PM 5597L (L-version)
PM 5597M (M-version)
PM 5598D (K-version)
PM 5598G (G-version)
PM 5598I (I-version)
PM 5598L (L-version)
PM 5598M (M-version)

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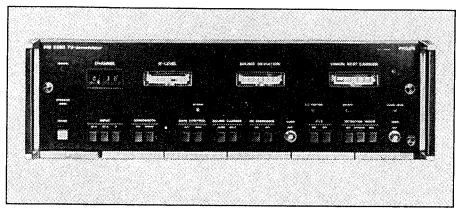
Options

PM 8521G Group Delay Precorrector
PM 8522M Group Delay Precorrector

Power Amplifiers PM 5691, 5693 & 5694



- **1 Watt RF power into 75 ohm.**
- **Usable with natural cooling or forced air cooling.**
- **Very low distortion and intermodulation.**
- **Small mechanical dimensions.**

The PM 5691, 5693 & 5694 power amplifiers are for high quality, high power distribution systems in, for instance, TV set and video recorder factories. The amplifiers are supplied for a specific channel in band I VHF (PM 5691), band III VHF (PM 5693) and the UHF band (PM 5694).

The amplifiers have extremely flat amplitude response/group delay response and very low intermodulation/distortion. They are ideal for high quality, low power transmitters.

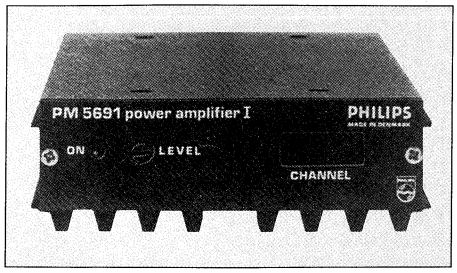
The standard output level is 1 Watt. However, if slightly more intermodulation is acceptable or a linearity corrector is applied, the amplifier can deliver substantially more power.

Ordering Information

Power Amplifier
PM 5691 (Band 1)
PM 5693 (Band 3)
PM 5694 (Band UHF)

These power amplifiers are factory-aligned for a specific TV channel or frequency, which must be specified when ordering.

TV Demodulator PM 5560



- **Synchronous and envelope detection modes allow the measurement of more parameters than previously and with improved accuracy.**
- **Unique ROM and synthesizer circuits facilitate straightforward channel dialing.**
- **Separate inputs for UHF and VHF channels at low and high levels, plus IF input.**
- **Channel and input section can be remotely controlled.**

The Philips 5560 TV demodulator is a compact precision Nyquist demodulator containing the tuner and the IF demodulator. The tuner is a combined VHF-UHF tuner using double conversion for good selectivity. Tuning is by means of thumbwheels, indicating the selected channel number. Provisions have been made to cover S-channels, special VHF channels and to tune to transmitters using an off-set frequency.

The IF demodulator can be used in two modes:
- Synchronous detection.
- Envelope detection.

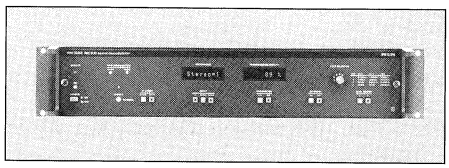
The modes can either be selected manually or automatically with a preference for the synchronous mode. Sound detection is also possible in two modes:
- Intercarrier sound.
- Split carrier sound.

Three meters are mounted on the front panel enabling simultaneous checks of IF level, sound deviation and vision rest carrier.

Ordering Information

TV Demodulator
PM 5560G (B/G-VERSION, 38.9 MHZ IF)
PM 5560D (D/K-VERSION, 38.0 MHZ IF)
PM 5560I (I-VERSION, 38.9 MHZ IF)
PM 5560M (B/G-VERSION, 45.75 MHZ IF)
Options
PM 8532 Screened Extension Board

PM 5688 Digital TV Sound Demodulator



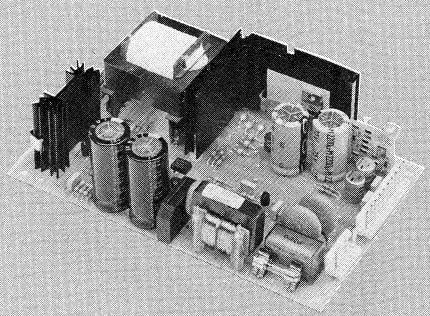
The PM 5688 is a Digital TV Sound Demodulator which fulfils and even surpasses NICAM-728 standards. Three inputs (IF, intercarrier and digital NICAM-728) provide for total system evaluation. The current transmission quality can be displayed in either eye-height or bit error rate (BER). A U-fold oversampling and digital filtering assures the highest audio performances.

Transmission data as A-bits, C-bits and CIB-bits are available from the rear-mounted outputs. All important signals for in-depth oscilloscope analysis are also available from the rear of the unit. The instrument operates with most common TV demodulators and is designed to cover future data transmission standards. PM 5688 is designed for TV systems B/G and I. It can be readily adapted for other TV systems on request.

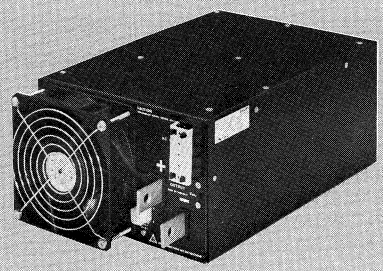
Ordering Information

Digital TV Sound Demodulator
PM 5688G/00 33.05 MHz/5.85 MHz TTL remote interface
PM 5688G/10 33.05 MHz/5.85 MHz GPIB/ IEEE-488 bus interface
PM 5688I/00 32.348 MHz/6.552 MHz TTL remote interface
PM 5688I/10 32.348 MHz/6.552 MHz GPIB/ IEEE-488 bus interface

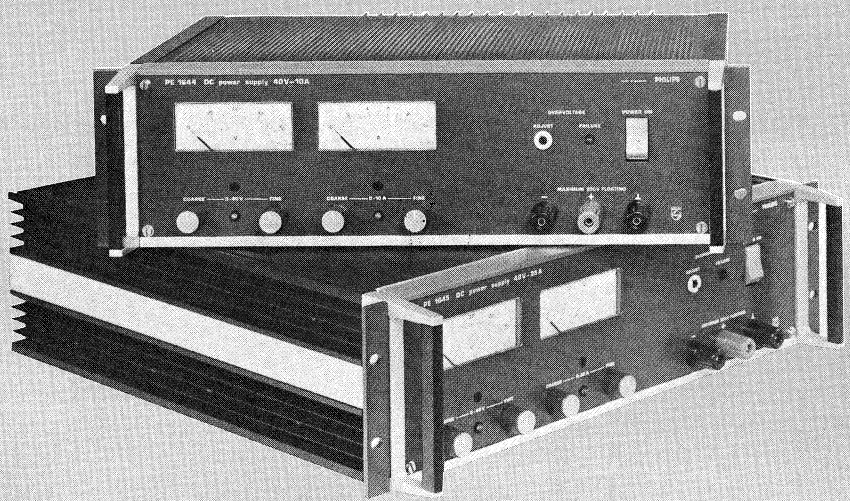
Power Supplies



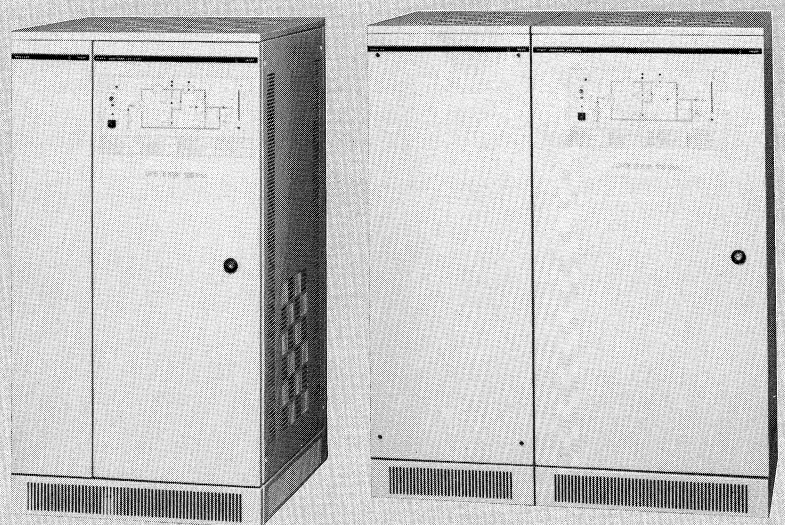
Series 190 40W Page 529



Series 190 1000W Page 531



PE 164X Lab/System Series Page 536



Compact U.P.S. Page 544

The Philips T&M range of power supplies and voltage stabilizers combines the latest design and state-of-the-art technology with high reliability, ensured by exhaustive testing at all stages of development.

The equipment includes DC power supplies for OEM, a range of bench, laboratory and system supplies, a power supplies programmer, line conditioners and uninterruptible supplies.

More than 80 Euro-switchers and over 150 open-frame switchers are available covering a range from 30 to 1000W. Their ease of mounting makes them suitable for a great variety of applications.

Introduction	Page 524
DC Power Supplies for OEM	Page 525
Fast-Programmable Power Supply	Page 532
Power Supplies for Bench Use	Page 533
Lab System Series	Page 536
IEC-Bus Power Supplies Programmer	Page 539
Line Conditioners	Page 541
Heavy Duty Uninterruptible Power Supplies	Page 544

Introduction

DC Power Supplies, AC Stabilizers & UPS Systems Introduction

The Philips T&M range of power supplies and voltage stabilizers combines the latest design and state-of-the-art technology with high reliability, ensured by exhaustive testing at all stages of development.

The Range

The equipment described in the following pages includes DC power supplies for OEM, a range of bench, laboratory and system supplies, a power supplies programmer, line conditioners and uninterruptible supplies. The information covered here is also available in leaflet form on request.

OEM Switching Modules

More than 85 Euro-switchers are available covering a range from 30 to 500W. Their ease of mounting makes them suitable for a great variety of applications.

Series 190 Switching Modules

A new range of 150 open-frame switchers is now available, offering power ratings from 40W to 1 kW. High quality has been assured by using power MOSFETs, hybrid circuits and advanced SMD techniques. Thanks to a modular, function-based design, semi-standard models tailored to customer requirements can be developed within 6 weeks.

Fast Programmable 10 kW Power Supply

The PE 5252 is a very accurate, programmable switched-mode DC source. It is ideal for a wide range of high-power applications which require a fast programmable power source. Applications include spot welding of electrical components, electro-plating and electrolysis processes.

Bench and Systems Types

Highly stable units are offered for bench use, producing outputs from 20 to 120W at varying voltage and current levels. Single, dual and triple output versions are available, while an MTBF of 75,000 operating hours guarantees long term reliability.

IEC/IEEE Bus Power Supplies Programmer

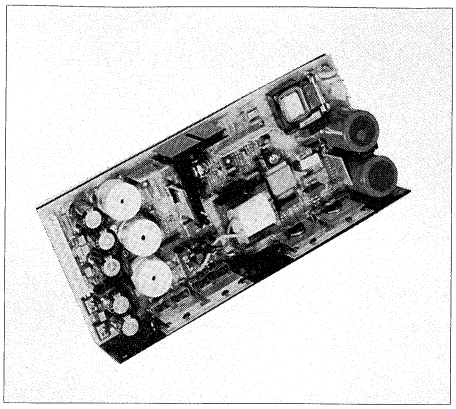
A universal IEC/IEEE bus power supplies programmer is available for use in automatic test systems. It combines a digital-to-analog converter with a microprocessor, to provide an interface between microcomputer and power supply.

AC Stabilizers

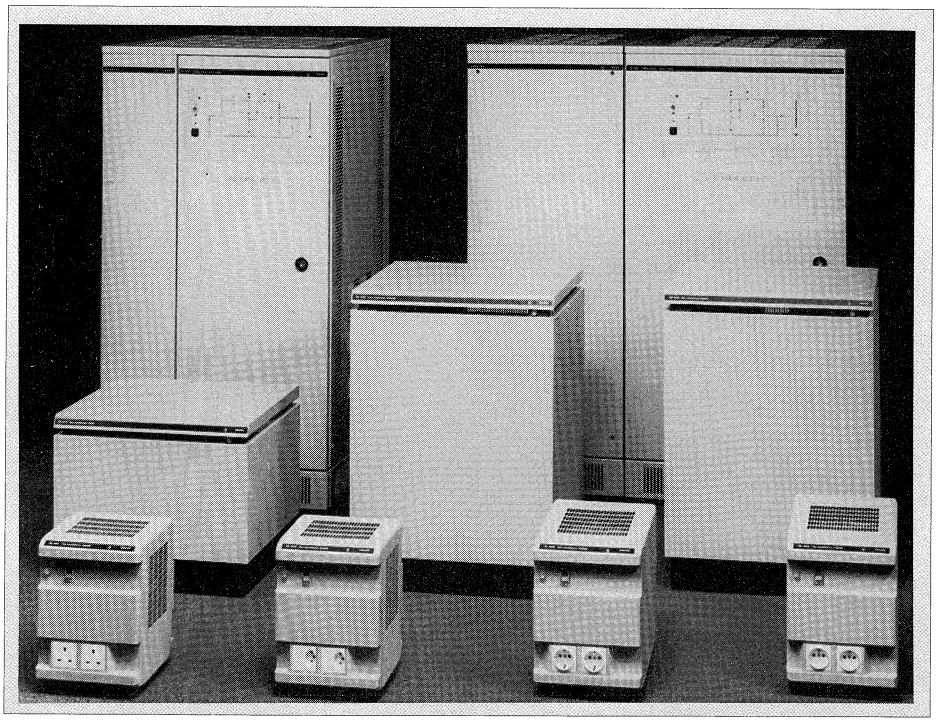
A range of 25 magnetic stabilizers or line conditioners is available for use at 220/240V, 50 to 60 Hz. The range covers power ratings from 200 to 6000 VA. Both open and closed versions can be supplied.

UPS

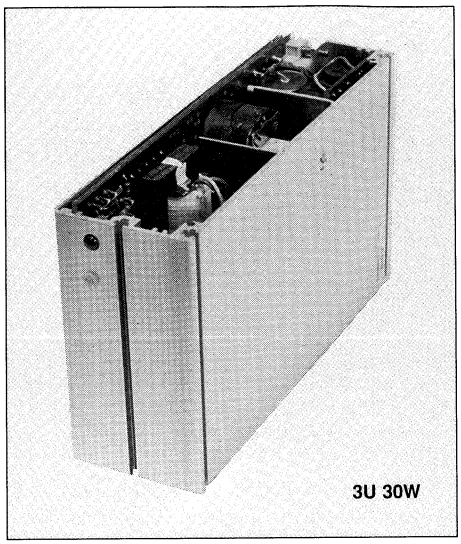
Philips T&M offers a new range of uninterruptible power supply systems (UPS) to protect and maintain power supplies against failure, particularly in heavy-duty applications. The standard models offer a range from 500 VA to 10 kVA while special units will be considered by the Philips team on request.



Multi-output 100 kHz MOSFET converter rated at 150/220W.



Attractive range of line conditioners and high frequency uninterruptible power supplies.



AC/DC Euro-Switchers 3U 30W

- Highly reliable forward converters: efficiencies to 77%,
- Nominal power at 55°C with convection cooling,
- Compliance with IEC, UL and VDE safety norms,
- Line regulation better than 0.1% and load regulation better than 0.2% for the main outputs, even with 10 to 100% load variations,
- RFI on source according to VDE 0871 level B with an external filter, e.g. EICHHOFF BV 10531,
- Effective protection by adjustable current limiter, adjustable overvoltage protection, mains and primary dc voltage fuses.
- Front LED indication of the main output voltage,
- Power failure TTL signal on dual and triple units,
- Remote on-off by external voltage,
- Resistor and voltage programming for the single output units,
- Remote sensing for the main outputs,
- Easy parallel and series connection (single output units),
- All units are UL 478 and 544 recognized.

Single Output

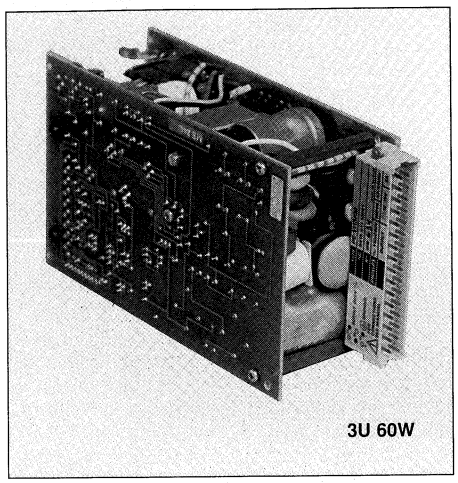
PE 1267/00	5V	6A	10T	220V
PE 1267/10	5V	5A	10T	110/220V
PE 1268/00	12(15)V	3A	10T	220V
PE 1268/10	12(15)	2A	10T	110/220V
PE 1269/00	24V	1.6A	10T	220V
PE 1269/10	24V	1.0A	10T	110/220V

Available as option: power failure indication (TTL) unit PE 1396

Multi-Output

PE 1138/50	±12(15)V	1.3A	10T	220/110V
PE 1140/50	5V4A±15 (12)V	0.25A	10T	220/110V

Dimensions: 100.0 H x 50.3 W x 176.2 L mm.
1U = 44.45 mm
1T = 5.08 mm



AC/DC Euro-Switchers 3U 60W

- Highly reliable forward converters: efficiencies to 73%,
- Nominal power at 55°C with convection cooling,
- Higher power at 40°
- Compliance with IEC, UL and VDE safety norms,
- Line regulation better than 0.1% and load regulation better than 0.2% for the main outputs, even with 100% load variations,
- Creepage distances of 8 mm between primary and secondary parts of the printed boards,
- RFI on source according to VDE 0871 level B for the enclosed versions,
- Full protection by adjustable, foldback type, current limiting with full short-circuit protection, overvoltage protection, overtemperature protection, mains voltage fuses, sense protection,
- Front LED indication of the main output voltage,
- Power failure TTL (LS) signal,
- Remote on-off with TTL logic,
- Remote sensing terminals,
- Easy parallel and series connection (single output units),
- Front panel adjustment of the main output voltage with a potentiometer,
- All models UL 478 and 544 recognized, VDE 0806 (SELV) and CSA certified.

Single Output

PE 1112/02	5V	14A	13T	110/220V o
PE 1112/52	5V	12A	17T	110/220V c
PE 1113/02	15(12)V	4.6A	13T	110/220V o
PE 1113/52	15(12)V	4.0A	17T	110/220V c
PE 1114/02	24V	2.9A	13T	110/220V o
PE 1114/52	24V	2.5A	17T	110/220V c

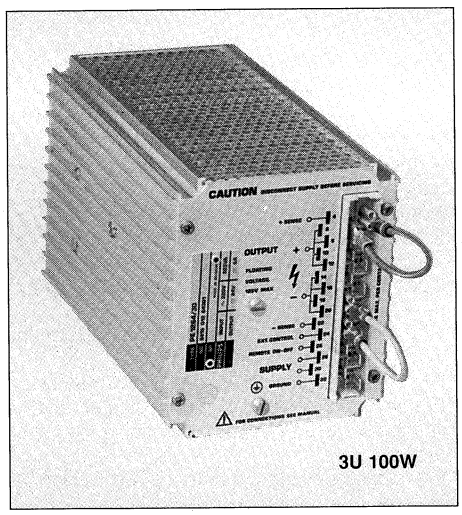
o: open c: closed

Multi-Output

PE 1113/02	±15(12)V	2.3A	13T	110/220V o
PE 1113/52	±15(12)V	2.0A	17T	110/220V c
PE 1141/02	5V 6A; ±15V	1A	15T	110/220V o
PE 1141/52	5V 4A; ±15V	1A	17T	110/220V c
PE 1143/02	5V 7A; ±12V	1A	15T	110/220V o
PE 1143/52	5V 6A; ±12V	1A	17T	110/220V c
PE 1144/02	5V 6A; +12V	2.5A	13T	110/220V o
	−12V	1A		
PE 1144/52	5V 6A; +12V	2.5A	17T	110/220V c
	−12V	1A		

o: open c: closed

Dimensions:
Single open versions: 100.0 H x 170.9 L mm
Multi-output open versions:
PE 1144/02 100.0 H x 170.9 L mm
PE 1141-43/02 110.6 H x 170.9 L mm
Closed versions: 110.6 H x 171.9 L mm
1U = 44.45 mm
1T = 5.08 mm



AC/DC Euro-Switchers 3U 100W

- Highly reliable forward converters: efficiencies to 78%,
- Nominal power at 55°C with convection cooling,
- Higher power at 40°C and up to 172 watts at 55°C with forced-air cooling (PE 1264),
- Compliance with IEC, UL and VDE safety norms,
- Line and load regulation better than 0.2%, even with 10 to 100% load variations,
- RFI on source according to VDE 0871 level B
- Effective protection by current limiter, overvoltage protection, sense protection, thermal protection and mains fuses,
- Front LED indication of the output voltage,
- Power failure or energy reserve TT (LS) signal,
- Remote on-off with TTL logic,
- Resistor and voltage programming,
- Remote sensing terminals,
- Easy parallel and series connection,
- UL 478 and 544 recognized.

1

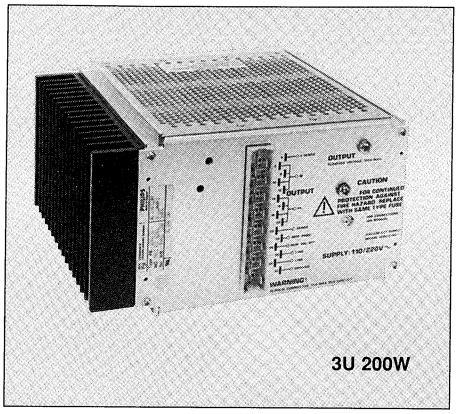
DC Power Supplies for OEM

Single Output

PE 1258/31	5V	18A	20T	110/220V c
PE 1261/31	12(15)V	8A	20T	110/220V c
PE 1264/31	24V	5A	20T	110/220V c

c: closed

Dimensions: 110.6 H x 97.5 W x 175.3 L mm.



3U 200W

AC/DC Euro-Switchers 3U 200W

- Highly reliable forward converters: efficiencies to 82%
- Nominal power at 55°C with convection cooling,
- Power up to 348 watts at 55°C and up to 396 watts at 40°C with forced cooling for 24V output,
- Compliance with IEC, UL and VDE safety norms,
- Line and load regulation better than 0.2% even with load variations of 10 to 100%,
- RFI on source according to VDE 0871 level B,
- Effective protection by current limiter, overvoltage protection, sense protection and mains fuses,
- Power failure or energy reserve TTL (LS) signal,
- Remote on-off with TTL logic,
- Resistor and voltage programming,
- Remote sensing terminals,
- Easy parallel and series connection (a power output up to 1200 watts can be obtained at 40°C with forced-air cooling by connecting 3 PE 1265/31 in parallel),
- UL 478 and 544 recognition pending.

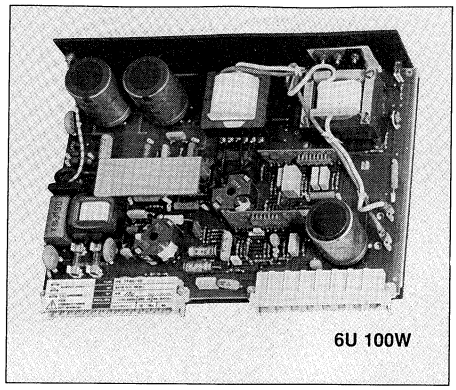
Single Output

PE 1259/31	5V	40A	40T	110/220V
PE 1262/31	12(15)V	18A	40T	110/220V
PE 1265/31	24V	11A	40T	110/220V

c: closed

Available on request: models with additional input and output connectors: PE 1259/60, PE 1262/60, PE 1265/60 (UL recognized).

Dimensions (for all units):
110.5 H x 196.2 W x 167.4 L mm.


6U 100W

AC/DC Euro-Switchers 6U 100W

- Highly reliable forward converters with efficiencies to 85%,
- Nominal power at 55°C, with convection cooling,
- Higher power at 40°C,
- Compliance with IEC, UL and VDE safety norms,
- Line regulation better than 0.1% and load regulation better than 0.2%, even with 100% load variations,
- RFI on source according to VDE 0871 level B with an external filter,
- Full protection by adjustable current limiter and short-circuit protection, overtemperature protection, adjustable overvoltage protection and mains voltage fuses,
- Front LED indication of output voltage,
- Power on and power failure TTL signal,
- Remote on-off with TTL logic,
- Resistor and voltage programming,
- Remote sensing terminals,
- Easy parallel and series connection,
- All models UL 478 and 544 recognized, VDE 0806 (SELV) and CSA certified.

Single Output

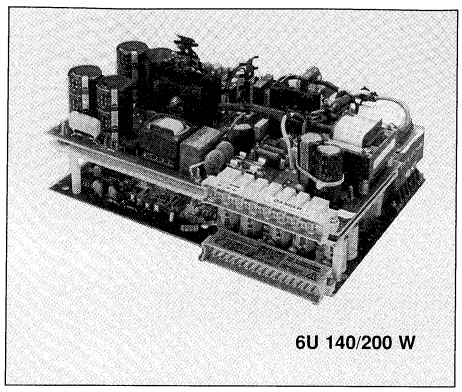
PE 1145/10	5V	20A	12T	110/220V
PE 1146/10	12(15)V	9A	12T	110/220V
PE 1147/10	24V	5A	12T	110/220V
PE 1148/10	48V	2.5A	12T	110/220V

Dimensions: 233.4 H x 173 L x 60 W mm,

Multi-Output

PE 1150/00	5V	10A	12T	110/220V
	±15V	1.5A		
	24V	0.5A		
PE 1150/20	5V	10A	12T	110/220V
	±12V	1A		
	24V	1.5A		
PE 1150/30	5V	10A	12T	110/220V
	±12V	2A		
	5V	1A		

Dimensions: 233.4 H x 173 L x 60 W mm


6U 140/200 W

AC/DC Euro-Switchers 6U 140/200W

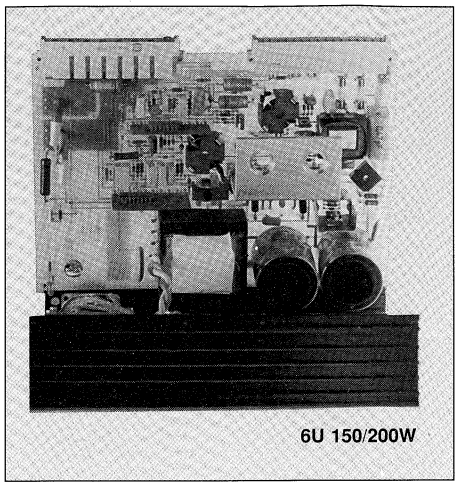
- Input voltage 110/220V user selectable,
- Highly reliable forward converters: efficiencies to 70%,
- Effective regulation on several outputs by using a dummy output,
- Nominal power at 55°C with convection cooling,
- Line regulation better than 0.10% and load regulation better than 0.15% for one, two or three outputs, depending on the model,
- RFI on source according to VDE 0871 level B with an external filter AEG EF 9888 (140W) or CORNELL DUBILIER APFS 600 L (200W),
- Effective protection by foldback type current limiting and overvoltage protection on several outputs, as well as by mains fuses,
- Remote sensing terminals for certain outputs depending on the model.
- Dedicated VME bus model (/33).
- Low cost model (/90).
- Power failure signal on all models,
- All models UL 478 and 544 recognized, VDE 0806 (SELV) and CSA certified.

Multi-Output

PE 1204/00	5V/20A; 15V/4A; 15V/4A; 24V/1.7A ±12V/0.2A
PE 1204/10	5V/20A; 15V/4A; 15V/4A; 5V/2A; ±12V/0.2A
PE 1204/20	5V/20A; 12V/4A; 12V/4A; 24V/1.7A -5V/0.2A
PE 1204/30	5V/20A; 12V/4A; 12V/3.4A; 5V/4A
PE 1204/33	5.05V/20A; 12V/5A; 12V/4A; 5V/0.05A
PE 1204/90 (140W)	5V/20A; 12V/4A; 12V/4A

Dimensions: 233.4 H x 88.9 W x 173.5 L mm
For all units the first four outputs are galvanically separated and usable positively or negatively.

DC Power Supplies for OEM


6U 150/200W

AC/DC Euro-Switchers 6U 150/ 200W

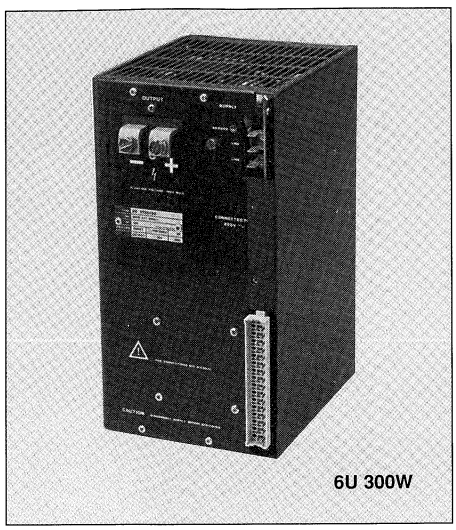
- Highly reliable forward converters: efficiencies to 85%,
- Nominal power at 55°C with convection cooling,
- Higher power at 40°C, up to 360W for PE 1128,
- Compliance with IEC, UL and VDE safety norms,
- Line regulation better than 0.1% and load regulation better than 0.2%, even wth 100% load variations,
- Very compact 200W units,
- RFI on source according to VDE 087 level B with an external filter such as FELLER 3712-65-63,
- Full protection by adjustable current limiter and short-circuit protection, overtemperature protection, adjustable overvoltage protection and mains voltage fuses,
- Front LED indication of output voltage,
- Power on and power failure TTL signal,
- Remote on-off with TTL logic,
- Resistor and voltage programming,
- Remote sensing terminals,
- Easy parallel and series connection,
- All models UL 478 and 544 recognized, VDE 0806 (SELV) and CSA certified models.

Single Output

PE 1123/00	5V	30A	14T	110/220V
PE 1124/00	12(15)V	12.5A	14T	110/220V
PE 1125/00	24V	6A	14T	110/220V
PE 1126/00	5V	40A	14T	110/220V
PE 1127/00	12(15)V	18A	14T	110/220V
PE 1128/00	24V	10A	14T	110/220V
PE 1148/20	48V	5A	14T	110/220V

For both power ranges:

Dimensions: 233.4 H x 173 L x 75.2 W mm.


6U 300W

AC/DC Euro-Switchers 6U 300W

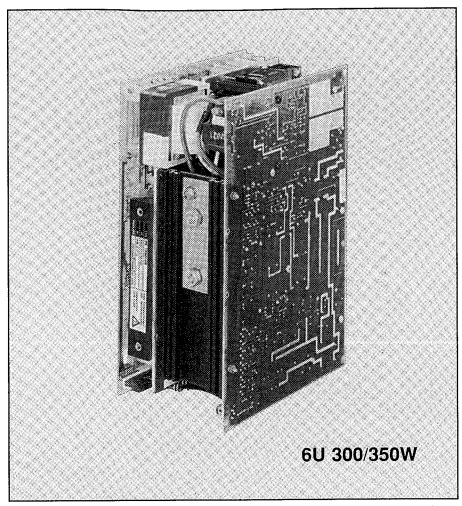
- Highly reliable forward converters: efficiencies to 85%,
- Nominal power at 55°C with convection cooling,
- Higher power at 40°C,
- Compliance with IEC, UL and VDE safety norms,
- Line regulation better than 0.1% and load regulation better than 0.2% even for 100% load variations,
- RFI on source according to VDE 0871 level B for the enclosed versions,
- Full protection by adjustable, foldback type, current limiting with full short-circuit protection, adjustable overvoltage protection, overtemperature protection, sense protection and mains voltage fuses,
- Power on-failure TTL signal,
- Remote on-off with TTL logic,
- Resistor and voltage programming,
- Remote sensing terminals,
- Front LED indication of the output voltage,
- Easy parallel and series connection,
- Front panel adjustment of voltage and current by means of potentiometers,
- UL 478 and 544 recognized, VDE 0806 (SELV) and CSA certified models.

Single Output

PE 1129/00	5V	60A	26T	110/220V o
PE 1129/50	5V	60A	27T	110/220V c
PE 1130/00	12(15)V	25A	26T	110/220V o
PE 1130/50	12(15)V	25A	27T	110/220V c
PE 1131/00	24V	15A	26T	110/220V o
PE 1131/50	24V	15A	27T	110/220V c
PE 1132/00	48V	8A	26T	110/220V o
PE 1132/50	48V	8A	27T	110/220V c

o: open c: closed

Dimensions:
245 H x 129 W x 180.5 L mm (open)
245 H x 133 W x 180.5 L mm (closed)


6U 300/350W

AC/DC Euro-Switchers 6U 300/ 350W

- Highly reliable forward converters: efficiencies to 70%,
- Effective regulation on several outputs by using a dummy output,
- Nominal power at 55°C with convection cooling,
- Line regulation better than 0.10% and load regulation better than 0.15% for one, two or three outputs, depending on the model,
- RFI on source according to VDE 0871 level B with an external filter CORNELL DUBILIER APFS 600 L
- Effective protection by foldback type current limiting and overvoltage protection on several outputs, as well as by mains fuses, remote sensing terminals for certain outputs depending on the model,
- Front LED indication of the output voltage,
- Dedicated VMEbus model PE 1142/33,
- All models UL 478 and 544 recognized,
- All models VDE 0806 (SELV) and CSA certified.

Multi-Output

PE 1142/00	5V/30A; ±15V/4A 24V/2A; ±12V/0.2A	24T	110/220V
PE 1142/20	5V/30A; ±12V/4A 24V/2A	24T	110/220V
PE 1142/30	5V/30A; ±12V/4; 5V/4A 5V/0.2A	24T	110/220V
PE 1142/33	5V/26A; 12V/5A; 12V/4A	24T	110/220V

Dimensions: 233.4 H x 111.7 W x 173.5 L mm.

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DC Power Supplies for OEM



AC/DC Euro-Switchers 6U 500W

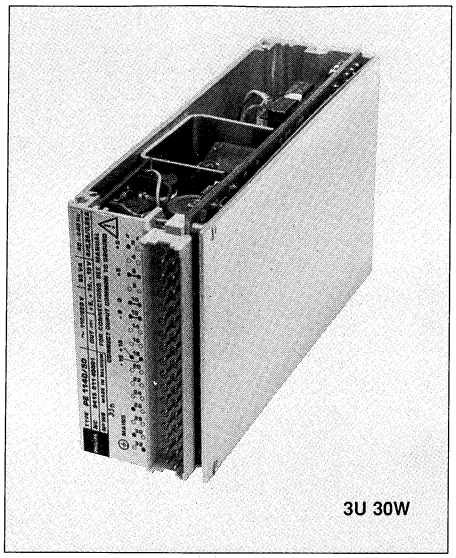
- Highly reliable forward converters with efficiencies to 85%,
- Nominal power at 55°C with convection cooling,
- Higher power at 40°C,
- Compliance with IEC, UL and VDE safety norms,
- Line regulation better than 0.1% and load regulation better than 0.2% even for 100% load variations,
- RFI on source according to VDE 0871 level B for the enclosed versions,
- Full protection by adjustable, foldback type, current limiting with full short-circuit protection, adjustable overvoltage protection, overtemperature protection, sense protection and mains voltage fuses,
- Power on-failure TTL signal,
- Remote on-off with TTL logic,
- Resistor and voltage programming,
- Remote sensing terminals,
- Front LED indication of the output voltage, easy parallel and series connection,
- Front panel adjustment of voltage and current by means of potentiometers,
- All models UL 478 and 544 recognized,
- All models VDE 0806 (SELV) and CSA certified.

Single Output

PE 1133/00	5V	100A	41T	110/220V o
PE 1133/50	5V	100A	42T	110/220V c
PE 1134/00	12(15)V	42A	41T	110/220V o
PE 1134/50	12(15)V	42A	42T	110/220V c
PE 1135/00	24V	22A	41T	110/220V o
PE 1135/50	24V	22A	42T	110/220V c
PE 1136/00	48V	11A	41T	110/220V o
PE 1136/50	48V	11A	42T	110/220V c

o: open c: closed

Dimensions: 245 H x 205 W x 160 L mm (open)



DC/DC Euro-Switchers 3U 30W

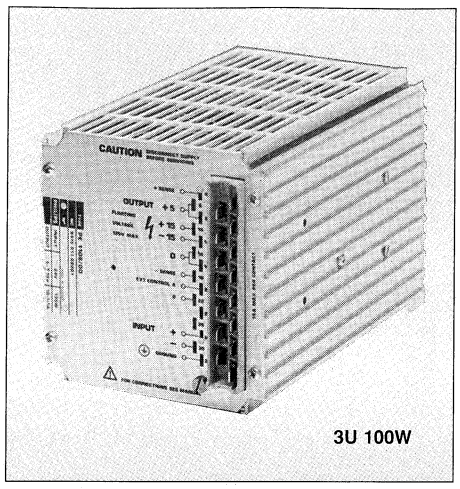
- Highly reliable forward converters: efficiencies to 73%,
- Nominal power at 55°C with convection cooling
- Compliance with IEC, VDE and UL norms,
- Source regulation better than 0.1% and load regulation better than 0.2% even with 100% load variations,
- Effective protection by adjustable overcurrent and overvoltage (crowbar) protection, input polarity error and sense protection,
- Remote on-off by external voltage,
- Resistor and voltage programming,
- Easy parallel and series connection.

Single Output

PE 1100/00	5V	5A	10T	24V input
PE 1100/10	5V	6A	10T	48V input
PE 1101/00	12(15)V	3A	10T	24V input
PE 1101/10	12(15)V	3A	10T	48V input
PE 1101/11	24V	1.5A	10T	48V input

Dimensions (for all units):
100.0 H x 50.3 W x 176.2 L mm.

Available as option: power failure indication (TTL) unit PE 1396.



DC/DC Euro-Switchers 3U 100W

- Highly reliable forward converters: efficiencies to 72%,
- Nominal power at 55°C with convection cooling,
- Compliance with IEC, VDE and UL safety norms,
- Source regulation better than 0.1% and load regulation better than 0.2% even with 100% load variations, for main outputs,
- Effective protection main outputs by adjustable current limiter and overvoltage protection, input polarity error, sense and temperature protection,
- Remote on-off and remote sensing,
- Resistor and voltage programming,
- Easy parallel and series connection, (single output units)
- Low battery voltage indication (TTL).

Single Output

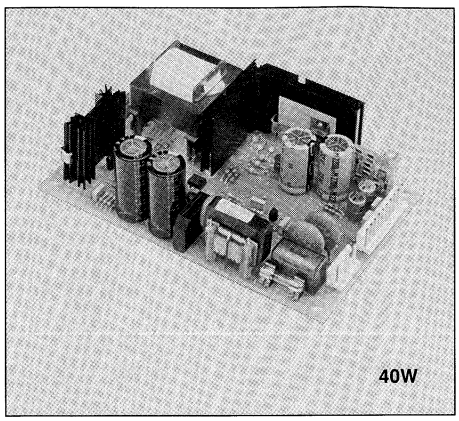
PE 1104/00	5V	18A	20T	24V input
PE 1104/10	5V	18A	21T	48V input
PE 1105/00	12(15)V	8A	20T	24V input
PE 1105/10	12(15)V	8A	21T	48V input
PE 1105/11	24V	4A	21T	48V input

Dimensions:
110.6 H x 97.4 W x 174.2 L mm /00 version
110.6 H x 101.6 W x 174.2 L mm /10 version
110.6 H x 102.5 W x 174.2 L mm /11 version

Multi-Output

PE 1108/00 5V 10A; ±15(12)V 1A 22T 24V input
PE 1108/10 5V 10A; ±15(12)V 1A 22T 48V input

Dimensions (for both units):
110.6 H x 106.7 W x 174.2 L mm.



Series 190 Switching Modules

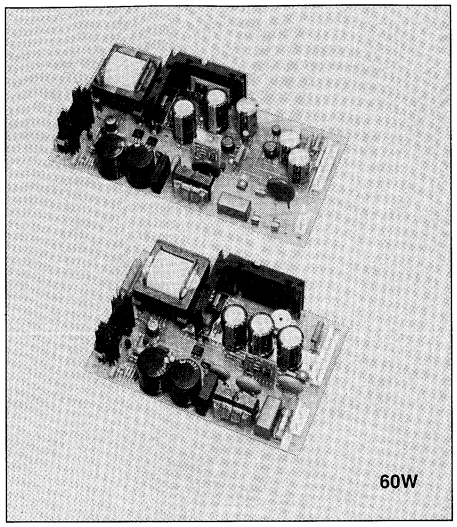
40 Watt

- Compact design with surface mounted devices.
- Nominal output power at 50°C with convection cooling.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Oversized output capacitors guarantee a long lifetime.
- Low conducted EMI: complies with VDE 0871 and FCC 20780.
- Overvoltage protection on 5V output as standard.
- Short-circuit protected.
- IEC 65, IEC 348, IEC 380, IEC 435, VDE 0805, VDE 0806 (SELV).
- UL 478, UL 544, UL 1012.
- CSA C22.2-143 and 154.
- Creepage distances of 8mm between primary and secondary.
- Input voltage: 180...264V or 90...140V user-selectable.

Model	Output 1	Output 2	Output 3	P out
PE 1900/00	5V/6A	-	-	30 W
PE 1901/00	12(15)V /2.5A	-	-	38 W
PE 1902/00	24(30)V /1.25A	-	-	38 W
PE 1905/00	+12(15)V /1.25A	-12(15)V /1.25A	-	38 W
PE 1906/00	+5V/4A	+12V/2A	-	40 W
PE 1906/02	+5V/4A	+24V/1A	-	40 W
PE 1907/00	+5V/5A	+12V/2A	-12V/0.5A	40 W
PE 1907/01	+5V/5A	+12V/2A	-5V/1A	38 W
PE 1907/02	+5V/5A	+24V/1A	-12V/0.5A	40 W
PE 1907/04	+5V/5A	+24V/1A	-5V/1A	38 W
PE 1907/10	+5V/4A	+12V/0.8A	-12V/0.8A	35 W
PE 1907/15	+5V/4A	+15V/0.5A	-15V/0.5A	35 W

☐ *Regulated Outputs*
Note: Boxed units: add the suffix B to the PE number.

Dimensions
48(H) x 100(W) x 160(D)mm (open)
63(H) x 110(W) x 170(D)mm (closed)
Weight 0.45 kg.



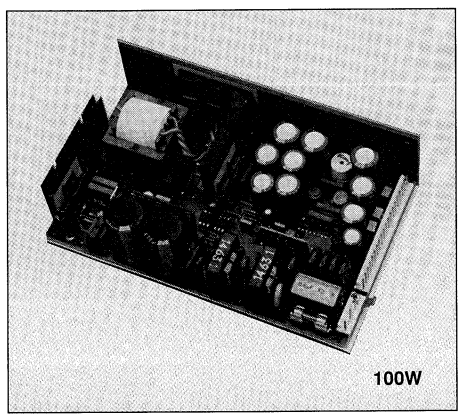
60 Watt

- Compact design with surface mounted devices.
- Nominal output power at 50°C with convection cooling.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Oversized output capacitors guarantee a long lifetime.
- Low conducted EMI: complies with VDE 0871 and FCC 20780.
- Overvoltage protection on 5V output as standard.
- Short-circuit protected.
- IEC 65, IEC 348, IEC 380, IEC 435, VDE 0805, VDE 0806 (SELV).
- UL 478, UL 544, UL 1012.
- CSA C22.2-143 and 154.
- Creepage distances of 8mm between primary and secondary.
- Input voltage: 180...264V or 90...140V user-selectable.

Model PE	Output 1	Output 2	Output 3
1910/00	5V/12A	-	-
1911/00	12(15)V/5A	-	-
1912/00	24(30)V/2.5A	-	-
1915/00	+12(15)V/2.5A	-12(15)V/2.5A	-
1916/00	+5V/8A	-12V/3A	-
1916/01	+5V/3A	-12V/4A	-
1916/02	+5V/3A	-24V/2A	-
1917/00	+5V/8A	-12V/3A	-12V/1A
1917/01	+5V/8A	-12V/3A	-5V/1A
1917/02	+5V/8A	-24V/1.5A	-12V/1A
1917/04	+5V/8A	+24V/1.5A	-5V/1A
1917/10	+5V/8A	+12V /1A	-12V/1A
1917/15	+5V/8A	+15V/1A	-15V/1A

☐ *Regulated Outputs*
Note: Boxed units: add the suffix B to the PE number.

Dimensions
Single:
51(H) x 100(W) x 160(D)mm (open)
63(H) x 110(W) x 170(D)mm (closed)
Weight 0.6 kg.
Dual and triple:
50(H) x100(W) x 208(D)mm (open)
63(H) x 110(W) x 220(D)mm (closed)
Weight 0.7 kg.



100 Watt

- Compact design with surface mounted devices.
- Nominal output power at 50°C with convection cooling.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Oversized output capacitors guarantee a long lifetime.
- Low conducted EMI: complies with VDE 0871 and FCC 20780.
- Overvoltage protection on 5V output as standard.
- Power fail signal standard.
- Short-circuit protected.
- IEC 65, IEC 348, IEC 380, IEC 435.
- UL 478, UL 544, UL1012.
- VDE 0806 (SELV).
- CSA C22.2-143 and 154.
- Creepage distances of 8mm between primary and secondary.
- Input voltage: 180...264V or 90...140V user-selectable.

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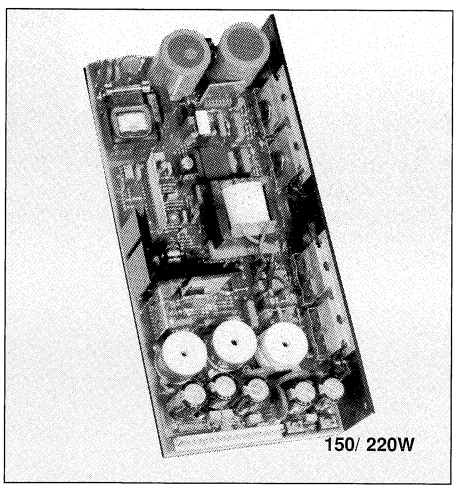
Series 190

Model	Output 1	Output 2	Output 3	Output4	P out
PE 1920/00	5V/20A	-	-	-	100 W
PE 1921/x0	12(15)V /9A	-	-	-	108 W
PE 1922/10	24(28)V /4.5A	-	-	-	108 W
PE 1925/x0	+12(15)V /5A	-12(15)V /5A	-	-	100 W
PE 1925/x2	+24V/2.5A	-24V/2.5A	-	-	100 W
PE 1926/x1	5V/12A	12V/5A	-	-	100 W
PE 1926/x2	5V/12A	24V/3A	-	-	100 W
PE 1927/x0	5V/8A	12V/5A	12V/1A	-	100 W
PE 1928/x0	5V/8A	12V/2.5A	12V/2.5A	5V/1A	90 W
PE 1928/x1	5V/10A	12V/4A	12V/2A	12V/1A	100 W
PE 1928/x2	5V/10A	12V/2A	12V/1A	24V/2A	100 W
PE 1928/x4	5V/10A	12V/4A	12V/2A	5V/1A	100 W
PE 1928/x5	5V/10A	15V/2A	15V/1A	24V/2A	100 W

☐ *Regulated Outputs*
Note: replace /x. by:
/0. for models with an L-shaped frame
/1. for models without frame (intended for forced-air cooling)
Boxed units: add the suffix B to the PE number

Dimensions
60(H) x 123(W) x 203(D)mm (open)
63(H) x 129(W) x 206(D)mm (closed)
Weight 1.2 kg.



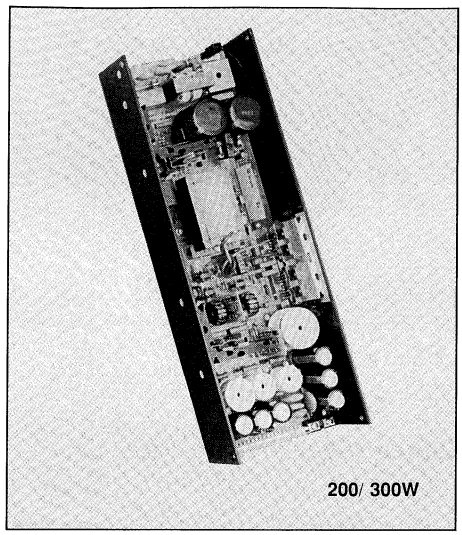
150/220 Watt Single and Multiple Output

- Highly reliable dual transistor forward converter.
- Power MOSFET technology, switching at 100 kHz.
- Compact design with surface mounted devices and hybrid circuits.
- Optimized 220W for cooling by forced air at 50°C.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Input 110/220V with protection against mismatch of input voltage.
- In accordance with VDE 0871 level B and FCC 20780 with additional filter.
- New mag-amps further extend the control range of 12V outputs to 15V.
- Overvoltage protection on 5V output as standard.
- Overload protected.
- Power fail signal standard.
- Logic signals for VMEbus, ACFAIL and SYS RESET, standard on PE 1937/03.
- IEC 380.
- UL 478, UL 544, UL1012, recognized.
- VDE 0806 (SELV), approved.
- CSA C22.2-143 and 154, certified.
- Creepage distances of 8mm between primary and secondary.
- Available in open-frame or boxed version.

Model PE	Output 1	Output 2	Output 3	Output4
1931/00	**12(15)V** /9A-**12A**	-	-	-
1932/00	**24V**/6A-**8A**	-	-	-
1936/11	**5V**/4.5A-**6A**	**12V**/9A-**12A**	-	-
1936/12	**5V**/4.5A-**6A**	**24V**/6A-**8A**	-	-
1937/02	**5V**/15A-**20A**	**12V**/4A-**5A**	**12V**/6A-**8A**	-
1937/03	**5V**/22A-**30A**	-	**+12V**/3A-**4A**	**-12V**/3A-**4A**
1937/11	**5V**/4.5A-**6A**	-	**+12V**/6A-**8A**	**-12V**/3A-**4A**
1938/00	**5V**/15A-**20A**	**5V**/4.5A-**6A**	**+12V**/3A-**4A** (**15V**/2A-**3A**)	**-12V**/3A-**4A** (**15V**/2A-**3A**)
1938/01	**5V**/15A-**20A**	**12V**/4A-**5A** (**15V**/3A-**4A**)	**+12V**/3A-**4A** (**15V**/2A-**3A**)	**-12V**/3A-**4A** (**15V**/2A-**3A**)
1938/02	**5V**/15A-**20A**	**24V**/3A-**4A**	**+12V**/3A-**4A** (**15V**/2A-**3A**)	**-12V**/3A-**4A** (**15V**/2A-**3A**)
1938/03	**5V**/15A-**20A**	**24V**/3A-**4A**	**+12V**/3A-**4A** (**15V**/2A-**3A**)	**-12V**/3A-**4A** (**15V**/2A-**3A**)
1938/04	**5V**/15A-**20A**	**5V**/4.5A-**6A**	**+12V**/3A-**4A**	**-12V**/3A-**4A**
1938/05	**5V**/15A-**20A**	**12V**/4A-**5A**	**+12V**/3A-**4A**	**-12V**/3A-**4A**
1938/06	**5V**/15A-**20A**	**24V**/3A-**4A**	**+12V**/3A-**4A**	**-12V**/3A-**4A**
1938/15	**5V**/15A-**20A**	**24V**/3A-**4A**	**+15V**/2A-**3A**	**-15V**/2A-**3A**

☐ *Regulated Outputs*
Notes: Values in bold indicate max. output current with forced-air cooling; lightfaced figures apply for convection cooling.
Boxed units: add the suffix B to the PE number

Dimensions
60(H) x 124 (W) x 240(D)mm
(PE 1931, 1932, 1936, PE 1937/11, open)
60(H) x 124 (W) x 280(D)mm
(PE 1937/02/03, PE 1938, open)
Weight 1.5 kg.
62(H) x 129 (W) x 244(D)mm
(PE 1931, 1932, 1936, PE 1937/11, closed)
62(H) x 129 (W) x 284(D)mm
(PE 1937/02/03, PE 1938, closed)



200/300 Watt Single and Multiple Output

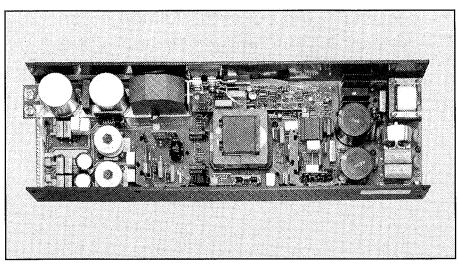
- Highly reliable dual transistor forward converter.
- Power MOSFET technology, switching at 100 kHz.
- Compact design with surface mounted devices and hybrid circuits.
- Optimized 300W for cooling by forced air at 50°C.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Input 110/220V with protection against mismatch of input voltage.
- Overvoltage protection on 5Voutput as standard.
- Overload and overtemperature protected.
- Power fail signal standard.
- Logic signals for VMEbus, ACFAIL and SYS RESET, standard on PE 1947/03, 1948/03, 1948/15.
- IEC 380.
- UL 478, UL 544, UL 1012 recognized.
- VDE 0806 (SELV), approved.
- CSA C22.2-143 and 154, certified.
- Creepage distances of 8mm between primary and secondary.
- Input voltage: 180...264V or 90...140V user-selectable.
- Available in open-frame or boxed version.
- In accordance with VDE 0871 level B and FCC 20780 with additional filter.

Model PE	Output 1	Output 2	Output 3	Output4
1940/00	5V/40A-60A	-	-	-
1941/00	12(15)V /16A-25A	-	-	-
1942/00	24(30)V /8A-12A	-	-	-
1947/00	5V/20A-36A	12V/8A	5V/6A	-
1947/02	5V/20A-36A	12V/8A	12V/4A	-
1947/03	5V/20A-36A	12V/6A-8A	12V/3A-4A	-
1948/00	5V/20-A-6A	12V/5A-8A	12V/3A-4A	5V/4A-6A
1948/01	5V/20A-36A	12V/5A-8A (15V/4A -6.5A)	12V/3A-4A (15V/2.4A -3A)	12V/3A-4A (15V/2.4A -3A)
1948/02	5V/20A-36A	24V/3A-4A	12V/3A-4A (15V/2.4A -3A)	12V/3A-4A (15V/2.4A -3A)
1948/03	5V/20A-36A	24V/3A-4A	12V/3A-4A (15V/2.4A -3A)	12V/3A-4A (15V/2.4A -3A)
1948/04	5V/20A-36A	12V/5A-8A	12V/3A-4A	5V/4A-6A
1948/05	5V/20A-36A	12V/5A-8A	12V/3A-4A	12V/3A-4A
1948/06	5V/20A-36A	24V/5A	12V/3A-4A	12V/3A-4A
1948/15	5V/20A-36A	24V/3A-4A	15V/2.4A-3A	15V/2.4A-3A

Regulated Outputs

Notes: Values in bold indicate max. output current with forced-air cooling; lightfaced figures apply for convection cooling.
Boxed units: add the suffix B to the PE number

Dimensions:
60(H) x 127 (W) x 300(D)mm
(PE 1940,41, 42, open)
60(H) x 127 (W) x 356(D)mm
(PE 1947,48, open)
Weight 2.1 kg.
62(H) x 127 (W) x 304(D)mm
(PE 1940,41, 42, closed)
62(H) x 127 (W) x 360(D)mm
(PE 1947,48, closed)



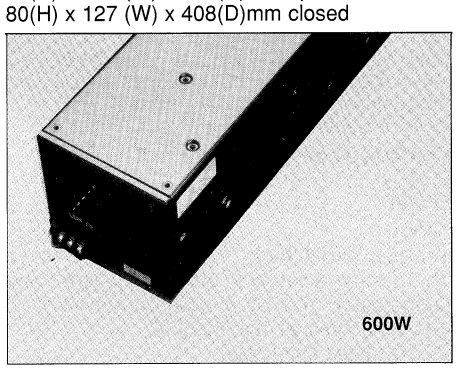
300/400 Watt Multiple Output

- Highly reliable dual transistor forward converter.
- Power MOSFET technology, switching at 100 kHz.
- Compact design with surface-mount devices and hybrid circuits.
- Optimised 400 W for cooling by forced air at 50°C.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Input 110/220V with protection against mismatch of input voltage.
- New mag amps further extend the control range of 12V outputs to 15V.
- Overvoltage protection on 5V output as standard.
- Overload protection.
- Power fail signal standard.
- IEC 380 and IEC 950
- UL 478, UL 1012 pending
- VDE 0805-100 and VDE 0806 (SELV) pending.
- CSA C22.2-220 pending.
- Creepage distances of 8mm between primary and secondary parts.
- Available in open-frame or boxed version.

Model PE	Output 1	Output 2	Output 3	Output4
1958/02	5V/40A-**60A**	24V/3A-**4A**	12V/3A-**4A** (15V/ 2.4A-**3A**)	12V/3A-**4A** (15V/ 2.4A-**3A**)

Notes: Values in bold indicate max. output current with forced-air cooling; lightfaced figures apply for convection cooling.
Boxed units: add the suffix B to the PE number

Dimensions:
79(H) x 127 (W) x 405(D)mm open
80(H) x 127 (W) x 408(D)mm closed



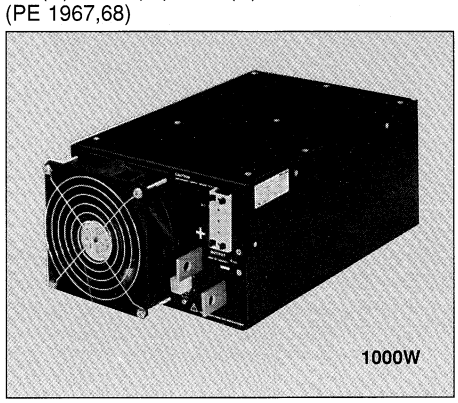
600 Watt Single and Multiple Output

- Two U-shaped units of the PE 194 series are mechanically combined to obtain a compact 5" x 5" power supply; an integral fan ensures the optimum cooling to reach too 600W output power.
  From the thousands of possibilities, the most currently requested units have already been selected.

Model PE	Output 1	Output 2	Output 3	Output4
1960/00	5V/120A	-	-	-
1961/00	12(15)V /50A	-	-	-
1962/00	24V/25A	-	-	-
1967/03	5V/60A	12V/12A	12V/6A	-
1968/00	5V/60A	12V/12A	12V/6A	5V/6A
1968/01	5V/60A	12V/12A	12V/6A	12V/4A
1968/02	5V/60A	12V/12A	12V/4A	24V/5A
1968/03	5V/60A	12V/12A	12V/4A	24V/5A

PE 1967/03 and PE 1968/03: with VMEbus signals

Dimensions:
127(H) x 120 (W) x 360(D)mm
(PE 1960,61, 62)
127(H) x 120 (W) x 413(D)mm
(PE 1967,68)



1000 Watt Single Output

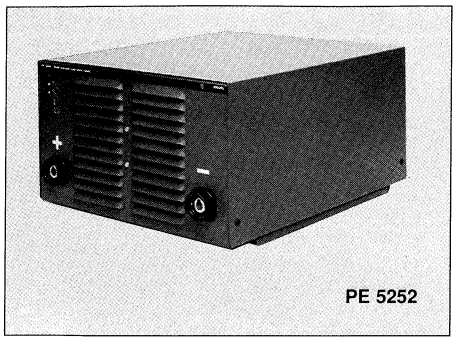
- Highly dependable two-transformer forward converter.
- Third-generation bipolar switching transistors.
- Compact design with surface mounted devices and hybrid circuits.
- Current-mode control loop offering excellent transient response.
- Continuous 1000W output power at 50°C.
- 40,000 hours MTBF specified for 100% load and 40°C.
- Overload and overtemperature protected.
- Power fail signal and remote ON/OFF standard.
- IEC 380.
- UL 478.
- VDE 0805 and VDE 0806 (SELV).
- CSA C22.2-143 and 154.
- Creepage distances of 8mm between primary and secondary.
- Input voltage: 180...264V.

Model	Output
PE 1980/00	5V/200A
PE 1981/00	12V/85A
PE 1982/00	24V/45A
PE 1983/00	48V/23A

Dimensions
127(H) x 201.5 (W) x 318.5(D)mm
Weight 9 kg.

Fast-Programmable 10kW Switched-mode Power Supply

PE 5252



The PE 5252 is a high-power switched mode d.c. source, primarily intended for high-tech welding equipment that needs a fast programmable current source. It is therefore ideal for a wide variety of applications, as the current can be controlled over the whole range from 10 amps to 315 amps.

The three-phase input of the PE 5252 enables industrial mains connection, where its high efficiency and high power factor are of particular interest. It finds industrial application in such areas as the spot welding of electrical components in assembly plants and a variety of robotic micro-spot welding processes where accuracy of control is essential. Its universal design also suggests many other kinds of high-power applications.

For instance, in the area of variable speed drives, d.c. motors with independent excitation still offer the most flexible and accurate means of speed regulation. The PE 5252 can be used to provide the necessary drive current.

Other uses for the high-current capacity of the PE 5252 include electroplating and electrolysis processes.

Features Include

- Constant voltage and constant current operation with automatic crossover and visual mode-indication:
- Output programmable over a wide range:
- Excellent output stability, virtually dependent on the stabillity of the programming signal:
- Digital programming instructions easily converted to suitable signals by our PE 1367 programmer:
- Highly-dependable components, ensuring wide safe margins and guaranteeing reliable operation:
- Fast programming permitted by small output capacitor, important when the unit is used as a current source with a variable load:
- Considerable size and weight reduction over conventional equipment due to 20 kHz switched-mode converter:
- Solid, protective enclosure with flush-mounted fuse-holders and connectors.

Specifications

Technical Specifications

Input Data

Input Voltage (a.c.).
Rated: 380V or 415V three-phase mains
Range: 342V...456V (between phases)

Frequency: 45-65 Hz
Inrush Current: Max. 400A
Efficiency: Min. 80%
Power Factor: 0.9 (at full load)

Output Data

The output terminals are insulated from the chassis. Either the positive or the negative terminal may be earthed.

Output Voltage and Current
Two voltages can be selected: 33V, or 44V: the corresponding currents are:

Uo	Io	
33V	315A*	(* -duty cycle 60%)
33V	250A	
44V	230V	

Output Specifications in the Constant Current Operation

Note: The static stability of output voltage and current depends essentially on the stability of the programming source: the specifications therefore refer to an ideal, zero-error programming voltage.

Combined source & load effect
0.5A
Offset
±2A

Temperature Effect
The average change in output voltage for any temperature variation between 0 and 40°C is <0.025 of nominal output per K.
PARD (ripple and noise)
p.p.≤12A
Programming
Programming voltage: 0.02V/A (preset tolerance: 1%)
Programming time: 0.5 ms (nom. load)

Output Specifications in the Constant Voltage Operation
PARD (ripple and noise)
p.p.<5V
Dynamic behavior and transient response
Recovery time: 1.5 ms
Overshoot: <60%
Programming
Programming voltage: 0.1V/V (precision: ±1V)
Programming time: 0.5 ms (nom. load)

Parallel Connection
Up to three units can be connected in parallel.

Environmental Conditions

The units have been subjected to exhaustive environmental tests according to IEC 68-2

Ambient Temperature
Rated Operating Temperature: 0...40°C
Storage and Transport: -40...+85°C

Cooling: By built-in fan
Safety: Complies with IEC 348 (safety class I)
Dielectric Strength Test
Every unit is tested over one minute with a.c. voltage of :
3000V between input and output
2000V between input and chassis
1000V between output and chassis

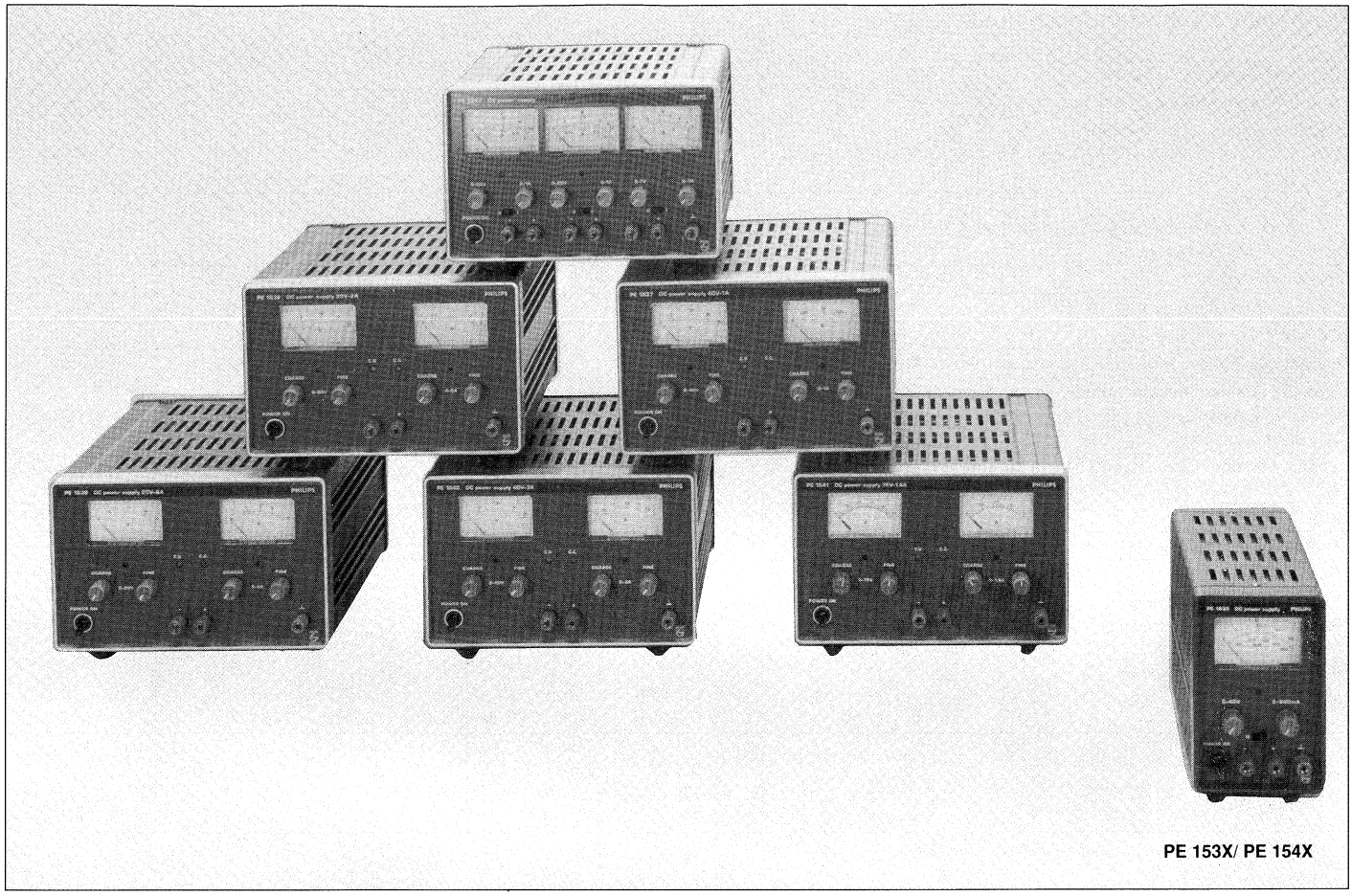
Protection
Input: Mains fuses
Switch-off in case of loss of one phase
Output: Automatic crossover from constant voltage to constant current, or vice versa
Temperature: Temperature sensors switch off unit if power semiconductors exceed their temperature limit.

Connections
Input: Four-pole connection block, rated 16 mm^2
The line cord is fixed by a clamp near to the connection block, to prevent broken wires touching the chassis.
Output: Two 'DINZE'-terminals on the front panel, rated 600A.
M 10 screw terminals on the rear panel.
Dimensions: 558 mm W x 288 mm H x 580 mm L (21.9 in W x 11.3 in H x 22.8 in L)
Weight: 47 kg (10.3 lb)

Features
- Remote on-off with a switch
- Auxiliary outputs: ±25V/10 mA, not stabilized
- Measuring points for output voltage and current
  voltage: 0.1V/V (±0.5V)
  current: 0.02V/A (±1%)

Indications
Five LEDs indicate:
- Equipment ready,
- Operating in the constant-voltage mode.
- Operating in the constant-current mode,
- Thermal overload,
- Phase interruption.

PE 153X & PE 154X



PE 153X/ PE 154X

Power Supplies for Bench Use

- Excellent stability
- Adjustable constant voltage/current
- Series/parallel operation
- MTBF 75,000 operating hours
- Advanced styling

This range of power supplies for bench use comprises a series of stand-alone units giving outputs from 20 to 120W at varying voltage and current levels. They will be of interest to laboratory personnel, educational establishments and service organizations. The design incorporates the most modern concepts of universal power supply equipment to achieve high conversion efficiency and exceptional price/performance ratios.

Reliability

Long-term reliability is assured by careful selection of components and materials and units are subjected to full mechanical, climatic and safety tests to IEC 68 and IEC 348. AC line interference conforms to VDE 0875, N-12 curve. The predicted MTBF is 75000 operating hours for max. load, stationary use, environmental temperatures between 0 and 40°C.

Output power ratings vary from 20W to 120W, depending on the model.

A performance table for the range appears on the next page.

PE 153X & PE 154X

Performance Table for Bench Units

	PE 1530	PE 1535	PE 1536	PE 1537	PE 1539
Constant Voltage Operation					
Output Voltage Ranges (continuously adjustable) (V)	2 x 0...20	0...40	0...20	0...40	0...20
Stability against Line Variations With ±10% line variations max. change of output voltage incl. short term drift	≤0.05% or 2 mV*	≤0.05% or 4 mV*	≤0.01% or 1 mV*	≤0.01% or 2 mV*	≤0.01% or 1 mV*
Recovery Time For a sudden increase from 80% load to max. load or for a corresponding decrement (µs)	≤50	≤10	≤25	≤25	≤50
Ripple Voltage (mV_{RMS})	≤1.5	≤1.5	≤1	≤1	≤1
Temperature Coefficient (0...40°C) (%/°C)	0.02	0.02	0.01	0.01	0.01
Constant Current Operation					
Output Current Ranges (Continuously adjustable) (A)	2 x 0...1	0...05	0...2	0...1	0...6
Stability against Line Variations With ±10% line voltage variations max. change of output current incl. short term drift	≤5 mA	≤0.05% or 5 mA*	≤0.05% or 0.4 mA*	≤0.05% or 0.2 mA*	≤0.05% or 1.0 mA*
Stability against Load Variations With load variations of 0...100% max. change of output current (mA)	≤5	≤4	≤3	≤3	≤3
Ripple Current (mA_{RMS})	≤1	≤1	≤2	≤1	≤2
Temperature Coefficient (0...40°C) (mA/°C)	≤2	≤0.05	≤0.2	≤0.1	≤0.6
General					
Parallel and series connection	■	■	■	■	■
Remote programming/sensing	—	—	—	—	■
Master/slave operation	†	—	—	—	■
Ambient temperature (max)	40°C	40°C	40°C	40°C	40°C
Line supply	110; 127; 220 240V 50/60 Hz	110; 127; 220 240V 50/60 Hz	110; 127; 220 240V 50/60 Hz	110; 127; 220 240V 50/60 Hz	110; 127; 220 240V 50/60 Hz
Dimensions (w x h x l) (mm)	210 x 153 x 271	88 x 133 x 210	210 x 153 x 265	210 x 153 x 265	210 x 153 x 271
(-in)	8.3 x 6 x 10.7	3.5 x 5.2 x 8.3	8.3 x 6 x 10.4	8.3 x 6 x 10.4	8.3 x 6 x 10.7
Weight (kg)	5.5	2	5.1	5.2	7.8
(lb)	12	4.4	11.2	11.4	17.2

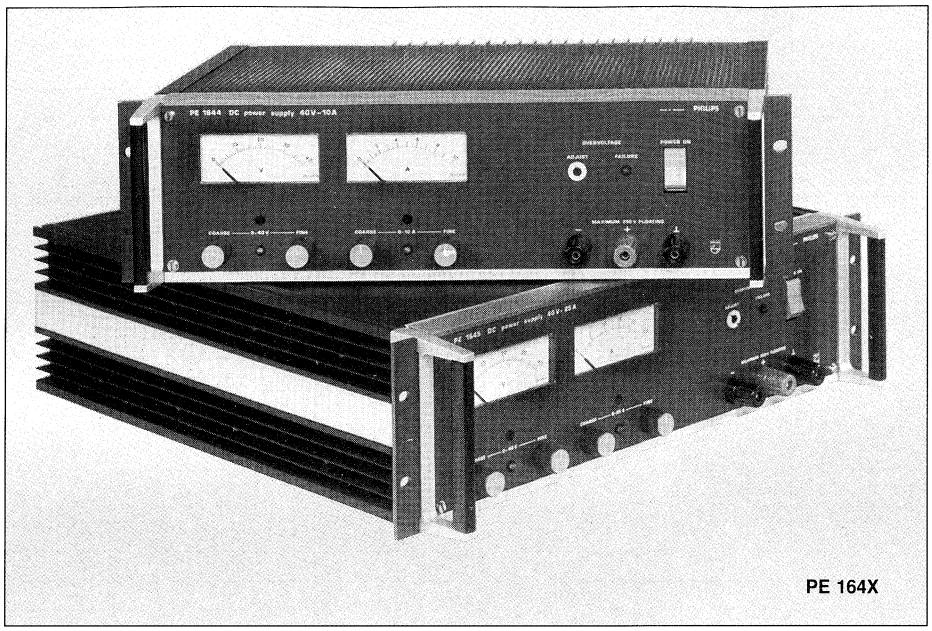
** Whichever is greater †Dual output with tracking mode*

	PE 1540	PE 1541	PE 1542 I	PE 1542 II	PE 1542 II
Constant Voltage Operation					
Output Voltage Ranges (Continuously adjustable (V)	0...40	0...75	0...20	0...20	0...7
Stability against Line Variations With ±10% line variations max. change of output voltage incl. short term drift	≤0.01% or 2 mV*	≤0.01% or 4 mV*	≤0.05% or 2 mV*	≤0.05% or 2 mV*	≤0.05% or 2 mV*
Recovery Time For a sudden increase from 80% load to max. load or for a corresponding decrement (μs)	≤50	≤50	≤25	≤25	≤25
Ripple Voltage (mV_{RMS})	<1	<1	<1.5	<1.5	<1.5
Temperature Coefficient (0...40°C) (%/°C)	0.01	0.01	0.01	0.01	0.01
Constant Current Operation					
Output Current Ranges (Continuously adjustable) (A)	0...3	0...1.6	0...1	0...1	0...3
Stability against Line Variations With ±10% line voltage variations max. change of output current incl. short term drift	≤0.05% or 0.5 mA*	≤0.05% or 0.3 mA*	≤0.5% or 3 mA*	≤0.5% or 1 mA*	≤0.5% or 1 mA*
Stability against Load Variations With load variations of 0...100% max. change of output current (mA)	≤4	≤4	≤5	≤5	≤5
Ripple Current (mA_{RMS})	≤1	≤1	≤1.5	≤0.5	≤0.5
Temperature Coefficient (0...40°C) (mA/°C)	≤0.3	≤0.15	≤2	≤0.2	≤0.6
General					
Parallel and series connection Remote programming/sensing Master/slave operation Ambient temperature (max) Line supply	■ ■ ■ 40°C 110; 127; 220 240V 50/60 Hz	■ ■ ■ 40°C 110; 127; 220 240V 50/60 Hz		■ — — 40°C 110; 127; 220 240V 50/60 Hz	
Dimensions (w x h x l) (mm) (-in) Weight (kg) (lb)	210 x 153 x 271 8.3 x 6 x 10.7 8 17.6	210 x 153 x 271 8.3 x 6 x 10.7 8 17.6		210 x 153 x 271 8.3 x 6 x 10.7 7 15.4	

** Whichever is the greater. Specifications for stability against line variations include settling effect.*

400W and 1000W Lab/System Series

PE 164X



PE 164X

PE 164X 400W and 1000W Lab/System Series

- Choice of 400W or 1000W capacity
- Adjustable constant voltage/current operation with automatic crossover and visual LED indication
- Systems facilities: remote control, sensing, master/slave, etc.
- Separate volt and ammeters
- Built-in over-voltage protection
- MTBF of 50,000 operating hours

These 400W and 1000W power supplies use the thyristor, pre-regulation technique and a unique design feature that increases efficiency and reliability while reducing cost. They are ideal for both laboratory and OEM applications, having comprehensive systems facilities. Separate volt and ammeters, coarse and fine potentiometers, bright LED displays for mode indication and automatic indication of crossover also make the units simple and convenient to use.

The comprehensive over-voltage and overload protection is standard.

Systems Facilities

Simple jumper connections are made to provide the required system facilities.

These cover remote sensing, operation in series or parallel, master/slave operation plus remote programming of both voltage and current outputs.

High Efficiency

The units employ the standard anti-surge choke on the primary, not secondary side of the mains transformer, so that the mains supply makes up the losses directly, instead of having them compounded via the transformer. The overall result is a lighter, more compact design with greater reliability, lower price.

Ultra Reliable

The high MTBF figure of 50,000 operating hours is the result of many factors: experience, Philips being the leading European power supply manufacturer; research, into components and connection techniques, which in turn is backed by extensive quality control facilities and finally, conservative, worst-case designs, which ensure that under normal operating conditions there is considerable reserve in the Philips specification.

Stable Outputs

All units feature very stable outputs with high resolution and low ripple. They can work on a variety of line supplies and can cope with mains variations of up to 10%.

Specifications

Technical Specifications

Performance Table for 400W and 1000W Series

As a Constant Voltage Source	400W Series PE 1642	PE 1644	PE 1646	PE 1648	1000W Series PE 1643	PE 1645	PE 1647	PE 1649
Output Voltage Continuously adjusted with coarse and fine potentiometer between:	0-20V	0-40V	0-75V	0-150V	0-20V	0-40V	0-75V	0-150V
Resolution	0.5 mV	1 mV	2 mV	4 mV	0.5 mV	1 mV	2 mV	4 mV
Stability against Mains Variations With mains voltage variations of + or - 10% the max. change of the output voltage is:	≤0.02%* or 1 mV	≤0.02%* or 1 mV	≤0.013%* or 2 mV	≤0.013%* or 2 mV	≤0.02%* or 1 mV	≤0.02%* or 1 mV	≤0.02%* or 2 mV	≤0.01%* or 2 mV
Stability against Load Variations With load variations of 0...100% the max. change of the output voltage is:	≤20 mV	≤20 mV	≤25 mV	≤25 mV	≤50 mV	≤40 mV	≤25 mV	≤25 mV
Internal Resistance Dynamic For sinusoidal load variations from 80% to 100% of full load at frequencies up to 250 kHz the unit will have the following internal resistance values:								
1 kHz	0.01Ω	0.02Ω	0.02Ω	0.02Ω	0.005Ω	0.02Ω	0.1Ω	0.3Ω
10 kHz	0.04Ω	0.06Ω	0.1Ω	0.1Ω	0.01Ω	0.03Ω	0.15Ω	0.5Ω
100 kHz	0.1Ω	0.1Ω	0.1Ω	0.1Ω	0.015Ω	0.05Ω	0.15Ω	0.25Ω
250 kHz	0.2Ω	0.2Ω	0.2Ω	0.2Ω	0.015Ω	0.05Ω	0.2Ω	0.25Ω
Ripple Voltage The RMS value of the ripple voltage will be: This is valid for any input voltage between 90% and 110% nominal and for any load between no load and full load	≤1 mV	≤1 mV	≤1 mV	≤1 mV	11 mV	11 mV	11 mV	11 mV
Temperature Coefficient The temperature coefficient for any ambient temperature variation in a range of 0-40°C will be:	≤0.01%/°C or 0.2 mV/°C	≤0.005%/°C or 0.2 mV/°C	≤0.005%/°C or 0.5 mV/°C	≤0.005% /°C or 1.5 mV/°C	≤0.01%/°C or 0.2 mV/°C	≤0.01%/°C or 0.4 mV/°C	≤0.005%/°C or 1 mV/°C	1≤0.005%/°C or 2 mV/°C
Recovery Time For a sudden increase from 20% load to maximum load or for a corresponding decrement, the recovery time is:	≤25 µs	≤50 µs	≤50 µs	≤25 µs	≤50 µc	≤50 µs	≤50 µs	≤25 µs
As a Constant Current Source								
Output Current The output current is continuously adjustable in one range by means of a corase and a fine potentiometer between:	0-20A	0-10A	0-6A	0-3A	0-45A	0-25A	0-14A	0-7A
Resolution	10 mA	5 mA	3 mA	1.5 mA	25 mA	15 mA	10 mA	5 mA
Stability against Mains Variations With mains voltage variations of + or - 10% the max. change of the output current is:	6 mA	3 mA	2.5 mA	1 mA	30 mA	10 mA	7 mA	4 mA
Stability against Load Variations With load variations of 0...100% the max. change of the output current is:	≤5 mA	≤3 mA	≤4 mA	≤3 mA	≤30 mA	≤15 mA	≤15 mA	≤10 mA
Ripple Current In all circumstances the RMS value of the ripple current will be:	≤10 mA	≤5 mA	≤5 mA	≤3 mA	≤100 mA	≤15 mA	≤10 mA	≤10 mA
Temperature Coefficient With temperature variations in the range of 0...40°C the temperature coefficient of the output current is:	≤2 mA/°C	≤1 mA/°C	≤0.5 mA/°C	≤0.3 mA/°C	≤12 mA/°C	≤2.5 mA/°C	≤1.5 mA/°C	≤1 mA/°C

** Whichever is the greater. Specifications for stability against mains and load variation include thermal setting drift effects*

PE 164X

General Specification

Input Voltage
Suitable for mains voltages 110-127-220- 240V/ 50...60 Hz. The units are delivered preconnected for 220V.

Ambient Temperature
The ambient temperature is allowed to have any value between 0...40°C.

Polarity
The output terminals are insulated from the chassis; either the positive or the negative terminal may be earthed. The electrical data is valid with earthed output.

Protection
The units are protected against overvoltage by an adjustable o.v.p. which interrupts the drive of the power transistors. The units are also protected against overload and short-circuits.

Indication
LEDs indicate whether the units are used as a constant voltage or as a constant current source and also if the output voltage exceeds the preset overvoltage level.

Efficiency
62% PE 1642 at nominal mains
73% PE 1644 voltage
81% PE 1646 and max. output
81% PE 1648 power

Remote Voltage/Current Control
The output voltage/current can be programmed (remotely adjusted) with a resistance or by a voltage source.

Remote Sensing
Separate sensing terminals at the rear enable specified voltage regulation to be maintained directly at the load by compensating for voltage drops across the load.

Quality
The units are mechanical, climatic and safety test referred to IEC 68 and IEC 348 (Class I). The predicted MTBF is 50,000 operating hours for maximum load and stationary use.

Inrush Current
40A at 220V mains voltage (400W)
Duration 10 ms valid for all units.

Series/Parallel Connection
Two or more power supply units can be connected in parallel or in series.

Master/Slave Operation
One unit (master) can control the connected units (slaves) when more units are used in series or parallel connection. The terminal block at the rear of the unit eliminates the need to rewire internally for this function.

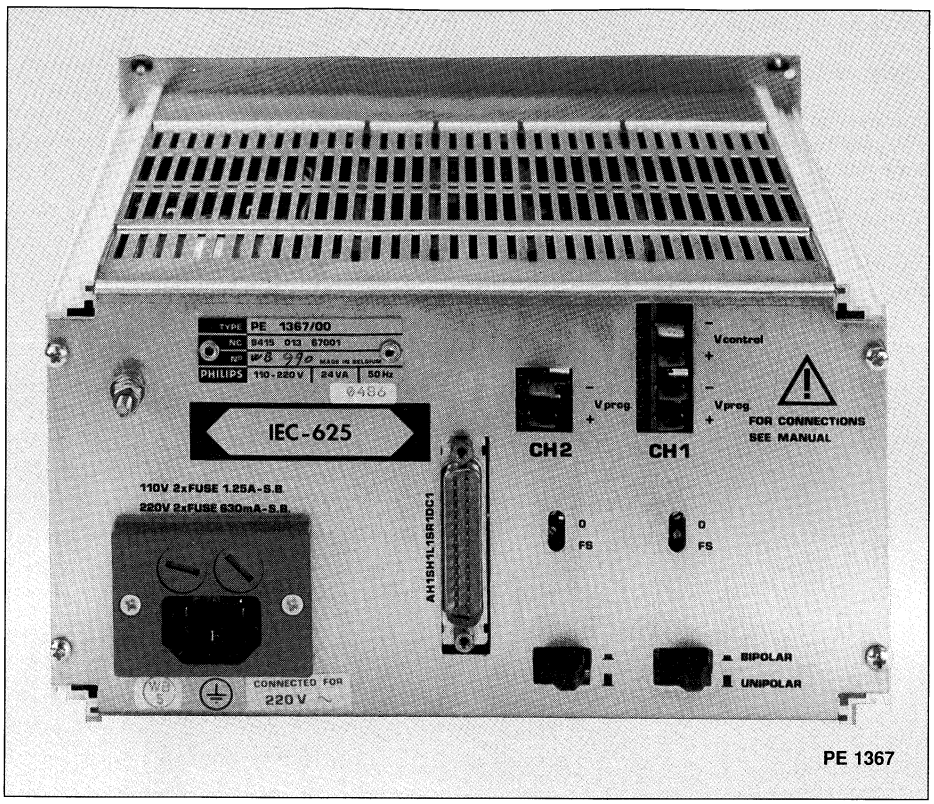
Design
The units have been designed for use as table model as well as for 19-in rack mounting.

Meters
The units feature separate volt and amp. meters.

Mains Interference
Conforms to VDE 0875 N-level

Dimensions and Weight
400W
Height: 132 mm (5.2 in.)
Width: 444 mm (17.5 in.)
Length: 360 mm (14.2 in.)
Weight: 21 kg (46 lb)
1000W
Height: 132 mm (5.2 in.)
Width: 444 mm (17.5 in.)
Length: 477 mm (18.8 in.)
Weight: 37 kg (81.4 lb)

PE 1367



PE 1367

PE 1367 IEC-Bus Power Supplies Programmer

- Programming speed 1 µs/V (programmer only)
- Simultaneous two-channel triggering
- Internal microprocessor control for greater flexibility, diagnostic routines
- IEC/IEEE-bus compatibility
- Multiple programming with auto and % mode (basic statements)
- Two-channel galvanic separation by fast opto-coupler
- Automatic ranging: 0-1V, 0-10V; high resolution of 1 mV for 1V, 20 mV for 10V

The following Philips power supplies can be controlled with the PE 1367 programmer via the IEC bus			
PE 1539	0...20V	0...6A	
PE 1540	0...40V	0...3A	120W lab types
PE 1541	0...75V	0...1.6A	
PE 1642	0...20V	0...20A	
PE 1643	0...20V	0...45A	
PE 1644	0...40V	0...10A	
PE 1645	0...40V	0...25A	400W and/or lab 1000W types
PE 1646	0...75V	0...6A	and 19-in rackmount versions
PE 1647	0...75V	0...14A	
PE 1648	0...150V	0...3A	
PE 1649	0...150V	0...7A	

The PE 1367 is designed to be run by any controller or computer using the IEC-625 instrument bus. It is essentially a dual-channel digital-to-analog converter fitted with a microprocessor (8085).

An IEC/IEEE bus interface chip allows conversion of bus line instructions to control signals for the DAC unit.

Two galvanically separated outputs are available, switchable for 0V to +1V and 0V to +10V unipolar or -1V to +1V and -10V to +10V for bipolar operation. The output current is 10 mA.

A resolution of 1000 steps is provided by the converter in any range, with autoranging in the unipolar and bipolar mode. PE 1367 also acts as a listener on the IEC-625 bus and responds to serial poll.

A simultaneous triggering is provided for the two channels, one of which is an adjustable current sink facility. All digital data can be stored internally; simple diagnostic routines are built-in. Basic statements can be used for programming by means of any computer keyboard with ASCII 7-bit code.

The programming speed of the programmer alone, is 1 µs/V. In addition, PE 1367 can generate service request messages, such as wrong character/parameter, overshoot, etc.

Wide Application Range

PE 1367 will satisfy a very wide range of applications, either as a stand-alone unit or as a bus line interface for voltage-controlled power supplies. In this latter function the two outputs may be used to control two independent power supplies or two separate functions of a single power supply, e.g., output voltage and current. This offers many possibilities in test and control systems.

18

Specifications

Technical Specifications

High Range: Unipolar mode 0V...+10V;
Bipolar mode -10V...+10V
Low Range: Unipolar mode 0V...+1V;
Bipolar mode -1V...+1V

Resolution
High Range: Unipolar mode 10 mV;
Bipolar mode 20 mV
Low Range: Unipolar mode 1 mV;
Bipolar mode 2 mV

Output Current: 10 mA (unipolar and bipolar)
Output Impedance: <0.1Ω (DC)
Linearity Error: ±½ LSB (least significant bit)
Zero Adjust: ±500 mV
Full Scale Adjust: ±5%
Programming Speed: 1 µs/V (typical)
Number of Channels: 2
Galvanic Isolation: 1000 VDC
Interface Functions: AH1, L1, SH1, DC1, SR1
Programming Modes: Auto, %

PE 1367

Calibration: Off-line possible
Current Sink: For channel 1
Temperature Coefficient: 150 ppm/K max.
MTBF: 50,000h

Power Requirements

Line Voltages and Frequencies: 110-120-220-240 VAC (±10%) 48...62 Hz

Environmental Conditions

Ambient Temperatures
Limits for Operating: 0...+55°C
Storage and Transit: -40°C...+70°C

Vibration and Shock: In accordance with IEC 68
Safety: In accordance with IEC 348 safety class 1
Interference: In accordance with VDE 0875N (RFI level transferred to the mains)
Dimensions: 213 mm W x 128 mm H x 220 mm L (8.3 in W x 5 in H x 8.7 in L)
Weight: 3.25 kg (7.2 lb)

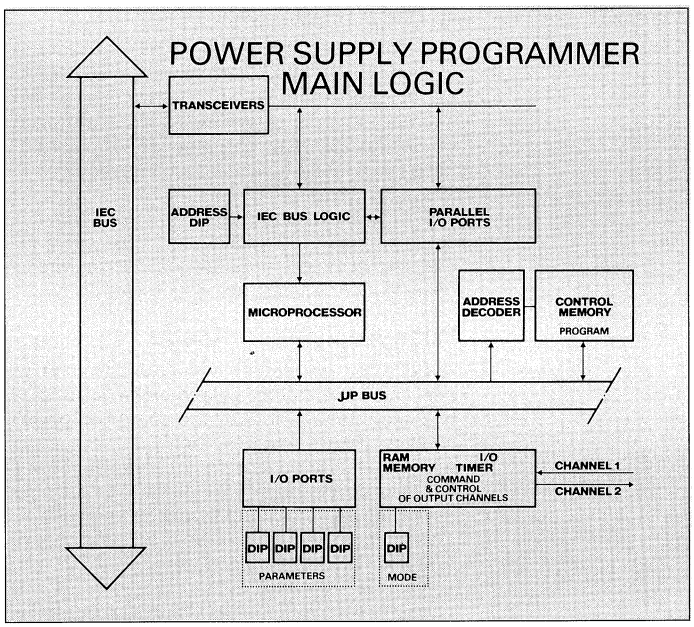
IEC/IEE Interface Data

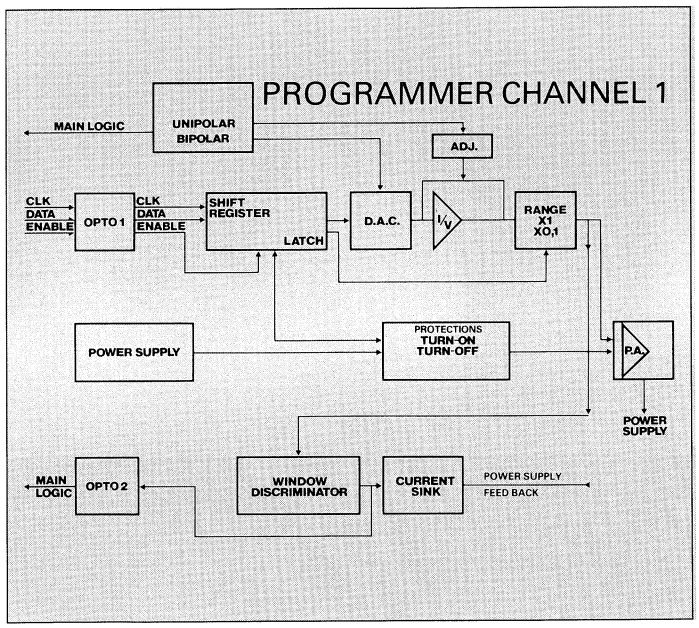
IEEE Interface Option PM 9483: Can be supplied fitted (to order) or retrofitted in the field
Connector: 24-pole

Interface Functions:

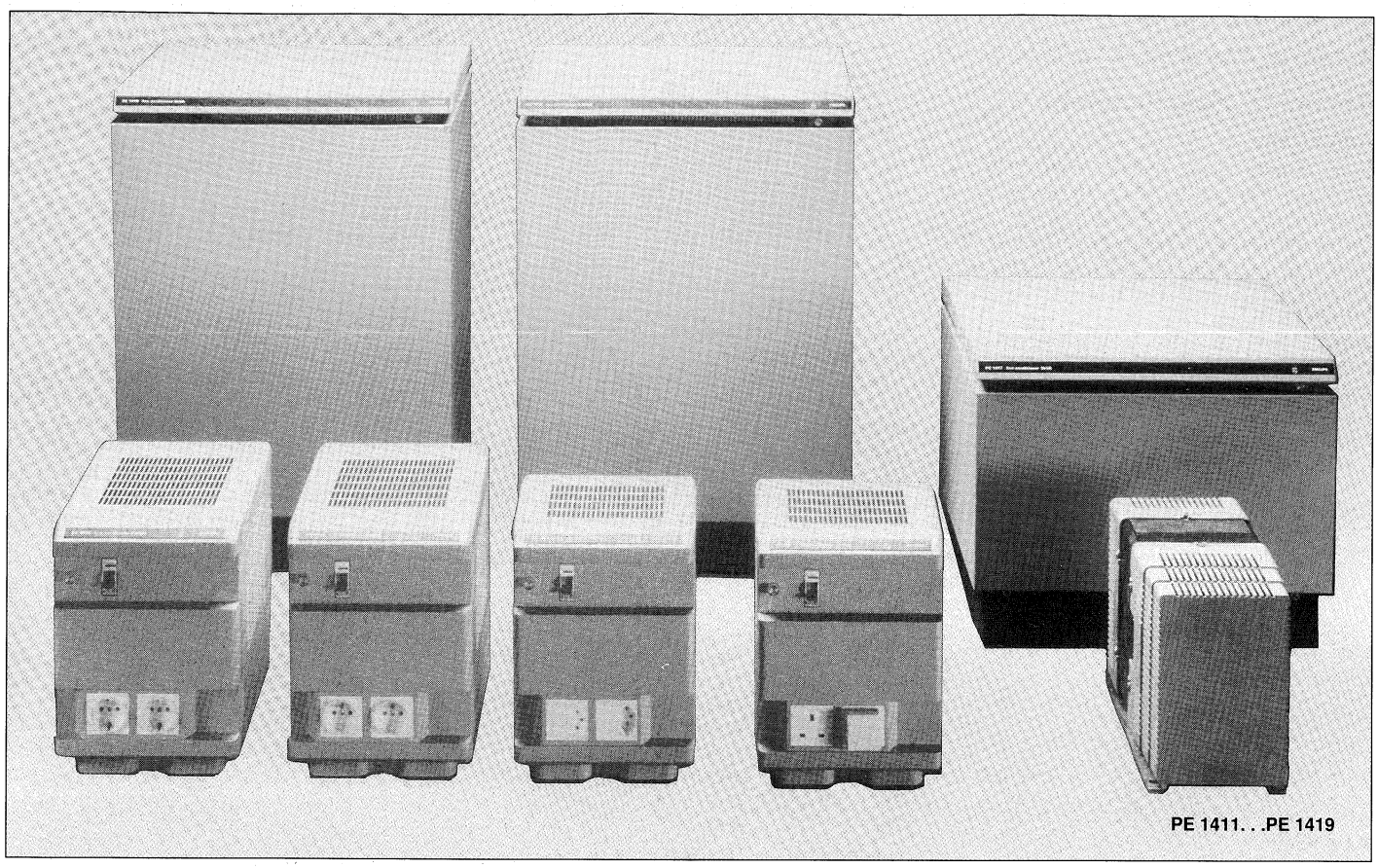
SH1	Source handshake
AH1	Acceptor handshake
L1	Listener: receives device-dependent data over the interface
SR1	Service request, generated in case of data available
DC1	Device clear: provides capability to reset a device to initial state (both channels OV) by remote message

Time Specifications
Programming speed: 1 µs/V
Codes: ISO 7-bit code
Input delimiter, ETX, CRLF, NL...





PE 1411...PE 1419


PE 1411. . .PE 1419

PE 1411...PE 1419 Line Conditioners

- Optimum combination of line stability and transient suppression
- More than 100 dB transient suppression for short pulse widths
- Output stability of 1% even for very low input voltages
- Sinewave output with distortion lower than 4% even for square wave inputs
- Short-circuit proof output due to automatic overload protection
- Mean time between failure in excess of 200,000 operating hours
- Operate from 220...240V, 50...60 Hz

Configurations

Power rating	Input voltage	Open types	Open with caps	Closed types
200 VA	220/240	PE 1411/10	PE 1411/15	PE 1411/20
400 VA	220/240	PE 1412/10	PE 1412/15	PE 1412/20
850 VA	220/240	PE 1413/10	PE 1413/15	PE 1413/20
1500 VA	220/240	PE 1414/10	PE 1414/15	PE 1414/20
3000 VA	220/240	PE 1417/10		PE1417/20
4500 VA	220/240	PE 1418/10		PE 1418/20
6000 VA	220/240	PE 1419/10		PE 1419/20

** 50 Hz only*

In many electronic systems such as computer systems, automatic test equipment, control systems, bank terminals, telecommunications, security systems, analytical instruments, point-of-sale equipment, etc., mains borne disturbances often cause serious problems.

Frequently, these disturbances include excessive voltage variations, troublesome spikes and transients, brutal power interruptions and frequency changes.

In order to offer a complete and universal range of protection equipment, Philips has developed a new range of line conditioners valid for 50/60 Hz and 220/240V operation.

By means of simple wiring changes, these units can be used either as a filter, or as a stabilizer.

PE 1411...PE 1419

Specifications

Technical Specifications

Input Data

Input Voltage: 220V nominal (198V...242V) or 240V nominal (216V...264V) by wiring (110V possible).
Mains Frequency: 50 Hz (±2%) or 60 Hz (±2%) by wiring.

Output Data

Output Voltage: 220V or 240V, depending on how the unit is connected.

Stability
As a Stabilizer

- Against mains voltage variations only.
  At mains voltage variations of 198V to 242V, a constant resistive load and a frequency of 50 (60) Hz ±1% the output voltage remains within: ±1% for all models
- For combined mains voltage variations (198V to 242V) together with resistive load variations from no load to full load and vice-versa, the output voltage remains within:
  PE 1411 + 3.0% to - 1.9%
  PE 1412 + 2.8% to - 1.6%
  PE 1413 + 2.3% to - 1.2%
  PE 1414 + 2.0% to - 1.0%
  PE 1415 + 2.3% to - 1.5%
  PE 1417 + 2.3% to - 1.5%
  PE 1418 + 2.3% to - 1.5%
  PE 1419 + 2.3% to - 1.5%

As a Filter

- Against mains voltage variations only. At mains voltage variations of 198V to 242V (or 216V to 264V), a constant resistive load and a frequency of 50 (60) Hz, the output voltage remains within: ±2% for all models.
- For combined mains voltage variations (198V to 242V respectively 216V to 264V) together with resistive load variations from no load to full load and vice-versa, the output voltage remains within:
  PE 1411 + 6.0% to - 2.9%
  PE 1412 + 4.9% to - 2.5%
  PE 1413 + 4.5% to - 2.1%
  PE 1414 + 4.2% to - 1.8%
  PE 1415 + 4.5% to - 2.1%
  PE 1417 + 4.5% to - 2.1%
  PE 1418 + 4.5% to - 2.1%
  PE 1419 + 4.5% to - 2.1%

Distortion: Less than 4% of its rms value.
Energy Reserve (hold up time): 10 ms (at full load).
Interference Supression: Between 50 and 110 dB (see fig. 3 and 4)
Overload Protection
If a short circuit occurs in the load, the ouput voltage will collapse and the current will be limited to approx. 200% of the maximum rated value.
Parallel Operation -and 3 Phase Configuration
The stabilizer provides galvanic separation between input and ouput, parallel use of two or three stabilizers is permitted and 3 phase configuration is possible.
Efficiency
At full load better than:

For PE 1411	76%
For PE 1412	81%
For PE 1413	88%
For PE 1414	89%
For PE 1415	89%
For PE 1417	89%
For PE 1418	89%
For PE 1419	89%

Noise Level

Type nr.	Level dBA
PE 1411/10/15/20	≤40
PE 1412/10/15/20	≤40
PE 1413/10/15/20	≤50
PE 1414/10/15/20	≤50
PE 1415/15	≤50
PE 1418/10/20	≤50
PE 1419/10/20	≤50

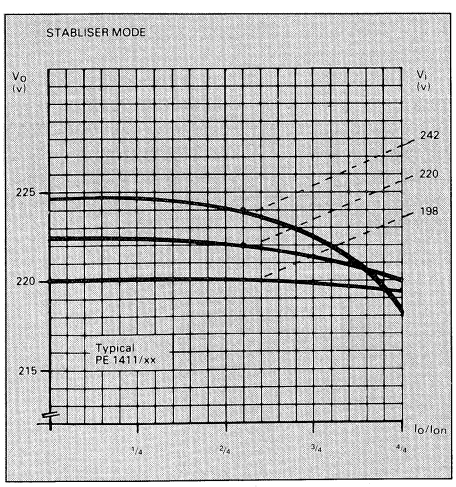


Fig. 1. Typical values

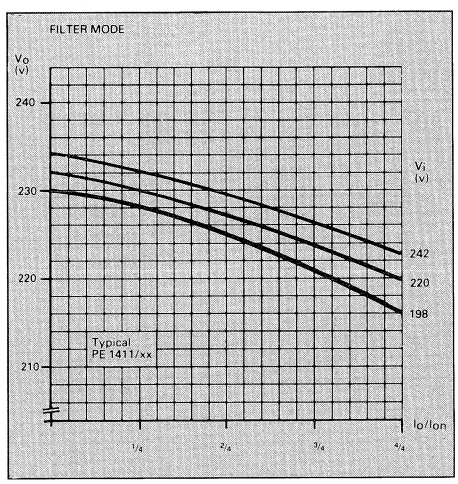


Fig. 2. Typical values

Ordering Information

Versions

- PE 1411/10 to 1419/10 completely open types, intended for in-building or rack-mounting, fitted with input and output terminal blocks.
- PE 1411/15 to 1414/15 identical to /10 versions but fitted with plastic caps.
- PE 1411/20 to 1414/20 completely enclosed types, contained in metal housing with plastic covers, fitted with mains switch, power on/off indicator, two output sockets*, and one mains cable (2m) with plug*
- PE 1417/20 to 1419/20 completely enclosed types, contained in metal cabinet, fitted with power on/off indicator, inut and output terminal blocks and cable entries.

*The following plugs and sockets are available:
/201 German types, valid in Austria, Germany, Holland, Italy, Sweden...
/202 French types, valid in Belgium, France...
/203 British types, valid in Great Britian, Hong Kong...
/204 Swiss type

Note: PE 1411 to 1414/20 units fitted with the right output sockets (receptacles) and mains plug add the figure 1, 2, 3 or 4 to /20.
For example, PE 1414/201 is completely enclosed unit of 1500 VA, fitted with a German mains plug and two Schuko output sockts.

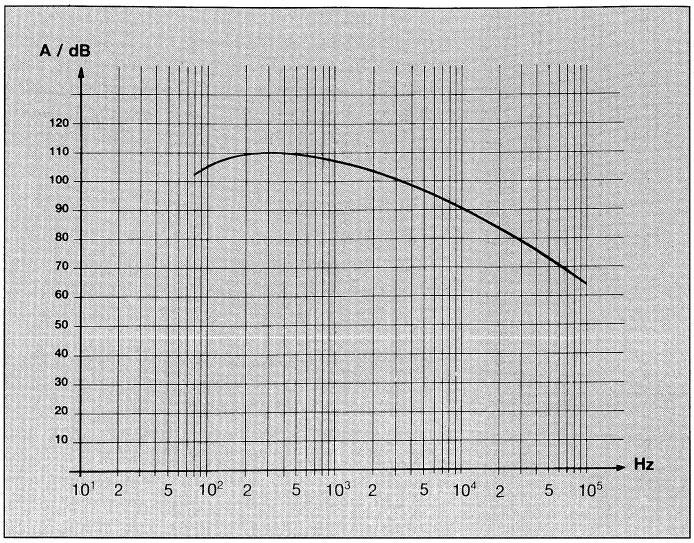


Fig. 3. Transient suppression as filter

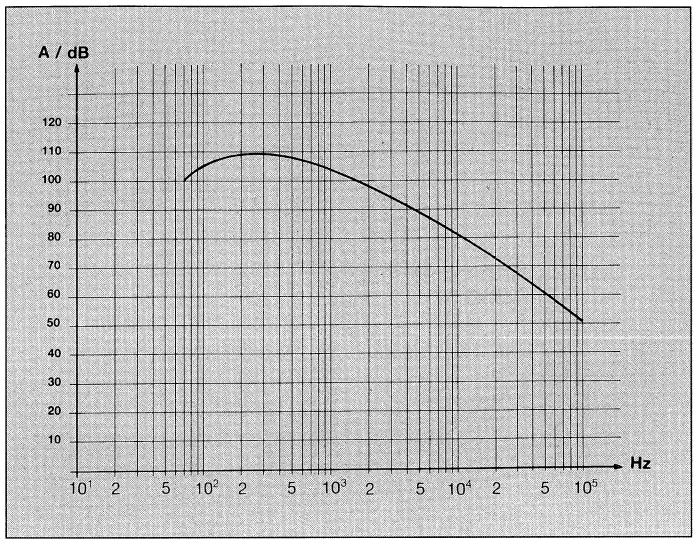
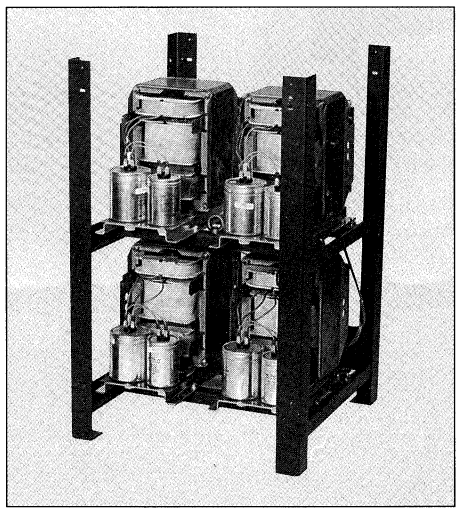


Fig. 4. Transient suppression as stabilizer

Dimensions and Weight

Type no.	Height	x	Width	x	Length/mm	Weight/kg
PE 1411/10	178	x	160	x	212	7
/15	183	x	158	x	226	8
/20	310	x	220	x	270	9
PE 1412/10	178	x	160	x	240	10.5
/15	183	x	158	x	252	11.5
/20	310	x	220	x	270	13.0
PE 1413/10	249	x	163	x	286	20
/15	256	x	206	x	315	21
/20	310	x	220	x	384	22
PE 1414/10	249	x	163	x	332	31
/15	256	x	206	x	360	32
/20	310	x	220	x	429	33.5
PE 1417/10	396	x	447	x	447	70
/20	397	x	480	x	470	75
PE 1418/10	692	x	447	x	447	106
/20	694	x	480	x	470	112
PE 1419/10	692	x	447	x	447	137
/20	694	x	480	x	470	143

Line conditioner in the OEM version



Compact UPS

PE 5207...PE 5217



Compact Uninterruptible Power Supplies 0.5 to 10 kVA

- True on-line uninterruptible systems
- Extremely reliable
- Fully protected
- 100% safe
- Capable of handling all types of mains disturbances
- Particularly suited for critical applications

Some applications require mains sources to be totally reliable and constant. In these cases, Philips series of Uninterruptible Power Supplies (UPSs) guarantee the required level of mains continuity.

Typical applications include supply of computers and peripherals; bank terminals; life critical equipment in, for example, operating theatres; aircraft landing systems; and emergency lighting systems. Other areas where a totally reliable source is vital include traffic control signalling systems, offshore platforms, industrial robots, intensive care wards, etc.

Various power capacities and back-up time are available in the UPSs, to deliver power automatically the instant the mains supply fails. Power is supplied for long enough for the failure to be corrected or to introduce local emergency power systems (e.g. diesel-electric generators). Most UPSs have some capacity for tailoring to specific needs.

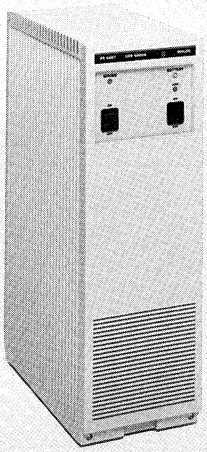
This new range of uninterruptible power supplies is designed for computer room operation. In keeping with the modern office environment, they are extremely compact, quiet and aesthetically designed.

They use the most up-to-date technology to provide power the instant the mains supply fails. In addition, these UPSs will neutralize otherwise damaging transients, e.g. from lightning; noise inducing equipment (lifts, welders, etc.); mains demand fluctuations; and most other common mains aberrations.

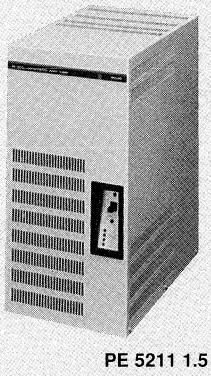
Main Features

- Full on-line systems
- Automatic bypass unit on all high power systems (1.5 to 10 kVA), providing high current to meet the demand during start-up of the critical load.
- The various sub-assemblies are fully protected by electronic current-limiting devices, electrothermic switches and fuses.

Construction is modular, allowing quick and simple repair by module replacement with no special tools. They are simply installed by the user with no need for any measurements, tests or adjustments. Design and construction is such that a long, reliable life is guaranteed. All systems are fully calibrated at the factory prior to shipment and appropriate batteries are included.



PE 5207 500VA UPS



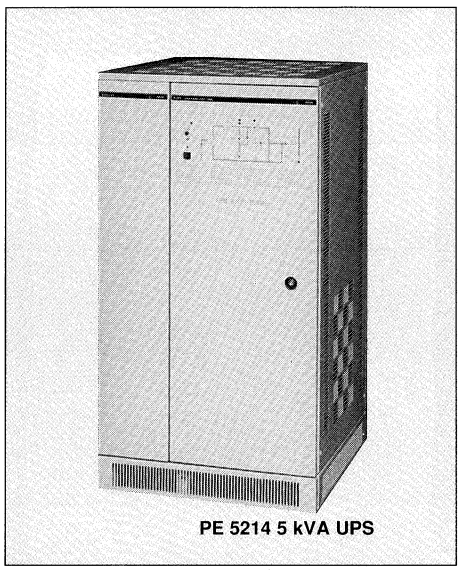
PE 5211 1.5 kVA UPS

Technical Specifications/Ordering Information

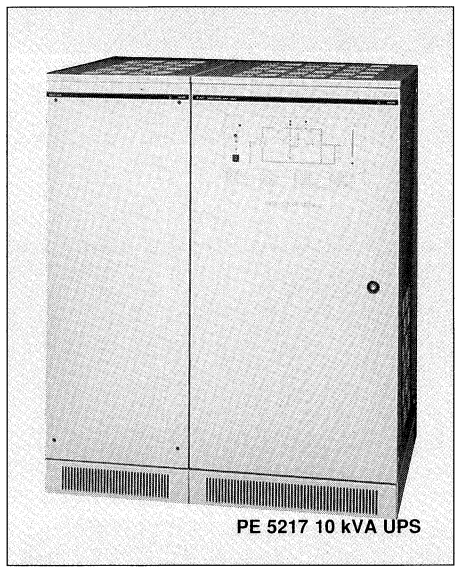
Power Type number	500 VA PE 5207	1000 VA PE 5210	1500 VA PE 5211	3000 VA PE 5213	5 kVA PE 5214	10 kVA PE 5217
Input data:						
Voltage Vac	220/240	220/240	220/240	220/240	380-3 ph*	380-3 ph*
Frequency (Hz) ±5%	50/60	50/60	50/60	50/60	50*	50*
Power factor	0,99	0,99	0, 8-1	0,8-1	0, 8-1	0, 8-1
Output data:						
Voltage Vac ±1%	220/240	220/240	220/240	224/240	220-1 ph*	220-1 ph*
Frequency (Hz) ±0.5%	50/60	50/60	50/60	50/60	50*	50*
Harmonic distortion	<3	<3	<2	<2	<2	<2
Efficiency (%)	>85	>85	92	92	80	80
MTBF (hrs at 40°C)	40000	40000	40000	40000	40000	40000
Overload (% in 1 minute)	-	-	150	150	150	150
Battery unit:						
Voltage Vdc nominal	48	96	324	324	120	120
Static bypass unit:	-	-	yes	yes	yes	yes
Transfer time (ms)	-	-	<4	<4	zero	zero
Overload (%)	-	-	400	400	500	500
Standard back-up time (min.)	12*	12*	10	20	8*	10*
Environmental data:						
Operating temperature	0...-40°C	0...-40°C	0...-40°C	0...-40°C	0...-40°C	0...-40°C
0 Storage & transport temp.	-40...+50°C	-40...+50°C	-40...+50°C	-40...+50°C	-40...+50°C	-40...+50°C
RH (non-condensing)	20...95%	20...95%	20...95%	20...95%	20...95%	20...95%
Audible noise (dBA at 1m)	<35	<35	<48	<48	<53	<53
Cooling	convection	convection	convection	convection	fan	fan
Mechanical data:						
Dimensions - width (mm)	190	190	255	320	650	1030
- height (mm)	570	570	525	555	1220	1220
- depth (mm)	340	340	405	565	650	650
Volume (dm^3)	37	37	54	132	515	817
Weight (kg, inc. batteries)	33	47	75	140	370	640

** Other specifications on request*

General Data
All UPS units are delivered with maintenance-free sealed lead acid batteries.
Expected life-time: 5 years at 20°C.

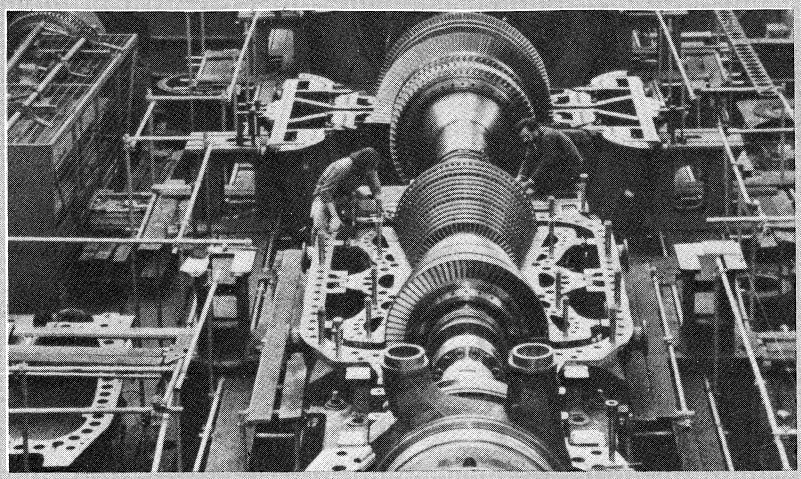


PE 5214 5 kVA UPS

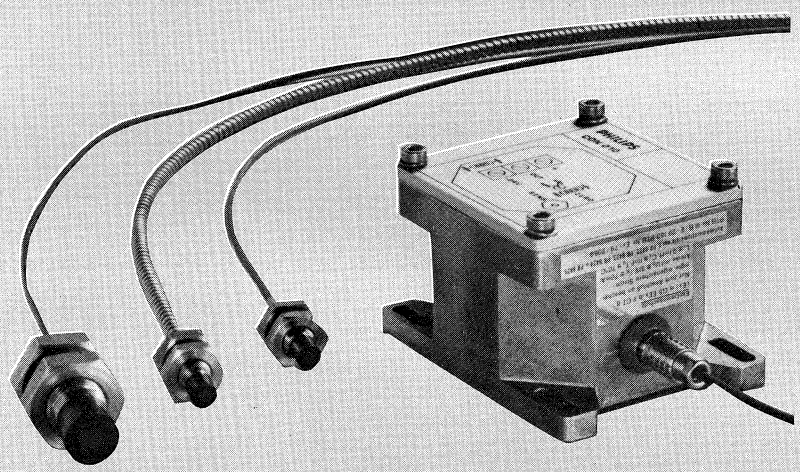


PE 5217 10 kVA UPS

Machine Monitoring System



Turbo machinery transmission Page 548



PR 6422 Page 548



Stroboscopes Page 550

Application

Industrial measuring chains for: Mechanical engineering, tool machines, machine monitoring, power plant/industrial turbines and compressor supervision etc.

A comprehensive modular range

Philips offers a complete range of equipment specially designed for measuring mechanical parameters. This equipment forms the subject of a separate catalog: Machine Monitoring Systems. Some items from this catalog are briefly mentioned here, as in many instances the measurement of mechanical parameters complements the test and measuring functions. For the complete information please order the catalog from your local Philips organisation or write to: Philips GmbH Werk für Messtechnik, 2000 Hamburg 73, Miendorferstrasse 205, P.O. Box 730 370 Dept. HMS. W.Germany.

Detection

Transducers for: temperature, strain, force, pressure, displacement, vibration, rotational speed, torque, web tension etc.

Measurement, Data acquisition and Monitoring

Electronics for: Measurement, processing and monitoring of mechanical quantities, temperatures, web tension and contactless data transmission systems, indication, recording, data acquisition and monitoring, digital and analog indicators, recorders etc.

Turbo Machinery Supervision RMS 700 System Page 548
Transducers Page 548
Industrial Data Acquisition and Monitoring Systems Page 549
Stroboscopes Page 550

Turbo Machinery Supervision RMS700 Systems

Philips has a vast experience in supplying monitoring systems for the widest variety of rotational machinery, including turbines, compressors, pumps etc., regardless of size, operating speed or ambient conditions. With over 30 years experience, reliability has been demonstrated in installations worldwide such as power plants, industrial compressors, pipeline systems and test beds. Modular units for various applications are available such as the RMS 700 system in rack or compact versions.

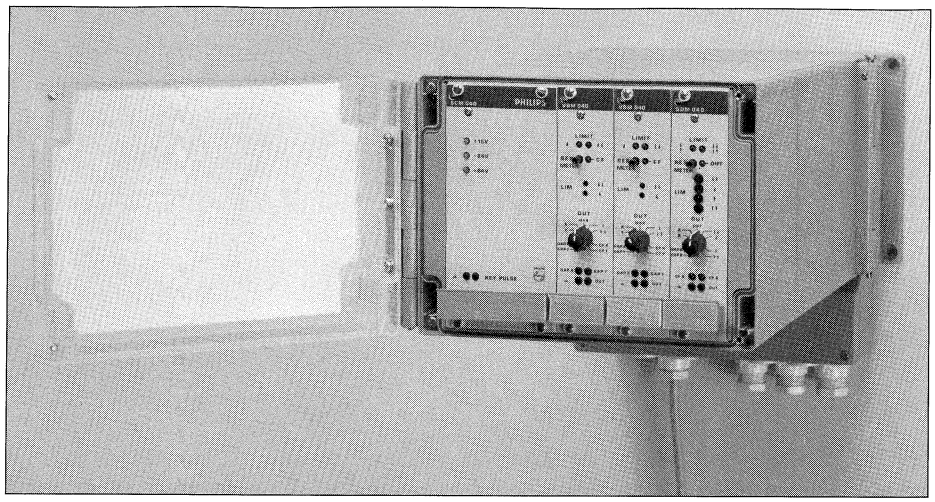
The Philips RS 700 Machine **Monitoring System** provides the complete answer, providing overall mechanical variables such as absolute and relative vibration levels, axial and radial displacement, rotational speed, wear, eccentricity, temperature, oil and steam pressures and valve position.

RMS 700 is rugged and will operate in the most hazardous conditions and environments. Design employs compatible plug in printed board modules for true flexibility and easy system extension. Operation is primarily based on contactless measuring principles ensuring long term accuracy, reliable and simple operating and zero maintenance.

Philips has a total concept in the field of machine health monitoring, the RMS 700 **Supervisory System**. It offers unrivalled advantages for supervision of rotational machinery such as pumps, fans, centrifugues, blowers, hydroturbines, gear boxes, high speed pumps and compressors, especially in the power generation, chemical, petrochemical, oil and gas industries. Tailored to meet the precise requirements of applications governed e.g. by API 670 E and VDI 2059 standards the RMS 700 system saves investment, time and labour by virtue of its integrated, multifunction concept. Its low cost enables machinery which was formerly considered unworthy of a supervisory network to be monitored more economically. It is fully compatible with existing Philips machine and process supervisory systems

Vibration is measured on rotational machinery parts, (e.g. shafts) in two planes (X- and Y-direction) the maximum vibration level in peak-to-peak values is indicated. The relevant transducers are mounted at the same axial position and at 90° to each other. Axial displacement measurements can be made on machinery parts in either two or one channel configuration.

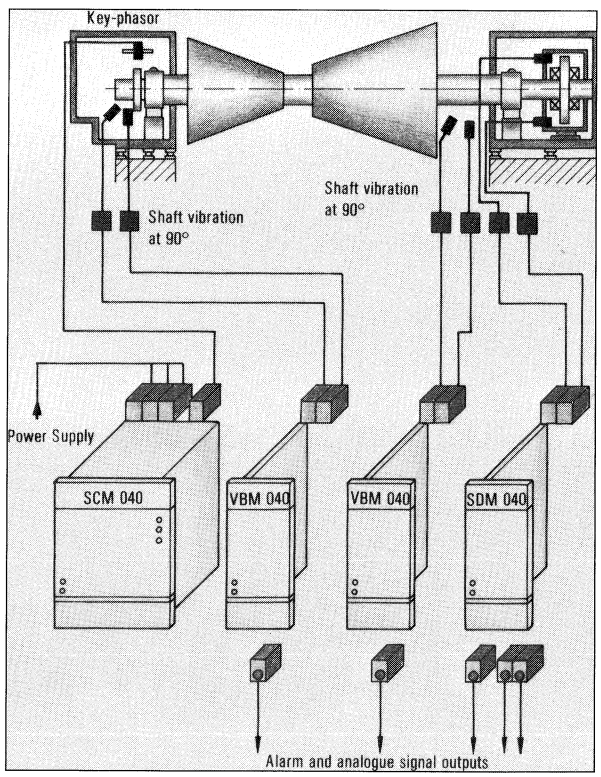
This permits a convenient measurement system for shaft vibration in the X-Y direction and for axial shaft displacement with and without indicators as required by API 670.



Set 050 wall mounting system comprising instruments for the system as shown below

Transducers

Philips has a complete range of general purpose and special purpose signal transducers for the measurement of mechanical parameters, dynamic and static. These signal transducers convert any change in the mechanical quantity into a proportional change of an electrical value, e.g. resistance, inductance or capacitance.



Typical small turbo supervisory system

Industrial Data Acquisition and Monitoring System

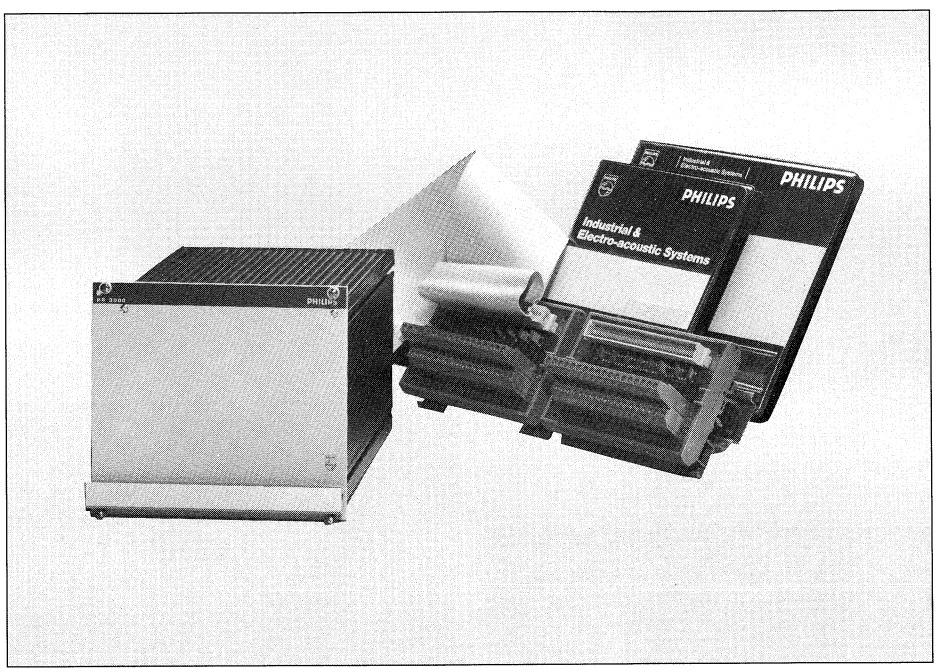
The PR 3000 Series of Industrial Data Loggers are low-priced, compact, independently operating data acquisition and monitoring systems for various applications in industry.

To gather the required information for management and staff in regard to the production process, data loggers, personal computers, point recorders, controllers, micro- and minicomputers and other devices are used. However, it is often very difficult to find a cost-effective, straightforward system that meets fully the technical demands of making a process transparent.

Philips has a vast experience in Industrial Automation, solving data acquisition problems and measuring, monitoring and control of machinery and processes. Some examples of installed systems are:

- Test rigs for brakes in the automobile industry.
- The off-shore industry
- Power stations and refuse plants for control and the emmission of air pollutants.
- Quality control in precision engineering firms.
- Automobile manufacturers to produce safer and more comfortable cars.
- Saving of energy and the reduction of plant down-time in the chemical industry.

In other branches of industry, for instance glass, metals and plastics, Philips is actively helping management to save energy, cut costs, improve efficiency and safeguard personnel and machinery.



PR3000 Industrial data acquisition and monitoring system

Data Acqusition

The PR 3000 series of industrial data acquisition system is low priced, compact and versatile to handle the complete spectrum of mechanical, physical and digital measurements, e.g. pressure, strain, thickness, temperature, voltage, current, resistance etc.

Ease of operation and high performance makes them specifically suitable for integration into process control and machine monitoring systems of all descriptions.

Features for Industrial Capability

Besides all the features which are generally offered by modern data acquisition systems the PR 3000 is equipped with facilities for unattended 24 hours a day continuous operation.

It is designed with complete automatic error detecting facilities, e.g. cyclic check of program parameters, microprocessor and power supply function, watchdog etc; in case of microprocessor and/or power supply failure, two independent alarm lines are set, so an active alarm can be given.

All units can be mounted in all types of 19-inch racks and cabinets. Unlike other acquisition systems the low power consumption, low heat dissipation and 24V dc supply allows mounting in waterproof industrial cabinets.

Monitoring Functions

Different alarm levels are available per measuring point, the value of which can be independently set.

Event triggered scans are also performed easily. Different alarm messages can be given in an alarm situation. In addition to absolute measuring values, "rate of change" values allow the monitoring of trends.

"Average value" calculation of channel measurements of up to 3 different channels or "average value" calculation over a maximum of three different time intervals, with minimum and maximum values, can be recorded and logged.

All normal mathematical functions can be applied to the measured values. To suppress unwanted incidental alarms, "trend" (rate of change) indication may be selected.

Colorgraphic System

Data can be displayed as curves, bargraphs or process graphics, on a monitor or printed as hard copy. Mimic diagrams, production flow charts, machine details etc, can all be clearly presented as self explanatory visual displays, each consisting of static and dynamic parts. The static part shows the machine, for example, while the dynamic part gives up-to-date graphic or numerical information on actual values, changing its colour to indicate alarms. The application range of data acquisition systems can be extended by combining their operation with personal computers (PCs). Data can be tailored and presented for operational or maintenance purposes. The standard software packages allow generation of historical data, display of graphics and mathematical calculations to be used for the generation of reports.

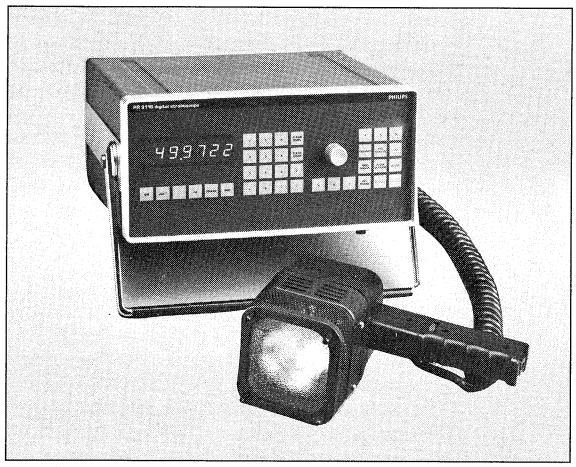
Stroboscopes

A range of stroboscopes is available, either for mains or battery operation. They provide high flash intensity over a wide frequency range. Light intensity is such that they can be used by photographers.

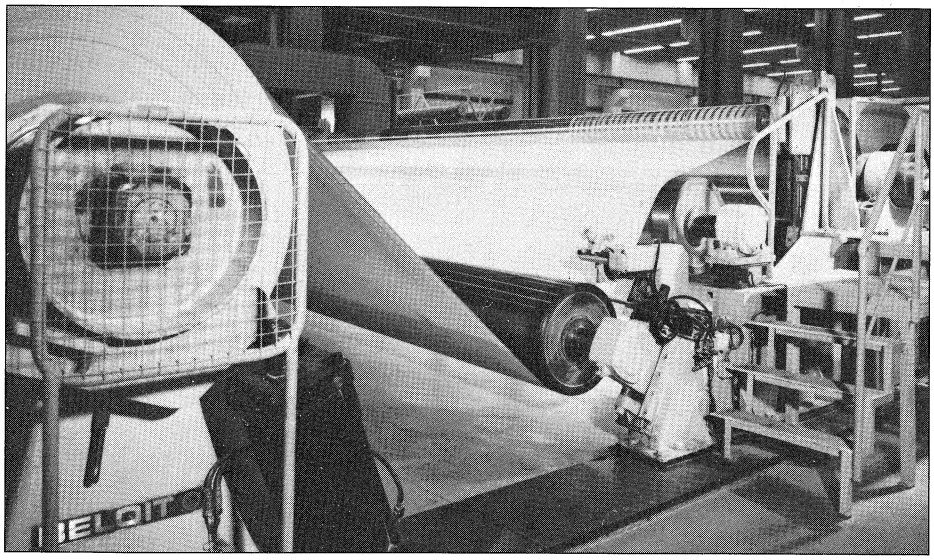
Web Tension Measurement

Accurate supervision of tensile strength is of vital importance in the production and processing of paper, textiles, plastics, wire and similar products. Only if the tension is under control is it possible to maintain the quality of the product at a consistently high level. Philips has developed a special range of equipment which provides an ideal way to monitor, indicate and control web tension at all stages of production.

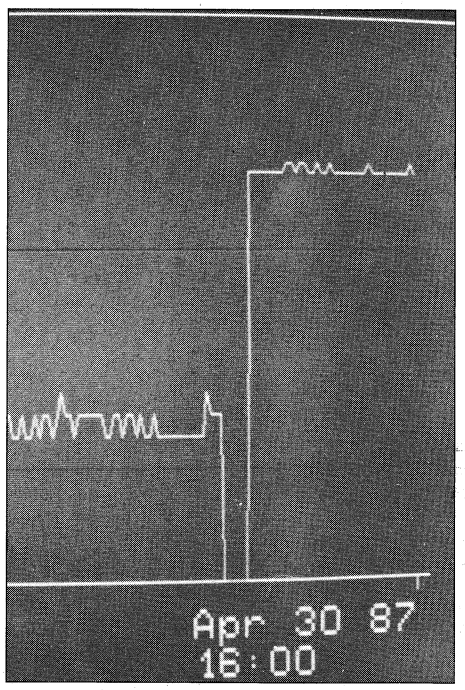
This equipment is very accurate and reliable, extremely robust, and is easy to install in existing or new production lines.



Universal Stroboscope **PR 9116**

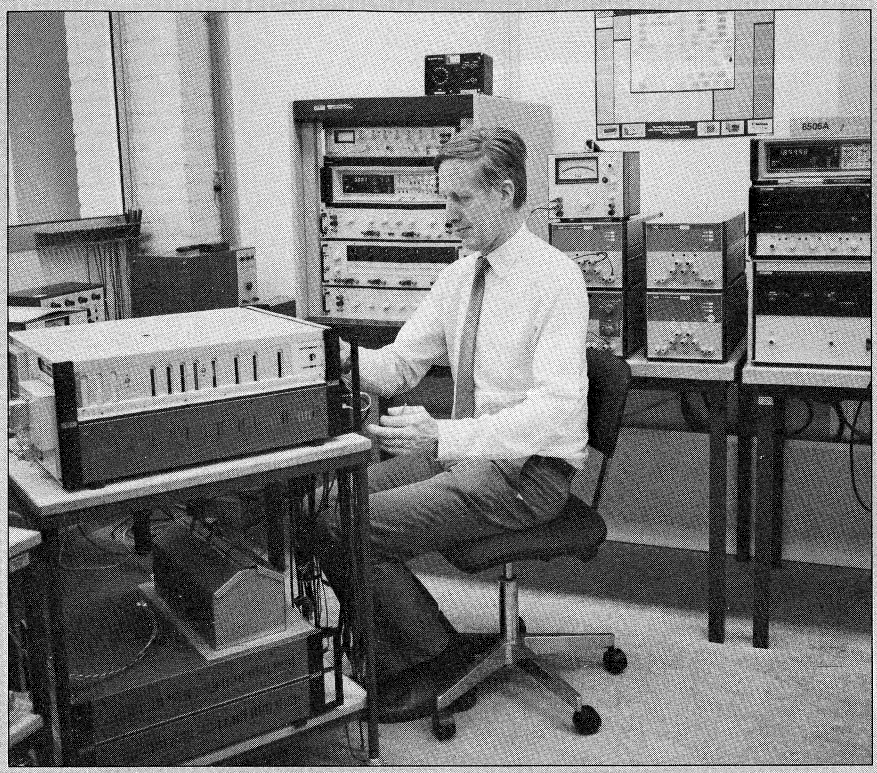


Application of web tension measurement in the paper industry



Colorgraphic presentation of, for example, turbine data and individual channels

Customer Support Services



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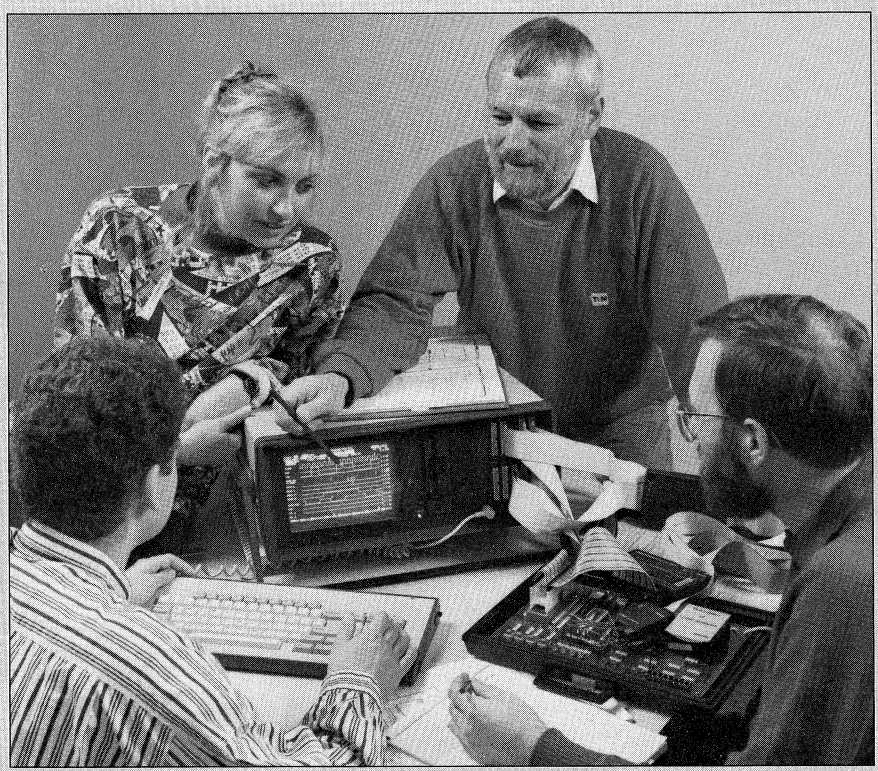


Customer Training Page 555

As our customers demand new and more complete test and measurement solutions, Fluke and Philips are becoming more than a manufacturer of affordable, efficient products. We are dedicated to providing the best services possible to support our products in your specific application. To protect your product investment, Fluke and Philips Technical Service Centers are located worldwide to support you with parts, repair and calibration services.

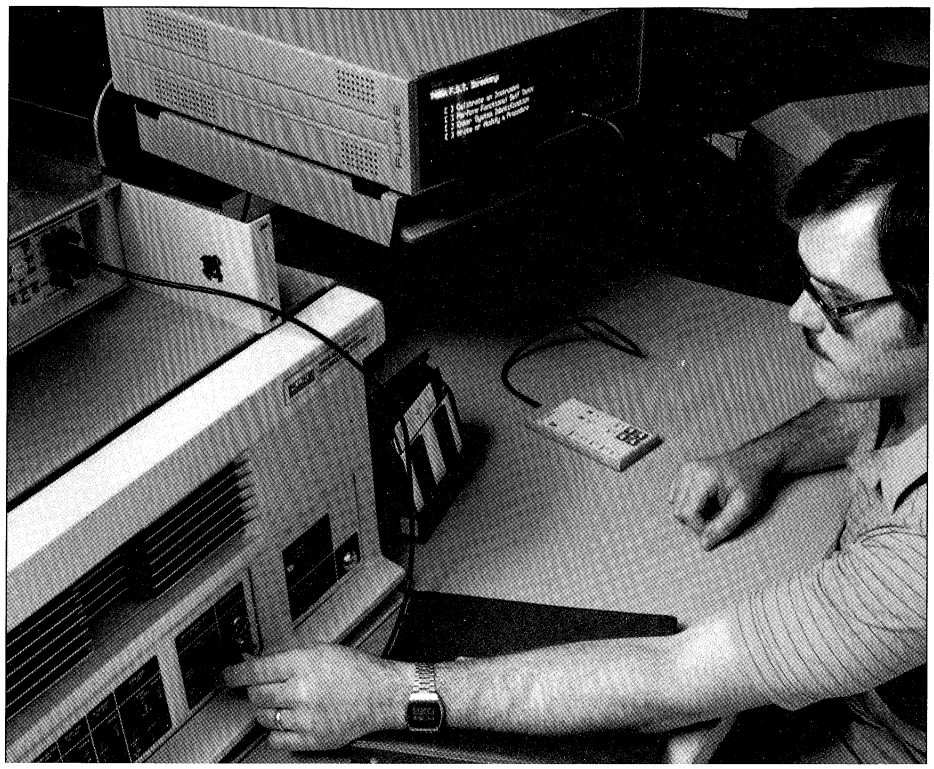
To ensure you realize maximum productivity in your specific application, Fluke and Philips also offer applications and maintenance training, software and systems integration services, and product application consulting.

Extend the quality of your instruments with our Customer Support Services. You can expect responsive service and support that's right for your specific needs.

Repair & Calibration	Page 552
Customer Training	Page 555
Education Support Programs	Page 560

Customer Support Services

Repair & Calibration



Systems Support/Solutions
Applications assistance and consultancy
Hardware assistance and consultancy
Software assistance and consultancy
Site evaluation and installation consultancy
Third-party support and consultancy

When Fluke and Philips electronic test and measurement equipment is used in a systems application the system builder may wish to request additional support from us. The Fluke and Philips Customer Support Groups provide wide ranging services from telephone consultancy and start-up assistance to on-site software and hardware development. We will make sure your project gets on track quickly, and stays on track.

The Fluke and Philips Sales and Customer Support Group can provide support tailored expressly for your application. Our services are designed to support a wide variety of customers from first-time users of Fluke and Philips equipment through to customers creating advanced systems on accelerated implementation schedules. When you plan to implement an instrument system, count on our Sales and Customer Support Group for help. No one knows test and measurement like Fluke and Philips.

Repair and Calibration Services
Variety of services to meet each customer's needs
Installation of product improvements
Calibration and/or alignment traceable to National Standards
Documented quality assurance program
Special calibration data available

Each Fluke and Philips Technical Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke and Philips products at peak performance. Proper use of measurement standards is carefully and continually monitored through a Controlled Audit program.

Fluke and Philips' Customer Support Services is dedicated to a single goal providing the best possible service for both our products and our customers. To achieve this goal, we have expanded our range of repair and calibration services to provide more solutions and flexibility for our customers.

Every service is designed to meet a different level of product support, whether it's a single unscheduled repair or an extended warranty agreement.

CalNet

CalNet is the most innovative advance in calibration services for many years and is a direct result of the cooperation of Fluke and Philips through the Alliance. It is a Europe-wide network of Philips calibration laboratories for electronic measurement instruments.

Through CalNet, which provides highly accurate calibration and guaranteed traceability, your instruments and working standards can be maintained at high accuracy and confidence levels - without the capital investment and increased operational costs associated with upgrading your in-house calibration facilities. CalNet offers you an economical and reliable way of meeting the increasing demand for calibration of highly accurate instrumentation.

CalNet is a two-tier multinational network of Philips calibration labs, basically for the physical quantities of resistance, frequency, direct and low-frequency alternating voltage and current. (Some labs also have other capabilities, such as oscilloscope and RF calibration.) Secondary CalNet labs offer calibration services at a level sufficient to support e.g. 7½ digit multimeters. Primary CalNet labs have the capabilities needed to verify and calibrate the most accurate instruments, including calibrators and reference standards.

The primary CalNet labs also play an important role in maintaining the desired performance and confidence levels throughout the network of participating calibration facilities. They govern internal audits and evaluate procedures used for maintaining standards, documentation, etc. CalNet is more than a number of calibration laboratories that happen to work under the same name: it is also a quality assurance system that gives you the certainty you need when you have your measurement instruments calibrated.

Both primary and secondary CalNet labs are direct traceable to the applicable national standards. In countries where a national calibration organization exists, CalNet labs have been accredited to issue calibration certificates in the name of this organization. Customers that need an official certificate of calibration with their instruments, for instance because they are required to provide legal proof of traceability to national standards, can rely on CalNet labs for this service.

Service Warranty

For warranty service, please contact your nearest Fluke and Philips Technical Center for shipping instruc tions. If the product is returned to the Technical Center, it should be shipped freight prepaid.

Repair & Calibration

Standard Price Service

- One-time repair or calibration at a fixed price
- Added support for your own maintenance program
- Take advantage of Fluke and Philips expertise and resources on an as-needed basis

These cost-effective services can be used to repair or calibrate your Fluke and Philips equipment on a one-time basis. For customers who routinely service their own instruments, this service offers an easy way to smooth out your peak work loads. For others, it's an easy and economical way to take advantage of Fluke and Philips' extensive service capabilities.

The Standard Price Service Program sets a fixed charge for calibration and/or repair for each type of instrument. The calibration and/or repair price includes all labor and material required.

These standard prices, which are based on historical time and material averages, help you determine service costs in advance. They also obviate potentially critical delays caused by quotation and approval procedures. Of course, some units may fall outside the scope of the program because of age or abuse. In such cases you will be advised and, only with your approval, charged on the basis of the actual labor and parts required.

Please contact your nearest Fluke and Philip' Technical Center for local availability and terms of this service.

Standard Price Calibration

Routine calibration ensures your is performing to published specification. Every instrument calibration follows the procedures detailed in our maintenance manuals. Instruments are returned with a Certificate of Calibration, and your proof of traceability to interational standards. We also include calibration labels which indicate the date of calibration and the date of next calibration due, plus tamper-proof seals to protect the integrity of the calibration performed.

Please contact your nearest Fluke and Philips' Technical Center for local availability and terms of this service.

Standard Price Repair Plus Calibration

This is a cost-effective way to service your Fluke and Philips products on a one-off basis. Using the industry's finest test equipment, our factory-trained technicians will test all functions and ranges while making the necessary repairs. We replace any defective parts with Fluke and Philips specified and tested parts to ensure the repaired instrument performs to manufacturer's published specifications.

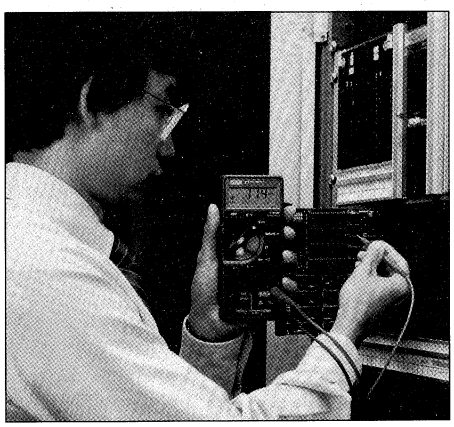
During repair, we will also install product changes that enhance the instrument performance and reliability. It is subsequently calibrated in the same way as in the Standard Price Calibration service, inclusive of the same certification, labels and seals. Each unit is completely performance tested and returned with a service report.

Please contact your nearest Fluke and Philips Technical Center for local availability and terms of this service.

Warranty

Standard Price repairs carry a 90 day* warranty. A Fluke and Philips Calibration guarantees your instrument's calibration for a full 90 days after it is returned to you.

**Subject to legal regulations.*



Extended Warranty Service

- Fixed maintenance cost allow accurate yearly budgeting
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources

The Fluke's and Philips' Extended Warranty Plan provides ultimate equipment protection at one economical price. Comprehensive agreements provide routine calibration at regular intervals or repair service as needed. You can, of course, combine these options for full service coverage.

Extended Warranty/Calibration Plan

Trust the scheduled calibration of your Fluke and Philips' instruments to the world's leading manufacturer of calibration instrumentation and standards. Under the plan, we will calibrate your instruments at the Fluke and Philips' recommended intervals. You will automatically receive priority service and turnaround.

We'll return the instrument with a Certificate of Calibration for your records. Should you need more documentation to meet MIL-Standards we can easily include detailed Calibration Reports as part of this plan for a nominal charge.

Please contact your nearest Philips' and Fluke Technical Center for local availability and terms of this service.

Extended Warranty Repair Plan

This plan is an extension to your product warranty. Whenever your product needs repair or service, simply send it to the nearest Fluke and Philips Technical Center. It will be repaired, recalibrated, and performance tested - with priority scheduling. All parts and labor are included in the price of this service, even parts that are normally excluded from the Standard Price Service plan. So there won't be any surprises, even return freight costs are included. As you might expect, a Philips' and Fluke Service Report and Certificate of Calibration is enclosed with each repaired instrument. Contact the nearest Fluke and Philips' Technical Center for availability and complete terms of the extended warranty.

Full Service Extended Warranty

If you need both scheduled calibration and periodic repair service, there is no better maintenance program for your Fluke and Philips' equipment than our full service plan. It combines all the features of the Extended Warranty Calibration and Extended Warranty Repair into a single integrated full service plan. You pay a reasonable fee for each instrument and eliminate most additional service expenses.

Please contact your nearest Fluke and Philips' Technical Center for local availability and terms of this service.

Plan Ahead and Save

We often offer special discounts on the listed price of the extended warranty plans when you take out the agreement at the same time as buying the instrument The same applies if you take out a service agreement before the product warranty expires. Your nearest Technical Center can give you all the details.

Pre-plan Inspections

Sometimes an instrument inspection is required before we can offer an Extended Warranty plan. This usually occurs when an instrument's warranty has expired. Should the condition of the equipment preclude coverage we will provide a Labor and Materials Service quote for the repairs necessary to qualify your instrument.

Repair & Calibration

Labor and Materials Service

- Instruments out-of-production and no longer included in the standard price list.
- Instruments that have been seriously damaged.
- Instruments that have been exposed to unusual conditions or harsh environments.
- Products that have special modifications.
- Any special service requirements.

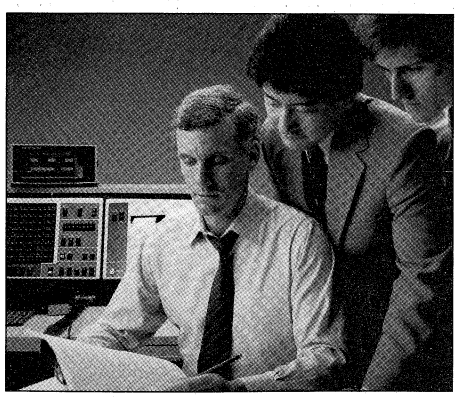
Sometimes you may want or need a firm labor and material repair. price quotation. Use this service, and you will know exactly what it will cost to get your instrument repaired. To keep you on schedule, this firm quote is valid for 30 days and also includes an estimated turnaround time for repair.

Discontinued Products

We stand behind each Fluke and Philips product for its full life cycle. This means we'll service instruments manufactured up to seven years ago even if discontinued These repairs are handled on a case-by-case basis because of the availability of certain parts.

Pre-agreement Inspection

If you would like to take advantage of our Extended Warranty plan, but your instrument does not pass the inspection, you can count on the Labor and Materials plan to get your equipment qualified. We'll always give you an estimate of the necessary repairs, whatever the reason for failure.

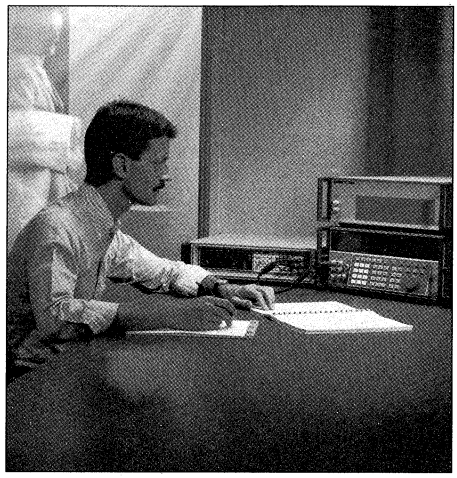


Modified Products

If you have a Fluke or Philips modified or special product, it may attract an additional charge to qualify for the Standard Price Service or Extended Warranty plan. To find out if this applies to your special equipment, call your Fluke or Philips Technical Center.

Warranty

Instruments repaired under Labor and Materials Service are warranted to be free from defects in material and workmanship for 90 days.



Special Services

- Calibration documentation
- Fast, emergency service
- Handle all your service needs with one simple plan

O.E.M. Services

If you are an O.E.M. customer for Fluke and Philips products, we also have repair and calibration services to meet your needs. Because your business needs require special support, we suggest you contact your local Fluke and Philips sales engineer. Once your needs are known to us, we can tailor a service plan that fully supports your business.

Emergency 48-Hour Service

When an instrument fails and you are faced with huge downtime costs, use our emergency 48-hour service. From the time your instrument arrives at the Fluke and PhilipsTechnical Center to the moment we ship it back to you, it receives first-priority access to parts, labor and equipment in the service lab.

This 48-hour service is available for an extra rush charge in addition to the standard repair price. It's a small price to pay when each hour counts. If for any reason we cannot meet the 48-hour commitment, you will be notified immediately and, of course, charged only the standard service fee. Call your nearest Fluke and Philips Technical Center for ilocal availability and terms of this service.

Replacement Parts

- Components meeting Fluke and Philips specifications standards
- Automatic notice of improved replacement types
- 90-day warranty
- Recommended spare parts & module kits

Availability of replacement parts is a key element in providing quick turn-around and product support for customers who perform their own maintenance. By providing quality parts and responsive support, Customer Support Services will help return your Fluke and Philips products to peak performance.

To support this service, an extensive inventory of repair parts is maintained by the Replacement Parts Centers. These computerized centers stock several hundred thousand components, subassemblies, and modules that are listed on a microfiche catalog. All replacement parts are warranted against defects in materials and workmanship for 90 days after shipment.

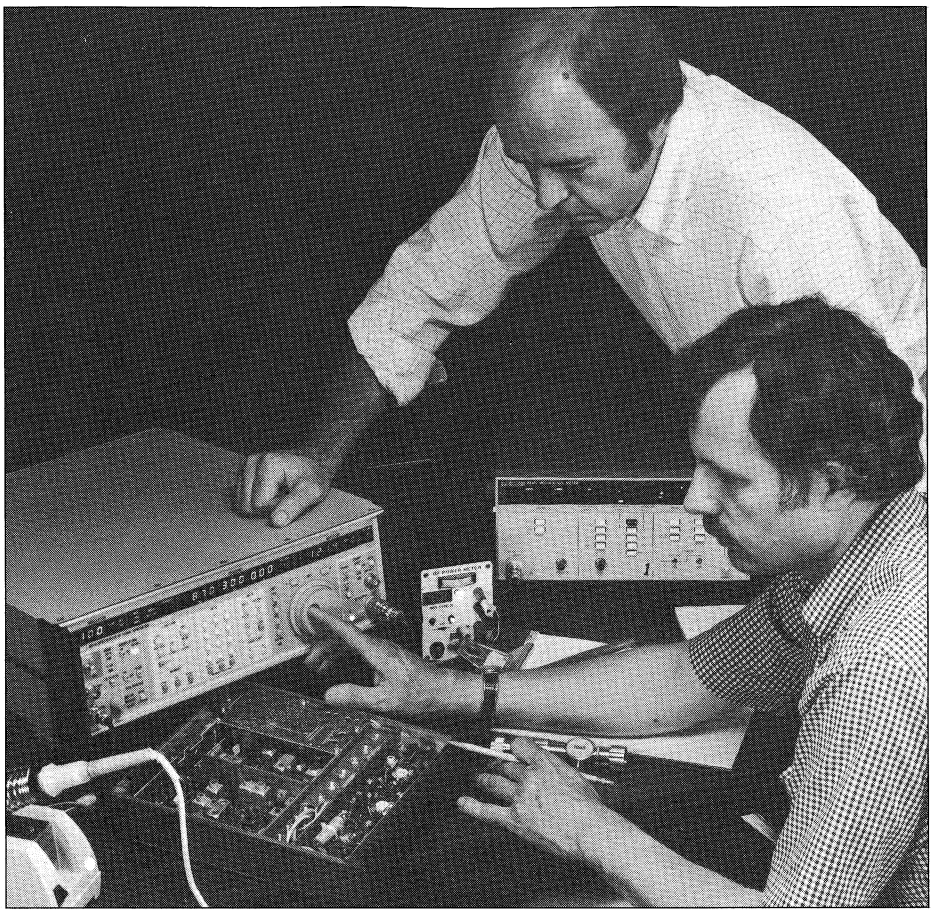
Place your orders with your nearest Philips and Fluke Technical Center. They will expedite processing or fill your order from the local inventory.

When ordering, please identify parts by either the Philips twelve-digit or Fluke six-digit part number and description as shown in the instrument manual and, if possible, by the schematic diagram circuit reference number. The model number and serial number will also help us supply the correct parts.

In some cases parts must be ordered in matched sets in order to maintain the specified accuracy and performance of the instruments after repair. Check the listings and diagrams for footnotes which contain the instructions for ordering special parts.

Recommended Spare Parts Lists and instrument manuals are also available for most Fluke and Philips products.

Customer Training



Customer Training

- Maintenance training
- Applications training
- Product training
- Technology seminars
- Special customer training packages

Training Pays Off In Productivity

Fluke and Philips Customer Support Services is dedicated to providing information, assistance, and training for people who use and maintain Fluke and Philips products. As designers and manufacturers of sophisticated instrumentation, we recognize that well trained technical personnel are an asset essential to productivity.

To gain maximum performance and productivity from your Fluke and Philips equipment, spend just a few days training with our experts. Our Applications and Maintenance Training courses combine comprehensive lectures with hands-on experience that will provide a sound understanding of both our equipment and documentation.

Application Training

Whether you've just purchased Fluke and Philips products or you already own them, our Applications Training will help you to enhance their effectiveness by taking advantage of every advanced feature.

Maintenance Training

If you repair your own equipment, our Maintenance Training courses give you the opportunity to learn about the technology behind the features and functions, and help you to effectively troubleshoot and maintain even the most complex systems.

Schedule

We schedule our courses throughout North America and Europe for your convenience. Dates, fees and locations are available from your local Fluke and Philips Sales Office.

On request tailermade courses are possible. Contact your local sales office.

Customer Support Training Courses

- GPIB Instrumentation Systems I
  Introduction & Programming
  Cat No. 4822 871 52001
- Oscilloscope Singal Processing
  Operation & Programming
  Cat No. 4822 871 52002
- PMDS II
  Performance Improvement
  Cat No. 4822 871 52003
- PMDS II Applications
  Operating & Target Handling
  Cat No. 4822 871 52004
- GPIB Instrumentation Systems II
  Advanced Programming & Applications
  Cat No. 4822 871 52005
- Analog & Digital Oscilloscopes
  Principles & Operation
  Cat No. 4822 871 52006
- Digital Storage Oscilloscopes
  Applications
  Cat No. 4822 871 52007
- High Frequency Oscilloscopes
  HF-Oscilloscope Measurements
  Cat No. 4822 871 52008
- PM 3570 Logic Analyzer
  Operation & Troubleshooting
  Cat No. 4822 871 52009
- PM 3655 Logic Analyzer
  Operation & Troubleshooting
  Cat No. 4822 871 52010
- 9100 Series Digital Test System
  Applications
  Cat No. 4822 871 52011
- 9100 Series Digital Test System
  Programming
  Cat No. 4822 871 52012
- 9010 Board Tester
  Troubleshooting
  Cat No. 4822 871 52013
- 9010 Board Tester
  Introductory Seminar
  Cat No. 4822 871 52017
- 9010 Board Tester
  Programming
  Cat No. 4822 871 52014
- Metrology for Technicians
  Principles & Measurement Techniques
  Cat No. 4822 871 52015
- 7400 Series Calibration Systems
  Procedure Writing
  Cat No. 4822 871 52016

GPIB Instrumentation System I
Introduction & Programming

Synopsis: A 3-day training course on the basic concepts of the GPIB (equivalent to IEEE-488/IEC-625) and in the programming of GPIB instrumentation systems.
Supplemented by hands-on training to develop your programming skills!

Customer Training

Specific Course Aspects:
- Configuring a GPIB instrumentation system
- Interpreting instrument interface specifications
- Controlling and programming GPIB instrument set-ups
- Writing and debugging application programs

Course Outline:

A. An introduction to automation in test and measurement
B. Basic theory of the GPIB
C. Installation and configuration of a GPIB set-up*
D. Interpretation of instrument functions
E. Codes and formats
F. Service request and serial poll
G. Writing an application program*
H. Grounding and shielding
I. Error checking and handling*
J. Overview of the available software tools
K. Programming with the latest software tools*

**With hands-on training sessions*

Who Should Attend: Engineers and programmers whose work involves programming GPIB instrumentation systems, or who are learning how to program such systems.
Prerequisites: Familiarity with BASIC programming and experience in the application of test instruments.
Cat No. 4822 871 52001

Oscilloscope Singal Processing
Operation and Programming

Synopsis: A 1-day training course covering the basic concepts of the PM 2260 Oscilloscope Signal Processing software package. This software package, while completely menu structured and thus quite simple to operate, has powerful mathematics facilities and significantly extends the functionality available to users of digital storage oscilloscopes.
Specific Course Aspects:
- Basic mathematic principles. e.g.
  - differentitation
  - integration
  - fourier transformations
  - auto- and cross-correlation
- Communication with Philips digital storage oscilloscopes via the GPIB interface.
- Application of mathematics to the signals measured with digital storage oscilloscopes.
- Interpretation of the results of calculations.
- Creation of user-defined functions.

Course Outline:

A. Principles of digital storage oscilloscopes and software introduction.
B. Basic theory of the available mathematics.
C. Software installation and configuration.
D. Communication with digital storage oscilloscopes.
E. Working with a scientific software package.
F. Application of selected mathematics to signals measured with digital storage oscilloscopes.
G. Creation of small macros to automate complex calculations.

**C through G above includes hands-on training.*

Who Should Attend: Engineers using or intending to use a digital storage oscilloscope and needing to do more with their measured signals.
Prerequisites: Basic mathematic knowledge. Experience with test instruments, especially oscilloscopes would be helpful. No programming experience is required.
Cat No. 4822 871 52002

PMDS II
Performance Improvement

Synopsis: A 3-day course designed to provide strategies, tools and solutions by which to speed-up a PMDS (or PEDS) system when intensive use and increasing loads threaten to reduce system performance.
Specific Course Aspects: Each participant will have the opportunity to fine-tune a standard configured system.
Course Outline:

A. UNIX processes:
1. Scheduling and priorities
2. System and disk usage
3. File system reorganization
4. RAM disk
5. Fast back-up and restore
6. Single system/Multi-system
7. Disk extensions
8. Memory extension
9. Interfaces

Who Should Attent: Experienced users and systems managers of PMDS II or PEDS systems.
Prerequisites: Sufficient PMDS system experience.
Cat No. 4822 871 52003

PMDS II Applications
Operating and Target Handling

Synopsis: A 4-day training course covering all aspects of the use of a Philips Development system. The user will be enabled to fully work with a PMDS system and complete all aspects of the development cycle.
Specific Course Aspects: A practical 'real-life' development based around an 8085, 8051 or 68000 microprocessor will be undertaken. All software and hardware tasks will be covered.
Course Outline:

A. Introduction to PMDS hard and software
B. The UNIX/XENIX Operating System, viz;
1. File structure
2. Protection mechanisms
3. Editors
4. Programming the Shell
5. System management aspects

C. The target environment:
1. Microprocessor and target
2. PCP assembler and linker
3. Debugging of soft and hardware
4. PROM burning

Who Should Attend: Engineers starting to work with the PMDS systems
Prerequisites: A working knowledge of hardware and software for microcomputers.
Cat No. 4822 871 52004

GPIB Instrumentation Systems II
Advanced Programming and Applications

For information about the course please consult the Philips Customer Support Organization in your country.
Cat No. 4822 871 52005

Analog and Digital Oscilloscopes
Principles and Operation

Synopsis: A 1-day training course covering the basic principles and operation of modern analog and digital oscilloscopes. Practical exercises and hands-on training using the Philips "Smart" Scope family will demonstrate the broad range of oscilloscope use and applications.
Course Outline:

A. Analog Oscilloscopes
1. What is an oscilloscope?
2. How does it operate?
3. What is triggering?
4. The use of the delayed timebase
5. Measurement cursor and CRT readout

B. Digital Storage Oscilloscopes
1. Basic principles
2. Sampling techniques
3. Analog to digital conversion
4. Measuring capabilities (catch & calculate)
5. Remote programming facilities

Who Should Attend: Service technicians, test engineers and student engineers.
Cat No. 4822 871 52006

Digital Storage Oscilloscopes
Applications

Synopsis: A 1-day training course designed to cover fully all aspects of Digital Storage Oscilloscopes and techniques for their use. The course provides hands-on training with practical applications examples.
Specific Course Aspects: Emphasis will be placed on the wide ranging measurement and problem solving capabilities of a modern digital storage oscilloscope.
Course Outline:

A. Principles of digital sampling techniques
B. Analog to digital conversion
C. Display techniques and resolution
D. Performance and accuracy
E. Timebase operation and the RESTART function
F. Trigger functions (pre/post)
G. Acquisition of different signal types
H. Cursor measurements of time and amplitude on traces
I. Mathematical calculations on waveforms including histograms and FFT (Fast Fourier Transforms)

J. Remote control and data transfer via IEEE-488 and RS232C
K. Dumping data on plotters and printers
Who Should Attend: Engineers and technicians who would like to refresh their knowledge of modern digital storage oscilloscopes.
Prerequisites: Basic knowledge of the principles and operation of an oscilloscope is recommended.
Cat No. 4822 871 52007

High Frequency Oscilloscopes
Principles of HF-Oscilloscope Measurements

Synopsis: A 1-day training course covering the principles of high frequency measuring techniques using the 2 GHz digitizing oscilloscope PM 3340.
Specific Course Aspects:
- Basic operation of digitizing oscilloscopes
- Practical high frequency measurement

Course Outline:
A. Principles of different sampling techniques
B. Multiple sampling, averaging, offset, pre- and post-trigger facilities
C. Transport of signals to the oscilloscope
1. Impedance matching
2. Terminations
3. Power splitters
4. Probes

D. Time interval measurements
1. Propagation delays
2. Switching times of semi-conductors

E. PCM measurements
1. Eye patterns
2. Constellation diagrams

F. Time domain reflectometry
Who Should Attend: Engineers with a basic knowledge of oscilloscopes needing to extend their expertise into high frequency measuring techniques.
Cat No. 4822 871 52008

PM 3570 Logic Analyzer
Operation & Troubleshooting

Synopsis: A 3-day training course covering all aspects of the use of this powerful analyzer. On completion of the course the participants will be able to operate the analyzer for effective troubleshooting. Beginners will receive a comprehensive introduction to its use and all participants will learn the extensive range of capabilities of advanced logic analyzers.
Specific Course Aspects: Some 50% of course time is devoted to practical, guided, hands-on exercises on a 68000-based target system.
Course Outline:
A. Using analyzers in development/production/service
B. Principles of logic analysis
C. Description of the 68000 and target system
D. State versus time Analysis. Hardware/software faults
E. Triggering
F. Selective data acquisition
G. Combined state and time operation
H. Fault finding in interrupt systems
I. The troubleshooting approach
J. Communication
K. Introduction to performance analysis
Who Should Attend: Digital design engineers, production and service engineers using logic analyzers. The course is also particularly relevant ot those using a logic analyzer on an occasional basis and who need to explore the full power and capabilities of this tool.
Prerequisites: Good working knowledge of hardware and software concepts.
Cat No. 4822 871 52009

PM 3655 Logic Analyzer
Operation and Troubleshooting

Synopsis: A 2-day training course covering all aspects of the use of this powerful analyzer. On completion of the course the student will be able to operate the analyzer for effective troubleshooting. Beginners will receive a comprehensive introduction to this subject and all participants will learn the extensive range of capabilities of advanced logic analyzers.
Specific Course Aspects: Some 40% of course time is devoted to practical, guided, hands-on exercises on a 68000-based target system.
Course Outline:
A. Using analyzers in development/production/service
B. Principles of logic analysis
C. Description of the 68000 and target system
D. State versus time analysis. Hardware/software faults
E. Triggering
F. Combined state and time operation
G. Fault finding in interrupt systems
H. The troubleshooting approach
I. PC functions and communication
Who Should Attend: Digital design engineers, production and service engineers regularly using logic analyzers. The course is also particularly relevant to those using a logic analyzer on an occasional basis and need to explore the full power and capabilities of this tool.
Prerequisites: Good working knowledge of hardware and software concepts.
Cat No. 4822 871 52010

9100 Series Digital Test System
Applications

Synopsis: A 3-day training course designed to generate a systematic approach to test strategy development using the 9100 immediate mode of operation. The course will provide the student with basic understanding of high-speed troubleshooting. It also offers the fundamentals for automated fault isolation to the node level.
Specific Course Aspects: Students will use emulative testing to functionally test digital circuits. They will learn to recognize circuit failures through the use of built-in diagnostics, signature analysis, level detection, frequency and overdriving techniques.
Course Outline:
A. What is emulative testing? Benefits derived from these techniques to test and troubleshoot digital circuits.
B. How to systematically plan for testing and troubleshooting a Unit Under Test (UUT)
C. Differences between functional test and fault isolation and the planning process involved in implementing both strategies.
D. Examination of the capabilities of built-in tests. Use of built-in tests to find faults in their respective functional blocks.
E. The stimulus functions and their appropriate utilization under varying circumstances.
F. Capabilities of the available measurement devices and their application under varying circumstances.
Who Should Attend: Manufacturing test engineers, test/repair technicians, service engineers.
Prerequisites: Familiarity with microprocessor based circuitry.
Cat No. 4822 871 52011

9100 Series Digital Test System
Programming

Synopsis: A 5-day program development training course designed to develop effective guided fault isolation programs for high-speed testing and troubleshooting of microprocessor based boards.
Specific Course Aspects:
- Recognition of different types of test and troubleshooting strategies for a wide range of circuits found in microprocessor based systems.
- Use of the high level TL/1 language to write functional test programs and troubleshooting routines for automated fault finding at node level.

Course Outline:
A. Test and troubleshooting approaches/strategies.
B. System configuration 9100A pod, probe, clock and I/O module.
C. Guided Fault Isolation (GFI) and Unguided Fault Isolation (UFI).
D. Immediate mode operation.
E. Editor and debugger operations.
F. TL/1 programming.
G. Stimulus programs.
H. Functional test programs.
I. Advanced techniques.
Who Should Attend: Design and service engineers.
Prerequisites: Experience in troubleshooting microcomputer circuitry. Some knowledge of a 'high-level' language such as BASIC.
Cat No. 4822 871 52012

Customer Training

9010 Board Tester
Troubleshooting

Synopsis: A 2-day, practical, hands-on training course designed to improve troubleshooting skills and cut downtime expense.

Specific Course Aspects:
- Use of the 9010 to troubleshoot to the component level using actual micro-computer boards.
- Isolation of actual hardware problems in a hands-on environment.
- Testing I/O LSI devices and use of the asynchronous signature probe option.

Course Outline:

A. Preparing the 9010A for testing
B. Micro-System troubleshooter strategy
C. Entering the memory map
D. Using the BUS TEST
E. Using the RAM SHORT TEST
F. More about RAM testing
G. The ROM TEST
H. Troubleshooting I/O
I. Forcing lines
J. Signature gathering using the probe
K. Peripheral interface
L. Asynchronous signature probe option.
M. More hands-on training

Who Should Attend: Design engineers, manufacturing test engineers, test/repair technicians, service engineers and others responsible for the troubleshooting and/or repair of microcomputer circuits.

Prerequisites: Previous 9010 Board Tester Troubleshooting experience is not necessary, but participants should have a basic understanding of microcomputer circuitry.

Cat No. 4822 871 52013

9010 Board Tester
Introductory Seminar

Synopsis: A 1-day introduction to Micro-System Troubleshooter and the repair of microprocessorbased equipment.

Specific Seminar Aspects: Participants will be familiarized with the Micro-System Troubleshooter and learn how to use it in specific troubleshooting problems. Through hands-on exercises participants will learn effective Micro-System Troubleshooting techniques used to diagnose failures encountered in practice.

Seminar Outline:

A. Introduction
1. Introduce instructors
2. Overview of Session

B. Self test
1. Power up
2. POD

C. Inputting "known good information"
1. Learn
2. Manual map entry
3. Viewing the memory map

D. Tape operation
1. Write
2. Read

E. Testing
1. BUS test
2. ROM test
3. RAM test
4. I/O test
5. AUTO test
6. RAM LONG test
7. Specifying test address

F. Mode keys
1. Without errors
2. With errors
3. RUN UUT

G. Troubleshooting functions
1. Read
2. Write
3. Ramp
4. Walk
5. Toggle

H. Probe operation
1. Logic probe
2. Pulser
3. Signature analysis
4. Transition counter

I. Registers
1. Types
2. Entering and reading data
3. Counting with registers (Incr & Decr)
4. Shifting
5. Binary operation

J. Programming
1. Creating
2. Executing
3. Editing
4. Display
5. Branching

K. Auxiliary interface
1. Set up menu
2. Select switches
3. AUX I/F key

L. The probe and the program
1. Read probe
2. Identifying device addresses

Who Should Attend: Manufacturing Test Engineers, Service Engineers and those interested in getting a better understanding in repair of microprocessor-based equipment.

Prerequisites: Each participant should have a basic understanding of microprocessor circuitry.

Cat No. 4822 871 52017

9010 Board Tester
Programming

Synopsis: An intensive 2-day hands-on training course designed to expand programming skills and maximize performance capabilities.

Specific Course Aspects:
- Programming techniques to make using the 9010 Board Tester easier and faster.
- The development and testing of utility programs, for use as building blocks for a full functional test.

Course Outline:

A Introduction

B. Review basic operations
1. Inputting "known good" information
2. Built-in tests
3. Troubleshooting functions
4. Probe operations
5. Registers
6. Arithmetic functions
7, Programming

C. Utility programs
1. The probe and the program
2. Identifying unknown devices on the UUT
   a. Address & data line identification
   b. Mapping identification
3. Display and print messages
4. Probe placement detector

D. Actual circuit applications
1. Working with I/O devices
   a. Basic approach to I/O
   b. Application examples

E. Course review
1. Questions and answers
2. Critique

Who Should Attend: Programmers, design engineers, manufacturing test engineers, service engineers and those interested in getting maximum utilization from the 9010 through programming knowledge.

Prerequisites: No previous 9010 Board Tester experience is necessary, but course participants should have a basic understanding of microcomputer circuitry.

Cat No. 4822 871 52014

Metrology
Principles, Measurement Techniques and Operational Aspects

Synopsis: A-4-day course covering electrical/electronic measurements and calibration.

Specific Course Aspects:
- Participants will become more productive in the calibration of test instrumentation.
- The course includes practical tips and exercises to illustrate:
  - loading errors
  - use of voltage dividers
  - low level measurements
  - thermal EMFs
  - grounding and guarding
  - measurement system uncertainties
- Participants will also be introduced to "Creative Metrology", an innovative method of examining measurement tasks from a variety of standpoints and extending the range of NBS traceability. The methodology and techniques required to extend measurement parameters will be covered in detail so that participants will be able to apply them in measurement and calibration tasks.

Course Outline:

A. Traceability
B. The standards laboratory
C. Understanding specifications
1. Definitions
2. Ratios of accuracy
3. Total uncertainty of measurement
4. Instrument specifications

D. Measurement, errors and statistical analysis
1. Characteristic of precision

2. Measurement errors
3. Statistical analysis

E. Null detectors

F. Standard resistors and dividers
1. Resistor requirements
2. How resistors are used

G. The Kelvin-Varley divider
1. A ratio divider
2. Construction of Kelvin-Varley
3. Specifications

H. Cables and connectors
1. DC and low frequency applications
2. Advantages of using copper
3. The effects of metal plating
4. The effects of soldered connectors
5. AC applications
6. General maintenance

I. Direct voltage sources
1. Histroy of cells
2. Standard cells
3. Solid state voltage references
4. Maintaining the volt

J. Direct current
1. Measurement of current
2. Calibration of shunts
3. Establishing current sources
4. Current source calibration

K. Alternating voltage and current
1. Sinusoid waveforms
2. AC referenced to DC
3. A replacement for the thermocouple
4. The transfer standard
5. Alternating current
6. Inductive voltage dividers

L. AC bridges
1. AC bridge configuration
2. Bridge errors
3. Inductors as bridge elements
4. Impedance matching
5. Bridge calibration

M. DC and AC power
1. The power formula
2. Power relationships
3. Measuring power
4. Errors in single phase measurements
5. Calibration-power measuring equipment

Who Should Attend: Engineers and technicians with an electronics background whose work involves measurement and calibration.
Cat No. 4822 871 52015

7400 Series Calibration Systems
Procedure Writing

Synopsis: Imagine the calibration laboratory of the future. A lab automated from the generation of instrument recall notices to the documentation of calibration results. A place where instruments are calibrated with speed, economy and consistency. A place where increased workload does not mean more staff. The calibration laboratory of the future is here today with Fluke 7411B calibration software.
With 7411B you do not need computer programming knowledge. Writing of automated calibration procedures is easy because it's based on your knowledge of your lab's calibration procedures.
As with all Fluke products, when you buy a 7411B calibration package, you get more than just calibration software. The 7411B is backed, like every Fluke product, by Fluke's reputation for quality and reliability - built on more than 30 years of metrology experience. And the 7411B is supported by a worldwide network of service centers and training courses such as the 7400 Procedure Writing course.
In this course you'll learn to write Performance Test and Calibration procedures for 7411 based calibration systems. You will also learn to manage Calibration Histories and become familiar with the 1722A Instrument Controller operating system and utilities. After 5 days you will be able to turn the features of the 7411 Calibration software into your calibration laboratory benefits.
Course Outline:
A. 1722A familiarization
B. 7411 calibration software use and operation
C. 7411 procedure generator and editor software. Use and operation
D. Writing procedures
E. Calibration history management
Who Should Attend: 7411 Calibration software users, programmers, production test engineers, Calibration line supervisors, managers and any others involved with computer automated calibration.
Prerequisites: A basic understanding of calibration philosophy and applications. Some knowledge of MIL-STD-45662A (Calibration Control System) and BASIC is beneficial but not mandatory.
Cat No. 4822 871 52016

To Enroll

Mrs. N. Beekers
Course Secretariat
Business Training Service
International (B.T.S.I.) B.V.
Stratumsdijk 29 b
5611 NB Eindhoven
The Netherlands

Telex 59443 btsi nl
Telephone 040-123404

Course Fee and Materials

Course Fee: Please contact the Philips Customer Support organization in your country.
Materials: Philips training materials are included in the fee and will be presented during the course. All graduates will receive a Philips Certificate of Accomplishment upon completion.

Cancellation Policy

For cancellations received by B.T.S.I. up to four weeks before the program starts any fees paid are refunded. If cancellation is received by B.T.S.I. four weeks or less but more than two weeks before the program starts only half the fees paid are refunded. Cancellation received by B.T.S.I. less than two weeks before the program starts - ***no fees*** can be refunded. In case of cancellation a substitute nominee from the orgainzation concerned will be accepted.

Economical Training for Groups

If our scheduled courses are not convenient, or you want to train a large group, an on-site course can be an economical solution.
For information about any of the courses please contact the Philips Customer Support Organization in your country.

Education Support Programs



Education Programs

Educational institutions face a tremendous challenge training tomorrow's electronic engineers and technicians. Continuous growth in technology along with perennial budgetary constraints make the educator's job of defining an electronic curriculm, choosing the right equipment and keeping that equipment in good working order a difficult task.

For many years Fluke and Philips have been working with many educators in facing this important obligation. Fluke's Educational Support Programs are centered around a broad array of rugged, high performance instruments, a worldwide network of service and support, a series of comprehensive training materials, all at competitive prices.

Product Reliability

Fluke and Philips are recognized in the electronics industry as premier suppliers of high performance industrial-grade test instrumentation, designed and built strong enough to take the toughest abuse. We recognize that a test instrument's application ranges from the laboratory to the production floor to remote field service sites and that users range from the highly skilled test engineer to the first-time technical trainee. Therefore, we design and build our instrumentation to be intuitively easy to use and to be able to withstand both physical and electrical mis-use. Most of our instruments meet or exceed the safety specifications outlined by UL, CSA and the European VDE. And our MTTF (Mean Time To Failure) specs attest to our rigorous design and Quality Control standards. In support of these claims for reliability, all of our instruments are backed by one-, two- or three year warranties.

Inherent quality and reliability pays big dividends in the classroom, where students subject equipment to heavy use, and sometimes, misuse. Where budgets for equipment maintenance, repair and calibration are limited, rugged, reliable instruments that keep on working can make a difference in today's full curriculums.

Product Breadth

Today's electronic education ranges from basic electrical theory to advanced electronics research. Fluke and Philips offer a broad array of instrumentation to meet these classroom and laboratory needs, all offering exceptional value.

Our products include real-time (analog) and storage oscilloscopes (analog and digital), handheld and bench digital multimeters, frequency counters and counter/timers, function generators, synthesized signal generators, digital testers, component testers (RCL Meters) and data acquisition equipment.

Of particular interest to those educators moving their students from the analog into the digital world are our oscilloscopes and DMMs that combine both analog and digital capability. Using both measurement modes, one gains a strong understanding for the vital aspects of the growing digital domain.

Today's electronic world increasingly requires that instruments and computers "talk" to each other via IEEE-488 or RS-232 links. The practical teaching of such concepts has been hampered until now by the complexity and high cost of such instruments and systems. Now, however, significant changes have made such teaching both more practical and affordable. Fluke/Philips offers the broadest array of low-cost building blocks for PC-based IEEE test systems available from any supplier in the world.

These building blocks include test instrumentation software (e.g., Test Team), IEEE-488 cards, modular interconnect switches (System 21), digital oscilloscopes, digital multimeters, counters, function generators, logic analyzers, microprocessor testers and more.

Whether your curriculum covers basic electronics or IEEE systems, your Fluke/Philips sales engineer can work with you, defining the equipment that best meets your needs.

Worldwide Support

When you choose a test equipment vendor, the product is just the first step. Fluke and Philips understand that selecting a vendor who backs that product with capable technical assistance and reliable, rapid and afforable service is a critical issue in your decision. Fluke and Philips rank "number 3" in sales of test instrumen- tation worldwide. That makes us large enough to have a network of service and support facilities to fully serve our cutomers yet small enough to give that "extra measure" of customer care long after the sale is concluded. For 40 years we have lived by the motto that we "... give the Customer a little bit more than he thought he paid for". Everyday, all of us at Fluke/Philips work hard to insure this motto gets translated into true customer satisfaction. (See previous Calibration & Repair Section for our array of flexible service agreements and plans.)

Training Tools

With the rapid changes in technology and electronics, schools are faced with a real dilemma in keeping their curriculum and the talents of their staff, up to date. Given today's increasingly powerful, complex instrumentation, this task becomes even more acute.

Fluke and Philips can help with an extensive array of training aids, including Basic Principles books, application notes, Quick Operating Guides, instruction manuals, service manuals and video tapes. In addition, a variety of product application courses, general technology workshops and maintenance training are also available.

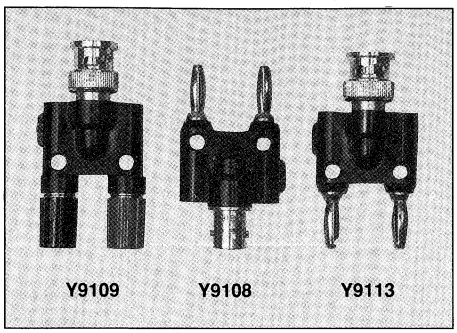
One new course is specifically designed for instruments in educational institutions: 70 Series Solutions. The 70 Series has been Fluke's standard in digital multimeters, with industry using over a million units.

Fluke has created this instructor package, including instructor manual, training overheads, video tape and student workbooks. You can get started quickly in setting up this core, hands-on electronics lab, with an instrument that is widely used throughout the electronics test world.

Exceptional Value

The Fluke and Philips companies have built their reputation by serving customers with products of exceptional value — high performance, proven reliability and fair prices. Nowhere is this more important than in educational institutions. In addition to products of superior value, we also support the teaching community with a series of **EDUCATIONAL DISCOUNTS, GIFTING PROGRAMS, EXTENDED PRODUCT SUPPORT PLANS and TRAINING PACKAGES** designed specifically for education.

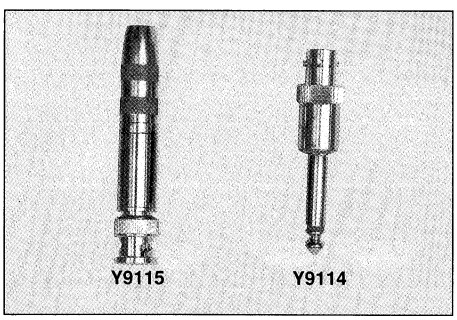
Accessories



BNC-Banana Adapters*

BNC-to-banana adapters permit interconnection between equipment having BNC plugs or jacks and equipment with double banana plugs or jacks.

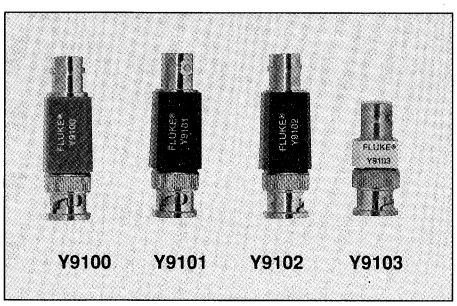
Y9108** BNC Jack to Double Banana Plugs
Y9109** Binding Posts to BNC Plug
Y9113** BNC Plug to Double Banana Plugs



Phone Adapters*

Adapters permit interconnection between equipment with phone plugs and equipment with BNC our double banana plug connectors.

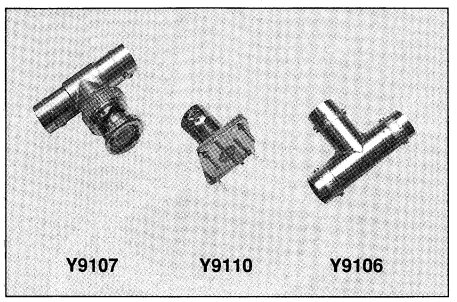
Y9114** BNC Jack to Phone Plug
Y9115** Phone Jack to BNC Plug



BNC 50-Ohm Attenuators, etc.

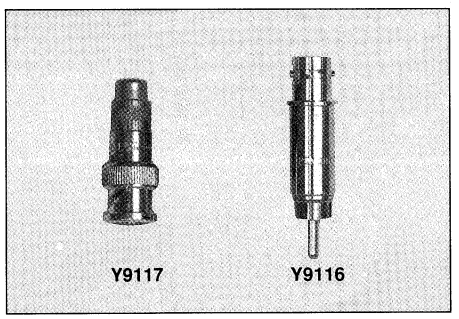
BNC 50-ohm, 2-watt attenuators for use with VHF and UHF instruments:

Y9100** 6 dB Attenuator
Y9101** 14 dB Attenuator
Y9102** 20 dB Attenuator
Y9103** BNC 508 feedthru terminator
Y9301 Min-Loss Pad, 50Ω to 75Ω, Type N
Y9317 50Ω Termination, Shielded, Type N



BNC Connectors

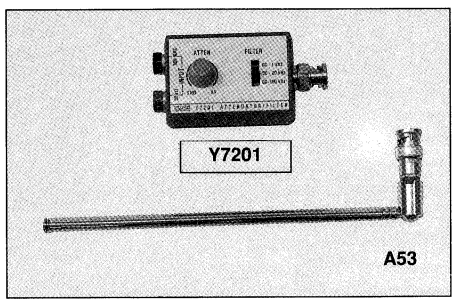
Y9107** BNC "T" Jack, Plug, Jack
Y9110** BNC Jack to PC Pins
Y9106** BNC "T" 3 Jacks
Y9307 Adapter, N to BNC, 75Ω
Y9308 Adapter, N to BNC, 50Ω
Y9316 Cap, Non-Shorting, BNC



Phono Adapters*

Adapters allow interconnection between equipment having phono connectors and BNC connectors.

Y9116** BNC Jack to Phono Plug
Y9117** Phono Jack to BNC Plug



Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all Fluke counters.

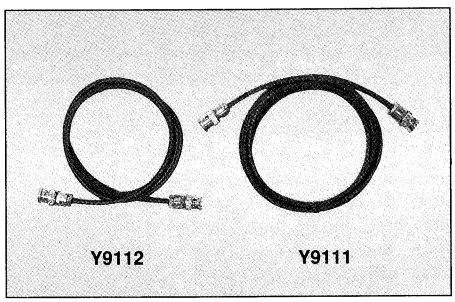
Input Impedance: 47 kΩ
Attenuation Range: ÷5 to ÷100, continuously adjustable
Low Pass Filter: 1 kHz, 20 kHz, or 100 kHz switch-selectable
Maximum Input: 30V

Y7201** Attenuator/Filter (Counters)

A53 Telescopic Whip Antenna

Telescopic Whip Antenna connects to input of all counters. Uses swivel BNC connector. Permits measurements without direct cable connections whenever input signal strength is sufficient.

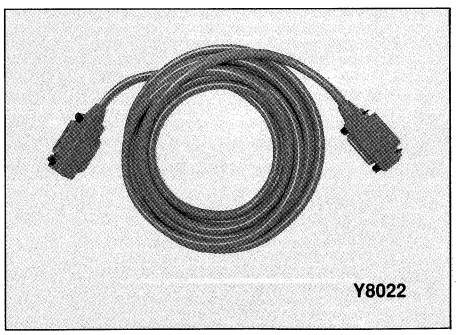
A53** Telescopic Whip Antenna



50Ω BNC Coaxial Cables*

RG-58 C/U coaxial cables with BNC connectors (plugs) on each end are available in two lengths:

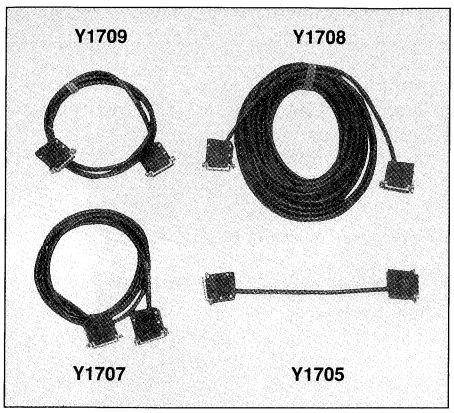
Y9111** BNC Cable 0.93m (3 ft) 50Ω
Y9112** BNC Cable 1.85m (6 ft) 508
Y9315 Coaxial Cable, N Mate



IEEE-488-Compatible Cables

A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.

Y8021 Shielded IEEE-488 Cable 1m (39.4")
Y8022 Shielded IEEE-488 Cable 2m (78.8")
Y8023 Shielded IEEE-488 Cable 4m (13')

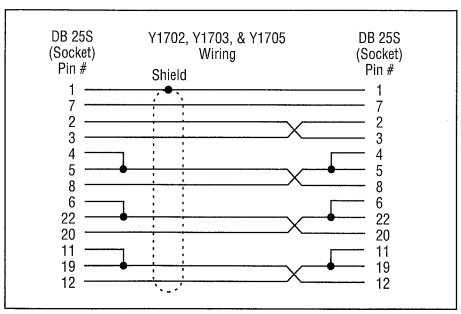


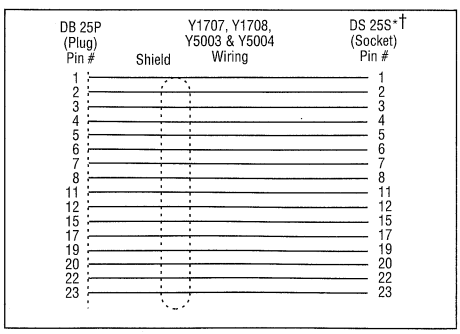
RS-232 Cables

These cables are to connect instrument controllers, terminals, modems, printers, etc. to other similar equipment compatible with EIA Standard RS-232-C.

Y1702 Null Modem Cable 2m (6.56 ft)
Y1703 Null Modem Cable 4m (13 ft)
Y1705 Null Modem Cable 30m (1 ft)
Y1707 Interface Cable 2m (6.56 ft)
Y1708 Interface Cable 10m (32.8 ft)
Y1709 Printer Cable 1m (3.28 ft)
Y5003 Interface Cable 1.52m (5 ft)
Y5004 Interface Cable 3.05m (10 ft)

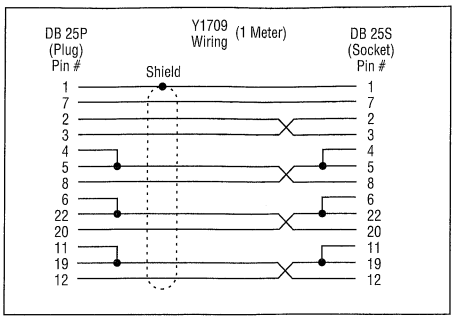
RS-232 Cable Wiring

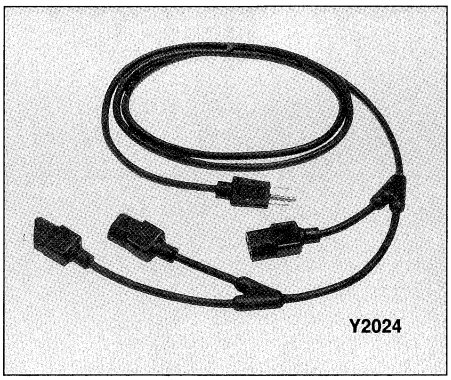




† DB 25P for Y5003 and Y5004

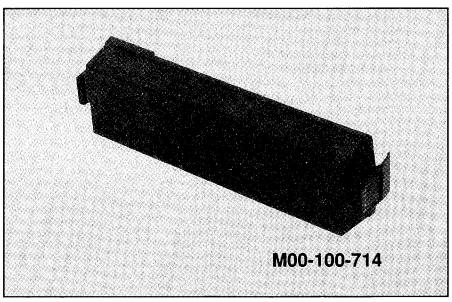
** These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*
***Available through Distributors*





Y2024 3-Module Power Cord

Three 3-wire receptacles for powering two or three PTI-style instruments from one power outlet.
Y2024 3-Module Power Cord



M00-100-714 Panel Protectors

A front panel protector is a molded plastic, snap-on accessory which fits over the front panel of a DMM, counter, etc. The cover provides protection for the front panel controls, and is useful for storing or transporting the instrument.

M00-100-714 is designed to fit the 8000A and 8600A DMM, and the 1900A, 1910A, 1911A, 1912A Counters. M03-203-700 is designed to fit the 515A Calibrator and the discontinued 8200A DMM.

M00-100-714** Dust Cover
M03-203-700* Dust Cover

Note: Also see pages 46, 125 and 446

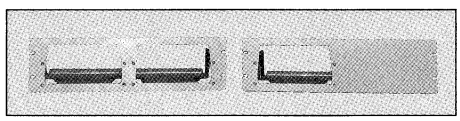
Rackmount Kits

Details on the most popular rackmount kits for Fluke products are included in this section, along with pertinent dimensions, drawings, model numbers and prices. Please also refer to the actual product pages in the catalog for further information; instruments that have kits available will list the kit model number and price in the Ordering Information block at the end of each product page. Any further questions should be directed to your closest sales office.

PTI-Style Instruments

Rack adapters and panel adapters are available for Fluke PTI-Style instruments as noted below. Please refer to the corresponding PTI case style to make your selection.

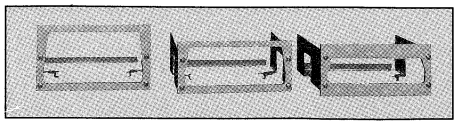
PTI Instruments & Accessories	PTI Case Style A	B	C	D
1120A			•	
2020A, 2030A, 2300A				•
2180A, 2189A, 2190			•	
Y2000, Y2001	•			
Y2002			•	
Y2003, Y2009		•		
7220A, 7250A, 7260A, 7261A			•	
8860A				•
8920A, 8921A, 8922A			•	
Y5020				•
Y2023			•	



PTI-Style Instrument Rack Adapters

Rack adapters for the 2180- and 2190-Series Thermometers, 7200 Series Counters, 8920 Series DVMs, and other Fluke products in PTI cases look like those shown in the picture except for the size of the opening or height of the panel.

PTI Case Style	Panel Opening Single	Panel Opening Double	Rack Panel Size Height	Rack Panel Size Width
A	Y2010	Y2011	3-1/2 in (89 mm)	19 in (483 mm)
B C	Y2012 Y2014	Y2013 Y2015	5-1/4 in (133 mm)	
D	Y2016	Y2017	7 in (177.8 mm)	
A+C	–	Y2027	5-1/4 in (133 mm)	



PTI-Style Instrument Panel Adapters

Fluke instruments in PTI-style cases may be mounted behind your own panel through a standard size panel opening by using one of the adapters identified below.

PTI Case Style	Adapt. No.	Panel-Mount Adapters			
		Panel Cutout		Bezel Size	
		Height	Width	Height	Width
A	Y2018	92 mm (3.62 in)	186 mm (7.32 in)	97 mm (3.82 in)	214 mm (8.43 in)
B	Y2019	92 mm (3.62 in)		97 mm (3.82 in)	
C	Y2020	†		122mm (4.80 in)	
D	Y2021	138 mm (5.43 in)		145 mm (5.70 in)	

Y2010 3½" Rackmount Kit PTI, Single
Y2014 5¼" Rackmount Kit PTI, Single
Y2015 5¼" Rackmount Kit PTI, Double
Y2016 17" Rackmount Kit PTI, Single
Y2017 17" Rackmount Kit PTI, Double
Y2020 4.80" DIN Panel Mount Kit PTI
Y2021 5.70" DIN Panel Mount Kit PTI

† Any dimension from 96 mm to 116 mm. Not Standard. Each kit fastens to a panel with four machine screws. The bezel fits over the front of the panel cutout and the screws hold the bezel and rear (instrument) support bracket to the panel.

Panel Mount Thermometer Adapters



2160A-7032



2160A-7033

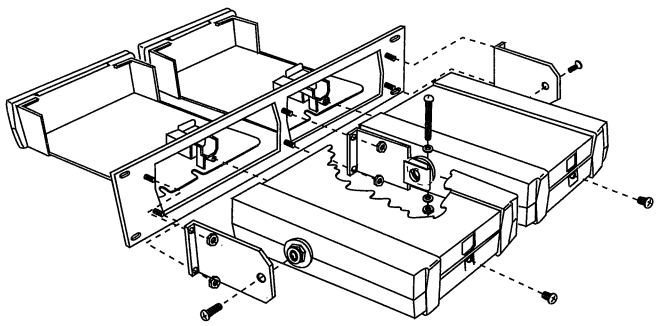
Either the 2160A or the 2170A Thermometer may be mounted in these rack-width panels that are 3½ inches high. Also, the 2161A Multipoint Selector and 2162A Digital Comparator will fit the panel openings.
2160A-7032 3½" Rackmount Panel Kit, Double
2160A-7033 3½" Rackmount Panel Kit, Triple
Available through Distributors

1900, 8000 & 2100 Series Instruments

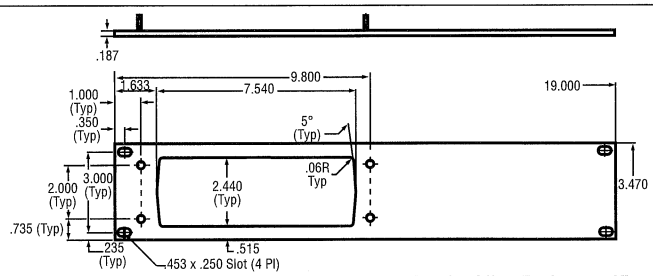
The kit includes two side mounting brackets and one center mounting bracket for the Dual Rackmount Kit.

For use on Models 1900A*, 1910A, 1911A, 1912A, 2165A, 2166A, 2168A, 2175A, 2176A, 8000A*, 8010A, 8012A, 8050A, 8600A*.

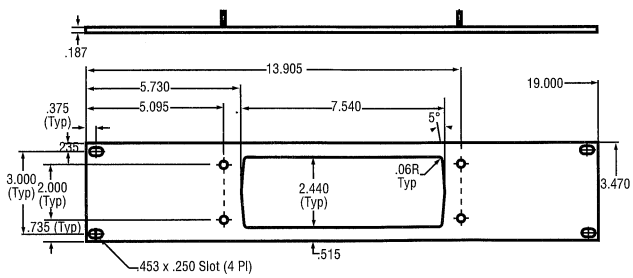
**Discontinued Products*



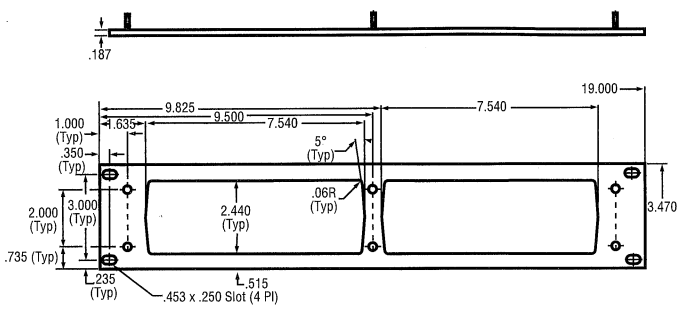
Dual Rack



Rackmount Plate for Offset Rackmount Kit



Rackmount Plate for Center Rackmount Kit

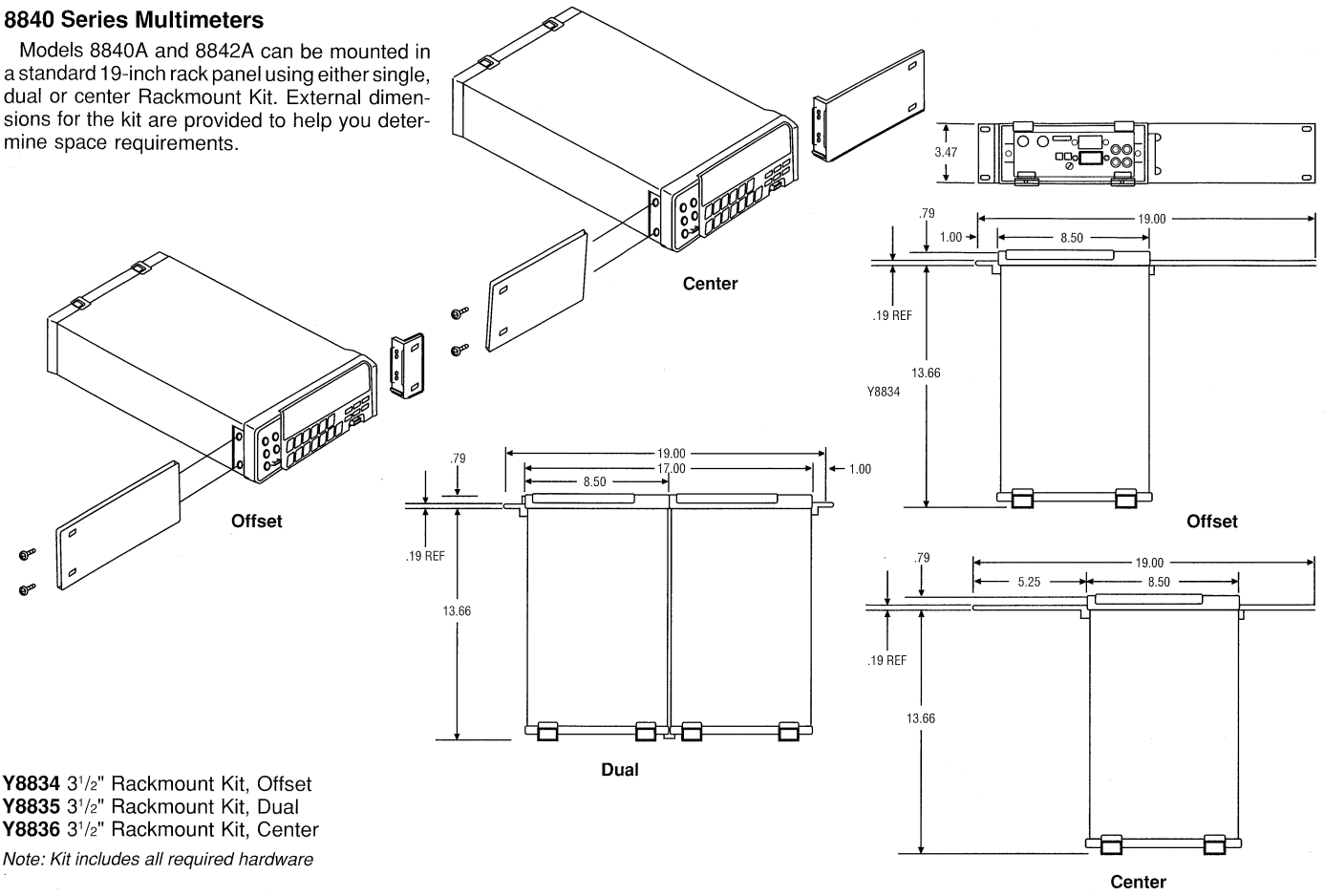


Rackmount Plate for Dual Rackmount Kit

M00-200-611 3½" Offset
M00-200-612 3½" Center
M00-200-613 3½" Dual
Available through Distributors

8840 Series Multimeters

Models 8840A and 8842A can be mounted in a standard 19-inch rack panel using either single, dual or center Rackmount Kit. External dimensions for the kit are provided to help you determine space requirements.

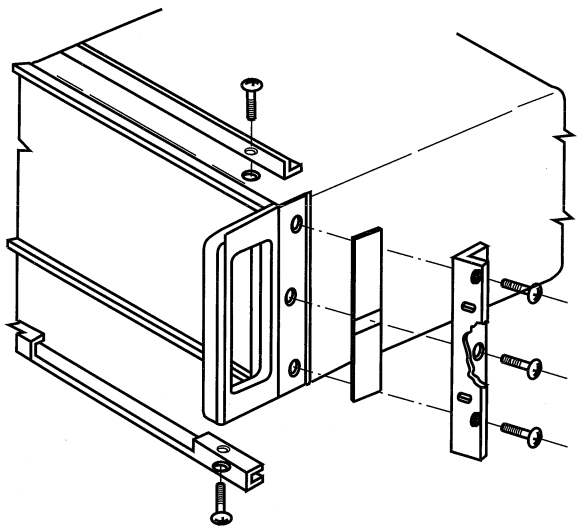


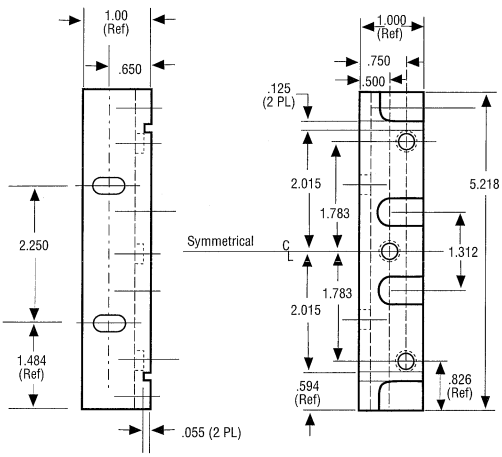
Y8834 3½" Rackmount Kit, Offset
Y8835 3½" Rackmount Kit, Dual
Y8836 3½" Rackmount Kit, Center

Note: Kit includes all required hardware

8500 Series Instruments

Kit includes top and bottom filler strips. Material is 0.187" thick. For use on 8502A, 8505A, and 8506A.

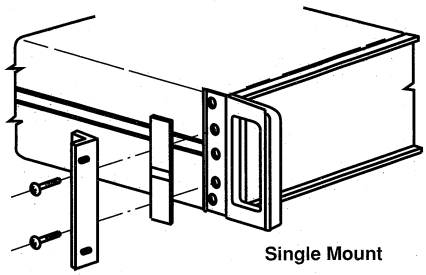




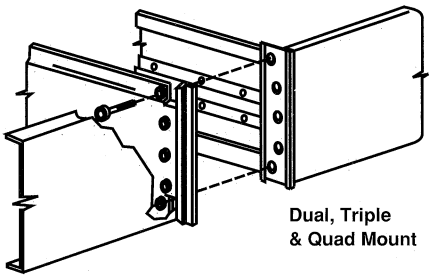
M04-205-600 5¼" Rackmount Kit

Note: Does not include slides. See M00-260-610, M00-260-610 and M00-280-610.

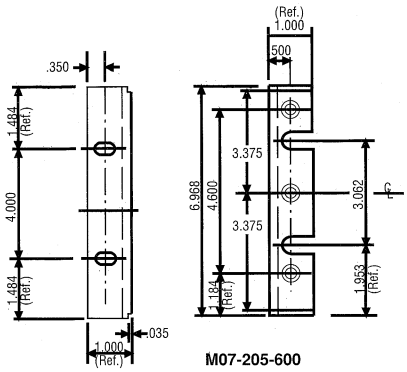
Modular Series Instruments



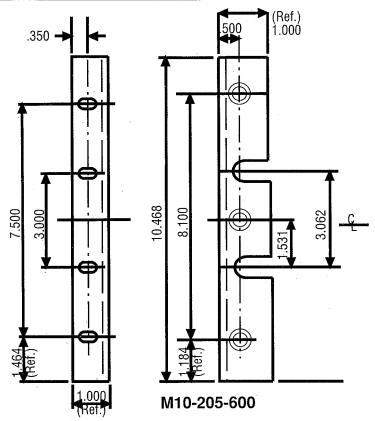
Single Mount



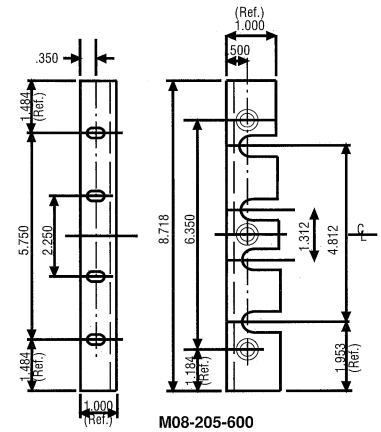
Dual, Triple & Quad Mount



M07-205-600

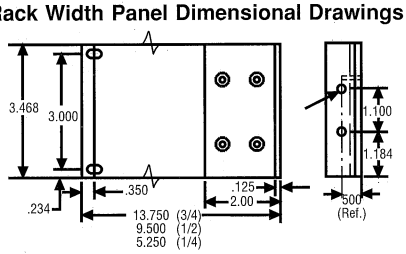


M10-205-600

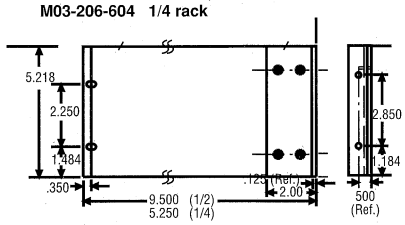


M08-205-600

Rack Width Panel Dimensional Drawings

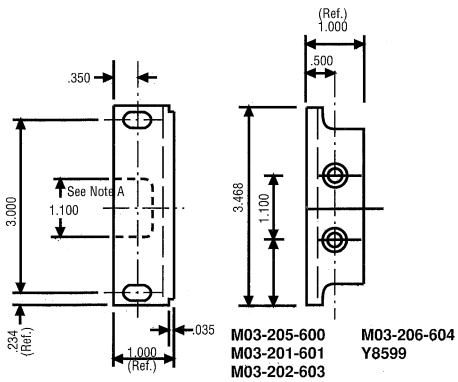


M03-201-601 3/4 rack, M03-202-603 1/2 rack
M03-206-604 1/4 rack



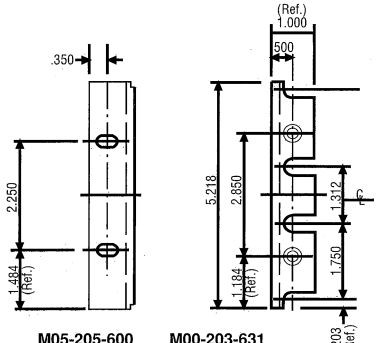
M05-203-601 1/2 rack, M05-203-602 1/4 rack

Rack Ear Dimensional Drawings



M03-205-600 M03-206-604
M03-201-601 Y8599
M03-202-603

Note A: This U shaped cut-out is only on the Y8599 Kit.



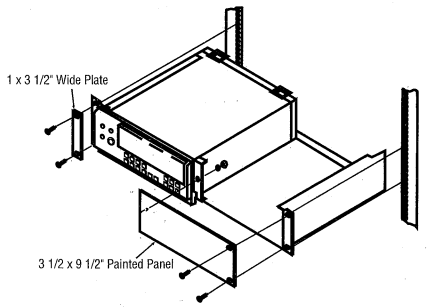
M05-205-600 M00-203-631
M05-203-601 Y1790 & Y6001
M05-200-603

Model (1)	Instrument Module Height mm (inch)	Description	Rack Ears Qty.	For Use On
M03-201-601	88.1 (3 1/2)	Quarter, Single	1	731B
M03-202-603	88.1 (3 1/2)	Quarter, Dual	1	731B
M03-206-604	88.1 (3 1/2)	Quarter, Triple	1	731B
M03-205-605	88.1 (3 1/2)	Quarter, Quad	2	731B
M05-203-601	132.6 (5 1/4)	Offset	1	4210A, 4216A, 6011A
M05-203-602	132.6 (5 1/4)	Center		4210A, 4216A, 6011A
M05-200-603	132.6 (5 1/4)	Dual	2	4210A, 4216A, 6011A
M05-205-600	132.6 (5 1/4)	Single	2	4250A, 4265A, 4270A, 4275A
M07-205-600	177.0 (7)		2	2205A, 5200A, 5220A, 6160B
M07-200-603	177.0 (7)	Side-by-Side		732 & 752A
M08-205-600	221.5 (8 3/4)		2	5100/01B, 2400 Series, 5440B, 5442A
M10-205-600	265.9 (10 1/2)		2	5205A, 5215A
Y1790 (2)	132.6 (5 1/4)		2	1722A, 1755A
Y6001 (2) (3)	132.6 (5 1/4)		2	6060/70 Series
Y8598 (4)	88.1 (3 1/2)			8520A, 8522A, 5450A
Y8599	88.1 (3 1/2)		2	8520A, 8522A, 5450A

(1) Rack Slides are not included unless otherwise stated
(2) Rackmount kit includes 2 pair 24" slides
(3) Also includes rear instrument corner pieces (without handles)
(4) Rackmount kit includes 2 pair 22" slides

Fluke 45

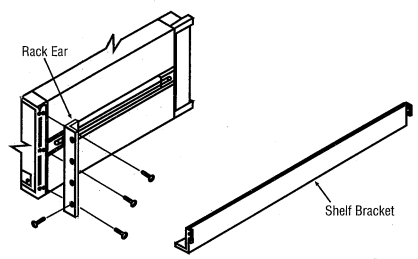
The Fluke 45 can be mounted in a standard 19-inch rack panel on either the right or left hand side using the Fluke M00-200-634 Rackmount kit.



M00-200-634 Rackmount Kit

2280 Series

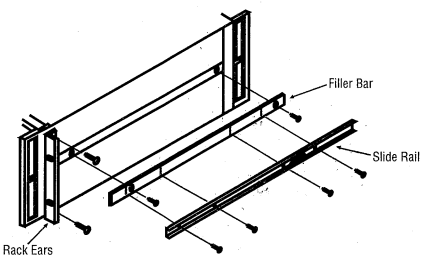
The Y2044 Rack Slide Kit facilitates the servicing of the instrument while it is installed in a standard 19-inch electronic equipment rack. The unit is secured in the equipment rack, yet may be pulled out along the slide for reconfiguring of serial link devices and servicing. The Y2045 Rackmount kit facilitates the placement of an instrument into a standard 19-inch rack.



Y2044 Rack Slide Kit w/24" Slides
Y2045 8 3/4" Rackmount Kit

5700 Series

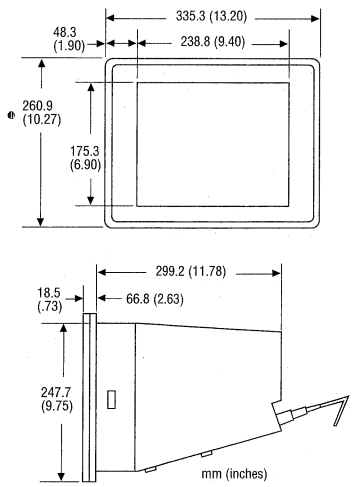
The 5700A Calibrator or the 5725A Amplifier are mountable in a standard 19.12-inch panel opening E.I.A. universal spacing equipment rack. Model Y5735 is for the 5700A and Model Y5737 is for the 5725A. Kit contents and instructions for installation are the same for both kits, except for the size of the rack ears and usage of filler bar to slide rail mounting holes.



Y5735 Rackmount Kit w/24" Slides
Y5737 Rackmount Kit w/24" Slides

1020 and 1030 Series

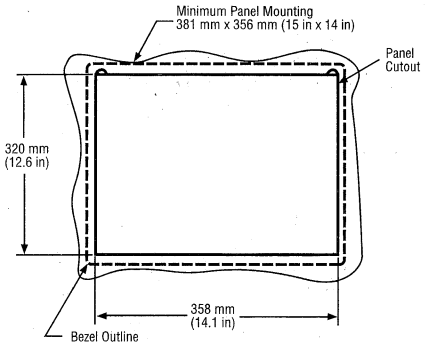
The Touch Control Screen is designed to be easily mounted into a simple cutout in a metal, fiberglass, or wood panel and is supplied with complete hardware for panel mounting.



Y1080 19-inch Rackmount Kit
Y1081 19-inch Rackmount Kit with 18-inch slides
Y1802 19-inch Rackmount Kit with 24-inch slides

NEMA Panel Mounting

To protect the Touch Control Screen (TCS) against environmental contaminants, the touch panel is sealed to the plastic bezel. For further protection in harsh environments, the NEMA 12 (National Electrical Manufacturer's Association) Panel Mounting Kit, when used with a NEMA enclosure, provides a drip-tight and dust-tight seal.



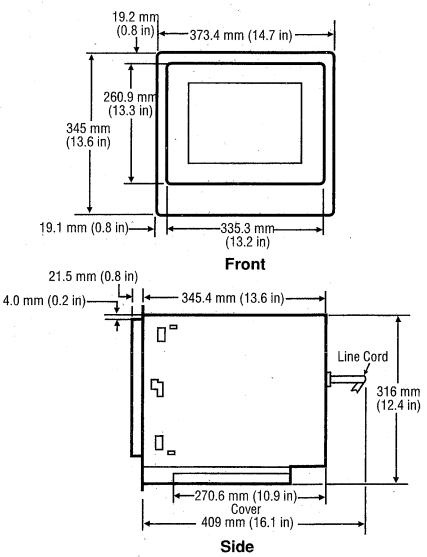
All dimensions are in mm (inches)

Y1070 NEMA 12 Panel Mounting Kit

1050 Series

The 1050 Series is designed to be easily mounted in a panel or a 19" instrument rack. The models 1050 and 1051 are used for applications requiring a panel mount.

For applications requiring mounting in a 19" instrument rack, the model 1052 is used.

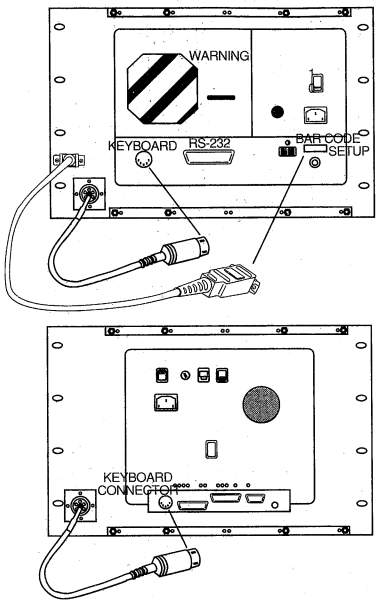


1052-81* Rack Slide Kit (18-inch)
1052-82* Rack Slide Kit (24-inch)

**Only one tyupe of Rack Slide Kit should be ordered per 1052.*

Y1085 Keyboard Extender Cable

The Y1085 Keyboard Extender Cable is used to extend the keyboard interface to the front panel of the Y1080, Y1081, and Y1082 rack-mounting accessories. The Keyboard Extender Cable can also be used in most custom panel mounting applications.

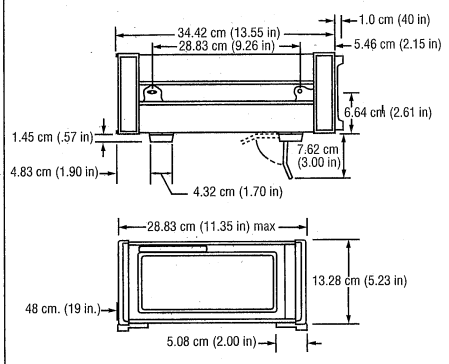


Y1085 Keyboard Extender Cable

1780

The 1780A is 5 1/4 inch (13 cm) standard rack height, and 2/3 standard rack width. With either the Y1791 or Y1792 Rackmount Adapters, the 1780A can be easily mounted in either the left or right side of a standard 19 inch (48 cm) rack.

Both the Y1791 and the Y1792 should be used with either the 18 inch (45 cm) (M00-260-610) or 24 inch (60 cm) (M00-280-610) rack slide accessories for proper mounting.



Y1791 Rack Adapter
Y1792 Rack Adapter and Keyboard Cable

Rack Slides

The units in the previous pages with a M00- number have provision for rack slides. These slides are the M00-260-610 (18" long). M00-270-610 (20" long), and M00-280-610 (24" long).

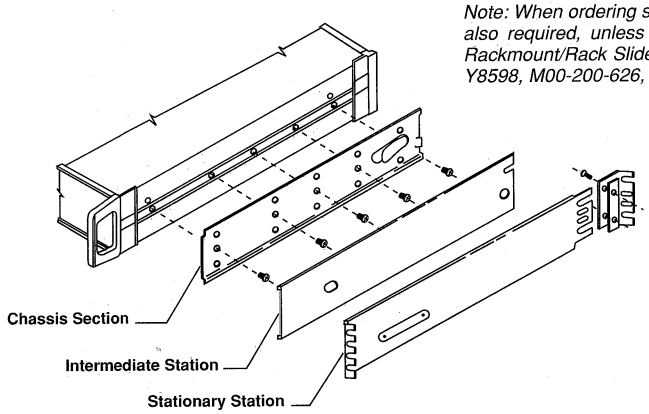
These are devices allowing the instrument to be pulled straight out, after panel screws are removed, for servicing. They are normally only put on larger heavier instruments that can't be easily lifted out to a workbench. The rack slides are bolted to the side of the instrument and Fluke units with provisions for slides have matching tapped holes under a decorative strip on each side.

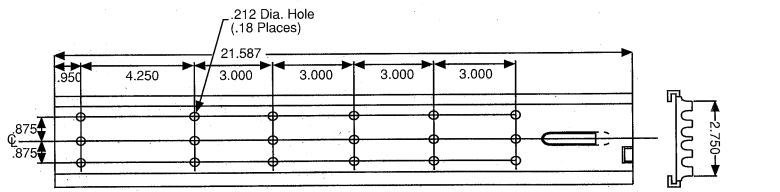
In order to match with the holes in the panel rail, rack slides are mounted in the center of a 1 3/4" module. Instruments whose panel height is an odd number of 1 3/4" modules has rack slides on the center line. Those with an even number have the slides 7/8" above or below the center line. The Fluke M00 slides have provisions for this 7/8" offset.

Three slide kits are available, one for 18" racks, 20" racks (between front and rear cabinet panel rails) and one for 24" racks. Both have rear brackets with 1 1/2" adjustments.

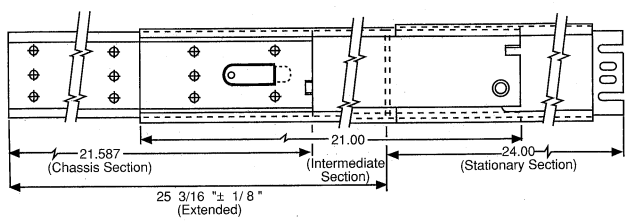
Matl: Hard, cold rolled steel.
Finish: Cadmium plated. Will withstand JAN 100 hr. salt spray.
Load Capacity: 125 lb may vertical load per pair when extended.

Note: When ordering slides, the Rackmount Kits are also required, unless it is one of the combination Rackmount/Rack Slide Kits (Y1790, &6061, Y7206, Y8598, M00-200-626, and M00-203-631).





Chassis Section — Front Mounting Bracket Stationary Slide Sections



Order No.*	Height	Chassis Section (A)	Extension (B)	Intermediate Section (C)	Stationary Section (D)
M00-260-610	3 1/2	17	22 1/4	17	18
M00-270-610	3 1/2	19	22 1/4	17	20
M00-280-610**	3 1/2	23	26 1/4	21	24

**Rackmount Kits are required when ordering Rack Slides*
Note: All mounting hardware furnished

Abbreviations & Symbols

The following lists are taken from ANSI Y1.1 and ANSI Y10.19, but they also include common abbreviations used by Fluke that are not part of either standard.

A

A	ampere (symbol)
a/d	analog-to-digital
ac	alternating current
ac/dc	alternating and/or direct current
adc	analog-to-digital converter
ADP	automatic data processing
adrs	address
af	audio frequency
afc	automatic frequency control
agc	automatic gain control
Ah	ampere-hour (symbol)
alc	automatic level control
alu	arithmetic and logic unit
am	amplitude modulation
amp	ampere (abbreviation)
amp hr	ampere-hour (abbreviation)
ampl	amplifier
AND	AND logic function
ANSI	American National Standards Institute
approx	approximate
ASCII	American Standard Code for Information Interchange
assy	assembly
ATE	automatic test equipment
atten	attenuation
auto	automatic
aux	auxiliary
avc	automatic volume control
AWG	American Wire Gauge

B

B	base (of transistor)
bat	battery (electrical)
bcd	binary-coded decimal
bfo	beat-frequency oscillator
bit	binary digit
bpi	bits per inch
bps	bits per second
BTU	British thermal unit
bw	bandwidth
bwo	backward-wave oscillator

C

°C	(degrees) Celsius
c	centi (prefix, 10^{-2})
C	collector (of transistor)
CAD	computer aided design
c/s	cycle(s) per sec (Hz is now preferred)
cal	calibrate
cap	capacitor
cath	cathode
ccw	counterclockwise
cfm	cubic foot per minute (abbreviation)
cfs	cubic foot per second (abbreviation)
cg	centigram
cgs	centimeter-gram-second
chan	channel
chgr	charger
ckt	circuit
clk	clock
cm	centimeter
cmd	command
cmil	circular mil
CMOS	complementary metal-oxide semiconductor
cmr	common mode rejection
cmrr	common mode rejection ratio
coax	coaxial
coef	coefficient
com	common
conn	connector
cont	control
cpi	characters per inch
cps	characters per second
CPU	central processing unit
crt	cathode-ray tube
CSA	Canadian Standards Association
CTL	complementary transistor logic
cu	cubic
cw	clockwise
cw	continuous wave

D

d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dBm	decibels above or below 1 milliwatt
dBv	decibels above or below 1 volt
dBW	decibels above or below 1 watt
°	degree(s) (symbol)
dc	direct current
dc/ac	direct and/or alternating current
DCTL	direct-coupled transistor logic
deg	degree(s) (abbreviation)
dgtl	digital
diel	dielectric
diff	differential
DIP	dual in-line package
DMA	direct memory access
DMM	digital multimeter
dn	down
dp	double-pole
dpdt	double-pole double-throw
dpst	double-pole single-throw
DSO	digital storage oscilloscopes
dspl	display
dt	double-throw
DTB	delayed timebase
DTL	diode transistor logic
dty cy	duty cycle
dut	device under test
dvm	digital voltmeter

E

E	emitter (electron device)
ECL	emitter-coupled logic
EDP	electronic data processing
EEPROM	electrically-erasable programmable read-only memory
EEROM	electrically-erasable read-only memory
ef	emitter follower
EIA	Electronics Industries Association
elec	electric
emf	electromotive force
emi	electromagnetic interference
EPROM	erasable programmable read-only memory
ext	external

F

°F	(degrees) Fahrenheit
F	farad
f	force
fc	footcandle
FCS	Fluke Cooperative Service
fdm	frequency division multiplex
FET	field-effect transistor
ff	flip-flop
fL	footlambert
fltr	filter
fm	frequency modulation
FM	Factory Mutual Research Corp.
fpm	foot (feet) per minute (abbreviation)
fps	foot (feet) per second (abbreviation)
freq	frequency
FS	Federal Specification
FSC	Federal Supply Code
FSN	Federal Stock Number
ft	foot (feet)
ft^3/min	cubic foot per minute (symbol)
ft^3/s	cubic foot per second (symbol)
ft lb	foot pound force (abbreviation)
ft.lb	foot pound force (symbol)
ft/min	foot (feet) per minute (symbol)
ft/s	foot (feet) per second (symbol)
fw	full wave

G

G	giga (prefix, 10^9)
g	gram
g	gravity force
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
GPIB	general-purpose interface bus

H

H	henry
h	hour (symbol)
hd	heavy duty
het	heterodyne
hex	hexadecimal
hf	high frequency
hfo	high-frequency oscillator
hp	horsepower
hr	hour (abbreviation)
hv	high voltage
hw	half wave
Hz	hertz (cycle(s) per second)

I

I/O	input/output
IC	integrated circuit
IEC	integrated electronic component
IEEE	Institute of Electrical and Electronic Engineers
in	inch
in^3	cubic inches
in lb	inch-pound

Abbreviations & Symbols

in/s inch per second (symbol)
instr instrument
intl internal
ips inch per second (abbreviation)

J

JFET junction field-effect transistor

K

K kelvin
K kilo (2^{10}, number suffix)
k kilo (10^3, units prefix)
kΩ kilohm
kg kilogram
kHz kilohertz
km kilometer
kV kilovolt
kVA kilovolt-ampere
kW kilowatt

L

L lambert
l liter (preferred spelling)
lab laboratory
lb pound(s)
LCD liquid-crystal display
LED light-emitting diode
lf low frequency
log logarithm
LSB least-significant bit
LSD least-significant digit
LSI large-scale integration

M

M mega (prefix, 10^6)
MΩ megohm
m meter
m milli (prefix, 10^{-3})
mΩ milliohm
mA milliampere
max maximum
mg milligram
mH millihenry
MHz megahertz
MIL-STD military standard (book)
min minimum
min minute
ml milliliter
mm millimeter
modem modulator-demodulator
MOS metal-oxide semiconductor
MPU microprocessor unit
ms millisecond
MSB most significant bit
MSD most significant digit
MSHA Mine Safety & Health Administration, U.S. Department of Labor
MSI medium-scale integration
MTB main timebase
mux multiplex
MV megavolt
mV millivolt
mv multivibrator
MV A megavolt-ampere
MW megawatt
mW milliwatt

N

nA nanoampere
NAND NOT AND logic function
NBS National Bureau of Standards
NC normally closed
neg negative
nF nanofarad
nH nanohenry
NIST National Institute of Standards & Technology
nm nanometer
NO normally open
no number
NOR NOT OR logic function
npn negative-positive-negative (transistor)
NRC National Replacement Code
ns nanoseconds
nS nanosiemens
NSN National Stock Number

O

OEM original equipment manufacturer
Ω ohm
OR OR logic function
osc oscillator
oz ounce

P

p pico (prefix, 10^{-12})
p-p peak to peak
pA picoampere
pca printed circuit assembly (Fluke prefers pca to pcb)
pcb printed circuit board
pcm pulse-code modulation
pF picofarad
pk peak
PLL phase-locked loop
pn part number
pnp positive-negative-positive
PO purchase order
pos positive
pot potentiometer
ppm parts per million
ppm pulse-position modulation
pps pulses per second
preamp preamplifier
PROM programmable read-only memory
ps picosecond
PTI portable test instrument
ptm pulse-time modulation
pwm pulse-width modulation
pwr power
pwr sply power supply

Q

QA quality assurance
QC quality control

R

R&D research and development
rad radius
RAM random-access memory
RC resistance-capacitance
rf radio frequency
rfi radio-frequency interference
rh relative humidity
RL resistance-inductance
RLC resistance-inductance-capacitance
RMM read-mainly memory
rms root mean square
ROM read-only memory
rpm revolutions per minute
RTD resistance temperature detector
RTL resistor-transistor logic

S

s second (symbol)
S siemens
sb sideband
sbc single-board computer
SCR silicon-controlled rectifier
SCS silicon-controlled switch
sec second (abbreviation)
sin sine
snr signal-to-noise ratio
SPC statistical process control
spdt single-pole double-throw
spec specification
spst single-pole single-throw
ssb single sideband
SSI small-scale integration
stby standby
std standard
sw shortwave
swp sweep
swr standing-wave ratio
sync synchronize

T

tan tangent
tc thermoccouple
tc time constant
TCS touch control screen
TCXO temperature-controlled crystal oscillator
thd total harmonic distortion
TTL transistor-transistor logic
tty teletypewriter
tvi television interference

U

μ or u micro (prefix, 10^{-6})
μA microampere
UART universal asynchronous receiver transmitter
μF microfarad
μg microgram
μH microhenry
uhf ultrahigh frequency
UL Underwriter Laboratories Inc.
μm micrometer (micron)
μP microprocessor
μs microsecond
UUT unit under test
μV microvolt
μW microwatt

Abbreviations & Symbols

V

V	volt
VA	volt-ampere
vco	voltage-controlled oscillator
VDE	Verband Deutscher Elektrotechniker
VDT	video-display terminal
vfo	variable-frequency oscillator
vhf	very high frequency
vlf	very low frequency
vm	voltmeter
vom	volt-ohm milliammeter
vs	versus
vswr	voltage standing wave ratio
vtvm	vacuum tube voltmeter

W

W	watt
wl	wavelength

X

xfmr	transformer
xmtr	transmitter
xstr	transistor
xtal	crystal

Y

yd	yard

Symbols for Units of Measure

Physical	Unit of Measure	Unit Symbol
Length	meter	m
Weigh	gram	g
Time	second	s
Voltage	volt	V
Electric Current	ampere	A
Resistance	ohm	Ω
Conductance	siemens	S
Inductance	henry	H
Capacitance	farad	F
Frequency	hertz	Hz
Power	watt	W
Temperature	degree	°F or °C or K
Energy, Qty of Heat	joule	J
Force	newton	N
Pressure, Stress	pascal	Pa

Common Conversions

To Convert	In To	Multiply By
centimeters	inches	0.3937
centimeters	feet	3.281×10^{-2}
centimeters	meters	0.01
inches	centimeters	2.540
feet	centimeters	30.48
feet	meters	0.3048
yards	meters	.9144
temp (°C) +17.78	temp (°F)	1.8
temp (°F) -32	temp (°C)	5/9

Power Cords

Power Cords

Fluke instruments are fitted with one of the power cord and plug options shown below and are wired for the voltage indicated. The power cord supplied with your instrument is the one commonly used in the country where the instrument will be delived.

If you require a power cord and plug other than the one listed below for the country where the instrument will be delivered, specify that power cord and plug when you order.

Philips instruments listed in this catalog are configured for standard North American power requirements. If you require a different configuration, specify power cord and plug combination from the list below.

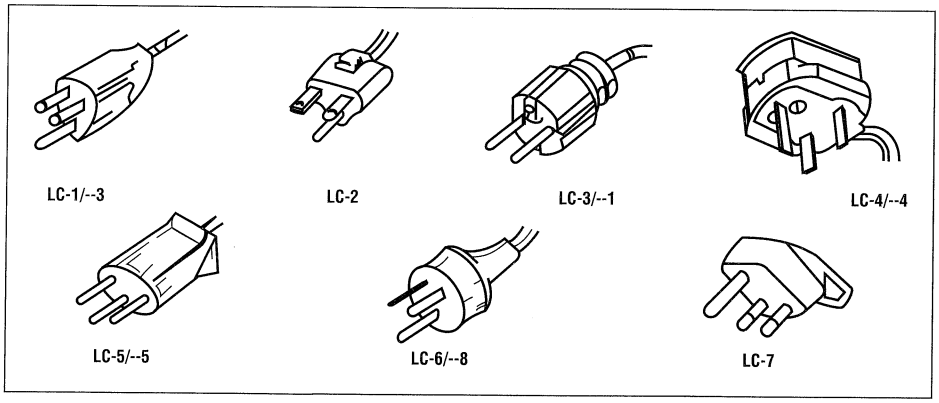
Environmental Capabilities

N.B.: The environmental data is valid only if the instrument is checked in accordance with the official checking procedure. Details of these procedures and failure criteria are supplied on request by your local Fluke or Philips organization.

		Fluke	Philips	
			Product Category 1*	Product Category 2**
North America	120V/15A	Option LC-1	/--3	Specify Country of destination on order
North American	240V/15A	Option LC-2		
Universal Euro	220V/16A	Option LC-3	/--1	
United Kingdom	240V/13A	Option LC-4	/--4	
Switzerland	220V/10A	Option LC-5	/--5	
Australia	240V/10A	Option LC-6	/--8	
South African	240V/5A	Option LC-7	Ask for LC-7	

* *Final digit in model number format PM----/--- for Philips Category 1 Products including Oscilloscopes (except as In 2 below), Multimeters, Recorders, and System 21*

** *Philips Category 2 Products including Logic Analyzers, Signal Sources, Pulse Generators, Pattern Generators, Counters and Oscilloscopes models PM 3219/3264/3266/3267*



Glossary of Terms

Absolute Accuracy. See Absolute Uncertainty.

Absolute Uncertainty. Uncertainty that includes contributions from three sources: (1) traceability to national standards, (2) the measurement process, and (3) relative uncertainty of the measuring instrument(s). Absolute uncertainty should be used to compute test uncertainty ratio. Also see **Relative Uncertainty**.

Accuracy. The extent to which the measured value of a quantity agrees with the accepted, consensus, or true value of that quantity. The accuracy of a measurment is its "closeness" to a defined true or reference value. For example, a measurement that is uncertain by ±1% is 99% accurate. Accuracy however is also sometimes used to mean uncertainty. Also see **Uncertainty**.

Acronym. Initials of descriptive name that can be pronounced as a word. For example, "PROM" for Programmable Read-Only Memory.

Address. A coded number representing the location of an item. Examples include bus address and program address.

Adjacent Trace Short. A short resulting from an inadvertent connection between two adjacent traces.

Aliasing. False reproduction of an input waveform in a Digital Storage Oscilloscope, for instance, caused by under-sampling (sampling the input at below the Nyquist rate).

Analog-to-Digital Converter. A circuit module that changes a voltage or current into a digitized number that can be displayed or further analyzed by digital circuitry.

ANSI. American National Standards Institute, Inc., a group that approves and publishes written U.S. industry standards.

Application Software. A program running on a host computer designed to perform specified functions in a working environment.

Artifact Calibration. An instrument calibration technique that uses a calibration system within the instrument to reduce the number of required external standards to a small number of artifact standards. The Fluke 5700A Calibrator uses Artifact Calibration.

Artifact Standard. A stable object that produces or embodies a physical quantity for use as a reference standard. An artifact standard may have an assigned traceable value when used for calibration purposes. Fluke 732A dc Voltage Reference Standard and the Fluke 742A Series Standard Resistors are examples. Also see **Transfer Standard**.

ASCII. American Standard Code for Information Interchange as defined by ANSI document X3.64-1077. ASCII is a standardized code set for 128 characters, including full alphabetic (upper and lower case), numerics, punctuation, and a set of control codes.

Astigmatism. Measure of the roundness of the spot on a CRT screen.

Asynchronous Data. Information transmitted or received at random times with respect to a particular system. Also see Synchronous Data.

ATE. Automated test equipment, including systems such as manufacturing defects analyzers, functional testers, and incircuit testers.

Autopolarity. A feature of a digital voltmeter or digital multimeter wherein the correct polarity (either negative or positive) for a measured quantity is automatically indicated on the display.

Autoranging. The capability of an instrument to automatically select the most appropriate range in response to an applied stimulus or requested output.

Average Responding. A measurement where the displayed value is proportional to the average of the absolute values of all input waveforms within a specified frequency range. It is calibrated in the rms value of a sine wave.

Backplane. An electronic system module whose primary function is to interconnect other modules.

Bandwidth. The range of frequencies within which performance remains within specified limits.

Base Units. Units in the SI system that are dimensionally independent. All other units are derived from base units. The only base unit in electricity is the ampere.

Baud Rate. The serial transfer rate in bits per second including all framing bits used to identify the start and end of codes or messages.

Binary. A base-two number system using the symbols "0" and "1". Binary codes are more easily handled by digital computer circuitry that uses bistable "off" or "on" states to store and process information.

Bit. A mnemonic for binary digit, the smallest single unit of computer information. Bits are normally represented as "0" or "1", and are often used in groups to represent addresses, numbers, or codes. Also see **Byte**.

Break-Before-Make. The action of opening a switching circuit before closing another associated circuit.

Buffer. (1) An area of digital memory for temporary storage of data. (2) An amplifier stage before the final amplifier.

Burden Voltage. Voltage drop across the input terminals of a current-measuring device, caused by internal shunt resistance. Burden voltage contributes measurement error, and should be as low as practical.

Byte. A group of eight bits. Information in computer memory is typically arranged as an array of bytes.

Calibration. The comparison of a measurement or source device (UUT) of unverified uncertainty with a measurement or device of known and lesser uncertainty, to report or correct variations. Calibration may or may not include adjustment of the UUT or assignment of values to its reponses. Also see **Traceability** and **Verification**.

Calibration Constant. A correction to be applied to the output or reading of an instrument. It may be applied manually or automatically. Also see **Closed Loop Calibration**.

Character. A member of a set of elements used for representing data visually. Characters are distinct from codes in that they are visual representations of data, while codes are numeric representations of data.

Character Cell. The portion of the display that is used to display a character. Typically expressed in terms of pixels.

Characterization. A calibration process that produces a table of calibration constants for use in correcting the output or reading of an instrument.

Character Set. A collection of characters used by terminal devices to display information. Character sets commonly contain 128 characters.

Character String. A grouping of ASCII characters.

Check Standard. A stable standard used to verify the integrity of another standard or measurement process. For example, in the 5700A, one Fluke rms sensor continuously monitors the output voltage while a second Fluke rms sensor confirms the integrity of the first.

Closed Loop. A circuit in which the output is continuously fed back to the input for constant comparison.

Glossary of Terms

Closed Loop Calibration. A fully automated calibration process in which the calibration system reads the UUT response to each stimulus and supplies an appropriate calibration constant for storage within the UUT.

Common Mode Noise. Noise that exists between both terminals of a measurement source device and ground. Also see **Noise** and **Normal Mode Noise.**

Common Mode Rejection. For a measurement device, the ability to measure a signal in the presence of common mode noise. For a source device, the maximum level of common mode noise that might appear on the output terminal. Common mode rejection is normally specified as a ratio (dB).

Compliance Voltage. The output voltage of a constant-current source. For a current calibrator, a "maximum compliance voltage" specification defines the load limit for which the calibrator can maintain uncertainty specifications.

Confidence Level. A statistical percentage indicating the likelihood of successfully isolating all faults.

Control Sequence. A sequence of codes that produces a desired response. Examples are display control sequences for such responses as cursor position or blinking.

Conversion Time. The time required for a complete measurement by an analog-to-digital converter.

Crest Factor. The ratio of the peak voltage of an ac waveform to its rms value, with any dc component removed. For an alternating voltage or current meter, crest factor expresses its ability to respond to non-sinusoidal waveforms.

Current Guard. A voltage source in phase with a current source, intended for shielding the current output. For example, the Fluke 5700A Calibrator includes a current guard on its rear terminal block. When connected to the inner shield of a triaxial cable with low-level ac current output on the center conductor, it shields the output from a capacitive leakage path to ground.

Cursor. The visible pointer on the CRT display that indicates to the user the position where the next character will appear.

Data. Any representation of information in a formalized manner suitable for communication, interpretation, or processing by manual or automatic means.

dB. Decibel, a means of expressing the ratio of two signal levels. [dB = 10 log P2/P1] Useful in RF work where people work with large gain or loss ratios.

dBc. The ratio (in dB) of a signal to the magnitude of an associated carrier signal. Useful for expressing relative levels for noise or spurious products on a signal generator's output signal.

dBm. A unit of power, dB relative to a 1 milliwatt reference. +3 dBm is 3 dB. (2x) above 1 milliwatt, or 2 milliwatts.

dBμv. Decibels relative to a 1 microvolt reference. Used in EMI work and in some parts of radio industry.

dBV. The increase or decrease in voltage independent of impedance levels.

dBW. Decibels referred to one watt.

Default Value. The parameter value for a mode or function that is assumed when no explicit value, or sometimes when a value of 0, is specified.

Delay Circuit or Line. A circuit which delays the passage of a pulse or signal from one part of a circuit to another.

Delayed Sweep. An oscilloscope function that allows you to delay the start of display for a specified time after a trigger event.

Derived Units. Units in the SI system that are derived from base units. Volts, ohms, and watts are derived from amperes and other base and derived units. Also see **Base Units.**

Digital Bandwidth. For a DSO, the maximum frequency for a repetitive signal that can be accurately reproduced. Generally limited to the analog bandwidth of the vertical input amplifier.

Distortion. Undesired changes in waveform of a signal. Harmonic distortion disturbs the original relationship between a frequency and other frequencies naturally related to it. Intermodulation Distortion (IMD) introduces new frequencies by the mixing of two or more original frequencies. Other forms of distortion are phase distortion and transient distortion.

Divide Band Architecture: Signal generator design in which low frequencies are created by dividing down from an octave that has been synthesized in a higher frequency range.

DOU. Data Output Unit. A circuit used to interface data between a measuring instrument and a recording or data storage device.

Drift. Gradual change in a value over time.

Duty Cycle. The ratio of a device's operating to idle time.

Dynamic Faults. Faults that appear only when the components on the board are interacting in sequence, at rated speed.

Dynamic Range. Maximum signal amplitude that can be displayed without distortion.

EEPROM. Electrically Erasable Programmable Read-Only Memory. An EEPROM is a memory device that provides the nonvolatile data storage characteristics of a ROM yet can be electrically erased and rewritten like a RAM device. EEPROM allows a large, yet finite, number of write operations.

EPROM. Erasable Programmable Read-Only Memory. A memory device that can be erased with ultraviolet light and reprogrammed using specialized equipment.

Firmware. Computer programs and data that are recorded in permanent memory. See **ROM** and **EPROM.**

Fixed Range Function. A special function, in which attenuator switching is inhibited, and amplitude is controlled electronically. Insures monotonic, transient-free control over a limited amplitude range. Used for receiver squelch testing.

Flatness. A measure of output level variation for an ac voltage source as frequency is varied. Flatness limits are normally specified as a ratio (%) to nominal output level at a reference frequency.

Floor Error. A contribution to measurement or source uncertainty that is independent of reading or output setting. In uncertainty specifications, floor error is often combined with fixed range errors and expressed in units such as microvolts or counts of the least significant digit. Also see **Offset Error** and **Systematic Error.**

Four-Terminal Ohms. A method for making accurate low-resistance measurements. In the four-terminal method, the current source and voltage measurement terminals are separate. This eliminates the test lead resistance.

Frequency. The number of recurrences of a periodic phenomenon in a unit of time.

Glossary of Terms

Frequency Synthesizer. Frequency generation section of modern signal generators, also sometimes sold as a standalone product. Produces a signal that is locked to a precision crystal reference oscillator. Gives programmable signals with crystal-controlled stability.

FSK. Frequency Shift Keying, a method of transmitting digital data over radio by shifting carrier frequency. Usually shift up in frequency for a "1", and down for a "0". Used in digital pagers, telemetry, and control signaling in radio systems.

Full Scale. The upper limit of measurement or source value for which a given uncertainty specification applies, including any "overrange". Also see **Overrange, Range**.

Gain Error. The portion of instrument error resulting when the slope of its response curve is not exactly 1. For example, a meter with only gain error (no offset or linearity error) will read 0V with 0V applied, but something other than 10V with 10V applied.

GPIB. General Purpose Interface Bus. See **IEEE-488.**

Ground Loop. Undesirable current induced when there is more than one chassis ground potential in a system of instruments. Ground loops can be minimized by connecting all instruments in a system to a single ground point.

Guard. See **Voltage Guard** and **Current Guard**.

Handshaking. A method by which data is exchanged between devices only when each device has signaled that it is ready.

Het Band. The lowest frequency range on most signal generators is created by mixing or "heterodyning" down signals that are synthesized at a higher frequency.

Hexadecimal. A base-16 number system using the symbols "0" through "9", and "A" through "F". Hexadecimal numbers are a more compact and easier to read way to represent binary number patterns. Also see **Binary**.

Horizontal (Time) Resolution. For a DSO, the minimum time duration needed to sample an incoming signal. Generally equal to the inverse of the real time sampling rate (assuming the scopes' rise time is at least that fast).

IEEE-488. A high-speed communications interface, often used in analog test equipment.

Incidental AM. Unwanted amplitude modulation that occurs when frequency modulating. Seldom a significant problem in modern signal generators.

Incidental FM. Unwanted frequency modulation that occurs when a signal is being amplitude modulated. Was a problem in older signal generators due to oscillator "pulling," but is rarely significant in synthesized generators.

Interface. A shared information boundary between systems.

Interface Pod. A microprocessor-specific unit used in connection with Fluke board test equipment, giving it the ability to emulate the activity of the microprocessor on the board.

Isolation. Separation of one section of a system from undesired influences of other sections.

Jitter. Instability of a signal in either its amplitude, its phase, or both.

Kernel. The nucleus or core of a computer's operating system software. For example, in the IBM PC environment, the kernel is its BIOS (Basic Input/Output System).

Life-Cycle Cost. The consideration of all elements contributing to the cost of an instrument throughout its useful life. This includes initial purchase cost, service and maintenance cost, and the cost of support equipment.

Linearity. Degree of conformity to straight-line response. For an analog to digital system such as a DMM or counter, or a digital to analog system such as a calibrator, linearity is the degree that nominally equal digital steps are equal in magnitude.

Linearity Error. Error resulting when the response curve of an instrument is not exactly a straight line. This type of error can be measured by characterizing fixed points near each end of a given range (to remove gain and offset errors), and then measuring deviations from a straight line through the characterized endpoints.

MAP (Measurement Assurance Program). A program for controlling measurement processes that provides information to ensure that the total uncertainties of measurements relative to national or other designated standards are quantified and sufficiently small to meet requirements.

Maximum Single-Shot Frequency. On a DSO, the highest frequency non-repetitive event that can be accurately captured and displayed. Generally equal to approximately $^{1}/_{10}$th the real-time sampling rate.

Metrology. The science of metrology is that field of knowledge concerned with measurement. The practice of metrology is all those activities which taken together result in proper measurements.

Mini-cassette. A storage medium used by Fluke board test equipment for storing test programs.

Minimum Use Specifications. Specifications computed to satisfy the calibration requirements of measurement or source device (UUT). Usually determined by a specified test uncertainty ratio between the absolute uncertainties of the UUT and its required calibration equipment. Also see **Test Uncertainty Ratio**.

Mnemonic. An abbreviated name. Examples are "pixel" for picture element, and "bit" for binary digit.

Modulation. The controlled variation of frequency, phase and/or amplitude of a carrier wave of any frequency in order to transmit a message.

Modulation Depth. Refers to amount of modulation, or "loudness" in audio terms. In FM and PM, modulation depth is determined by deviation; in AM it is determined by the percent of modulation.

Modulation Index. In FM, the ratio of Peak Deviation to Modulating Audio Frequency, i.e., at 1 kHz tone, with a deviation of 3.5 kHz, produces a modulation index of 3.5. Modulation index is important in mathematical analysis of modulated signals.

Multidrop. A communication configuration whereby several instruments share a common communications link.

Multidrop Control Code. Any of the control codes sent by the host to implement the multidrop communication protocol.

NEMA. National Electrical Manufacturers Association. Publishers of various standards, including the NEMA 12 standard that describes dust-proof and water-resistant enclosures.

New Volt. On January 1, 1990, the world will adopt a new worldwide standard of voltage. The change from the old standards is being made so everyone will have the same volt, and instruments calibrated in one country will measure accurately in another. Each country will adjust its volt by the amount needed to make it correspond to the SI volt.

Node. A terminal of any branch of a network, or a terminal common to two or more branches on a printed circuit board. Also called a junction point, branch point, or vertex.

Glossary of Terms

Noise. Any signal that does not contain useful information.

Nonvolatile Memory. An electronic memory that retains its contents when power is turned off.

Normal Mode Noise. Noise that appears between the input or output terminals of a device. Also see **Common Mode Noise**.

Normal Mode Rejection. Ability to measure the dc component of a signal which contains both ac and dc.

Nyquist Rate: Theoretical minimum number of samples needed to extract accurate data from a continuous, band-limited signal. Generally equal to half the real time sampling rate, for non-repetitive signals, (yielding 2 samples per period on the incoming signal) although for DSOs, 10 sample per period is more practical.

Offset Error. The reading reported by a measuring instrument connected to an actual input value of zero, or the actual output of a source instrument set to zero. Offset error is similar in concept to floor error, except that by common usuage offset error refers to the actual fixed error while floor error refers to the fixed portion of an uncertainty specification. Also see **Floor Error** and **Systematic Error**.

Overrange. An extension to the nominal upper limit of a measurement or source device for which a given uncertainty specification applies, often given in percent. For example, the uncertainty specification for the 10V range of an instrument with "100% overrange" applies up to 20V. Also see **Range**, **Scale**.

Parallax. An optical effect that occurs when viewing two objects at different distances from different angles.

Parameter. An adjustable operating feature. Examples of parameters include baud rate, cursor type, and light or dark background.

Parity. A method of error detection that uses one extra bit for each unit of information (such as a byte). The parity bit is set to 1 or 0 so that the total number of 1's in the byte, together with the parity bit, is even for even parity or odd for odd parity.

Period. The time required for one complete cycle of a regular, repeating series of events.

Phase Modulation. Method for modulating a signal by varying phase of carrier signal in response to an analog or, more commonly, a digital modulating signal.

Phase Noise. Short-term, random phase variations of an RF signal, a result of electrical noise in the signal generator's circuits. Expressed in dBc/Hz, which is noise density in a 1 Hz equivalent bandwidth, relative to the carrier amplitude.

Pin Verification. A preliminary test to make sure all tester pins are in contact with the UUT before the actual test begins. This feature is designed to be used with loaded-board tests. It is based on the assumption that, from any given point on a loaded board, there is a path to either V cc or ground.

Pixel. A mnemonic for picture element, an individual dot on a display screen.

Port. A connection point used for data transfer. See **Interface**.

Precision. The degree of agreement among independent measurements of a quantity under specified conditions. The precision of a measurement process is its coherence or repeatability. Note that while precision is necessary for accuracy, it does not imply it.

Predictability. A measure of what is known of the time-behavior of a device. A documented drift rate with understood characteristics (e.g., linear, exponential) can be highly predictable.

Process Metrology. A statistics-based method for controlling the accuracy of measurements actually made, in contrast to the accuracy of the instruments used to make the measurements. Process metrology uses check standards and statistical process control (SPC) to maintain measurement processes in statistical control, and uses measurements made on products of the measurement system to verify that the processes are properly controlled. Major benefits include continuous evidence that good measurments are being made, increased process uptime due to the fact that instrumentas are not recalled for periodic recalibration, and MIL-STD-45662A traceabiltiy without the need for 4:1 Test Uncertainty Ratios.

Program. Any meaningful sequence of computer instructions that causes a system to accomplish a task.

PROM. Programmable Read-Only Memory, a memory device that can be programmed using specialized equipment.

Prompt. A displayed message that guides the operator to the next step.

Protocol. A set of rules for exchange of information between systems or devices.

PSK. Phase Shift Keying, a method for transmitting digital data over radio by shifting carrier phase.

QPSK. Digital modulation with four phase states.

RAM. Random access memory. Through common usage, the term has come to mean the high-speed volatile semiconductor memory that is normally used for system and user memory. It is memory, both readable and writeable, used to store and recall information.

Random Error. Any error which varies in an unpredictable manner as successive measurements of the same quantity are made under effectively identical conditions. Also see **Systematic Error.**

Random Sampling. A form of Repetitive Sampling that takes samples of successive periods of an incoming repetitive signal at fixed intervals. In a DSO, these samples are stored in memory, and used to reconstruct a lower frequency replica of the incoming signal.

Range. Stated upper limits of measurement or source values for which given uncertainty specifications apply. Also see **Overrange, Scale**.

Raster. The scanning pattern of an electron beam on a CRT display. A raster display uses the same scan pattern all the time, forming images by turning the beam on and off at appropriate times.

RCU. Remote Control Unit. A circuit capable of operating an instrument's function and range controls by use of remote control signals.

Reading Rate. The speed at which a measurement system can take measurements.

Real Time. Pertaining to the actual time during which physical events take place.

Real Time Sampling. Takes a sequential series of samples from the incoming signal, even if they are not repetitive, as they occurred in time.

Relative Accuracy. See **Relative Uncertainty**.

Relative Uncertainty. Measurement uncertainty that includes only the error contributions from the measuring or source instrument. Also see **Absolute Uncertainty**.

Repeatability. See **Precision.**

Repetitive (or Time-equivalent) Sampling. Takes a series of samples from successive periods in a repetitive signal. May be either "sequential" or "random". In a DSO, these samples are then stored and used to reconstruct the incoming signal.

Glossary of Terms

Residual FM. A measure of FM noise (short-term instabilities) of a signal generator's output, as measured with an FM modulation meter. It is a key specification when a generator is used for testing FM radios.

Resolution. The smallest increment in value that can be detected and displayed by a measurement system or displayed and generated by a calibration source.

Rise Time. The time required for the leading edge of a pulse to rise from 10% to 90% of its final value. For an oscilloscope, it equals .25 ÷ analog bandwidth.

RMS (Root-Mean-Square). For voltage or current, the value assigned to a level equal to that of a direct voltage (current) producing the same power dissipation through a pure resistance. "RMS" is also applied to many other parameters.

ROM. Read-only memory. A memory used for permanently recorded computer programs and data.

RS-232C. An EIA-defined standard for a serial communications interface commonly used between computers, terminals, and modems.

Sampling. The process of obtaining a sequence of values of a signal. Sampling may be at regular or intermittent intervals.

Sampling Rate. The number of times that a particular data channel is sampled by a commutator in one second.

Scale. See **Full Scale.**

Scale Error. See **Gain Error.**

Serial Data. Information transmitted one bit at a time at a predefined baud rate.

Serial Port. A physical connector for transmitting and receiving serial data.

Sensitivity. In commercial FM mobile radio: the minimum input signal to a receiver that will produce a 12 dB SINAD.

Sequential Sampling. A form of Repetitive Sampling that takes a single sample of the incoming repetitive signal as each new period of the signal triggers the sampling device, with each sample occurring at progressively increasing time intervals beyond the trigger point. In a DSO, these are stored in memory, and used to reconstruct a lower frequency replica of the incoming signal.

Settling Time. The time interval, following the initiation of a specified stimulus to a system, required for a specified variable to enter and remain within a narrow band, centered on the final value of the variable.

Short. Any connection having relatively low resistance or impedance: an intentional interconnection of terminals for test or calibration purposes, or any resistance between two points below a preselected threshold.

Siemen. Unit of conductance (S), formerly mho, the reciprocal of resistance.

Signal Conditioning. To process the form or mode of a signal so as to make it intelligible to, or compatible with, a given device, including such manipulation as pulse shaping, pulse clipping, digitizing and linearizing.

Signal/Noise Ratio. Ratio of the magnitude of the signal to that of the noise (often expressed in decibels).

SINAD. The Signal plus Noise and Distortion to Noise and Distortion ratio, expressed in dB, measured at the output of a radio receiver with an audio distortion analyzer. Most commercial radio tests are run at 12 dB SINAD. If distortion effects are ignored, it is identical SNR (signal-to-noise ratio).

Slew Rate. The maximum rate of change of the output voltage of an amplifier operated within its linear region.

Software. Computer programs and data recorded in erasable memory. Also see **Firmware**.

Spectral Purity. A general term used to refer to the cleanliness of an RF signal – its freedom from contamination by noise and spurious signals.

Spurious. Unwanted discrete frequencies present on the output of a signal generator, measured relative to carrier level in dBc. Usually this term is taken to mean the "non-harmonic" spurious specification for a signal generator. In the more general sense, spurious refers to all undesired, discrete (non-random) ouputs from a signal generator, including additional harmonics, sub-harmonics, and line-related products.

SSB. Single Sideband, a form of radio used in long-distance military and marine transmissions. It is a modified amplitude modulation, in which the carrier and one sideband have been suppressed to achieve high efficiency.

SSB Phase Noise. A plot of the phase noise spectrum of one side of an RF signal. (Normally the two sides are symmetrical.)

Stability. A measure of the freedom from drift in value over time and over changes in other variables such as temperature. Note that stability is not the same as uncertainty.

Standard Cell. A primary cell which serves as a standard of voltage.

Sweep. The crossing of a range of values of a quantity for the purpose of delineating, sampling, or controlling another quantity.

Sweep Delay. The time between the application of a pulse to the sweep-trigger input of an oscilloscope and the start of the sweep.

Synchronous Data. Information transmitted at predictable times, for example in response to a command. Synchronous data may be in a predetermined block size, and may include a synchronizing clock signal for use by the receiving sytem. Also see **Asynchronous Data**.

System. An interconnection of instruments or other devices.

Systematic Error. Any error which remains constant or varies in a predictable manner as successive measurements of the same quantity are made under effectively identical conditions. Note that a known systematic error can be compensated for with a correction, whereas a random error cannot. Also see **Random Error.**

Temperature Coefficient. A factor used to calculate the change in indication or output of an instrument with changes in temperature. Uncompensated changes in temperature contribute to instrument uncertainty by an amount determined by the temperature coefficient.

Test Uncertainty Ratio. For calibration, the ratio between the absolute uncertainties of a UUT and of the equipment being used to calibrate it. For measurement, the ratio between the specified tolerance of a measurement parameter and the uncertainty of the instrument, process, and traceability used to measure it.

Thermal emf. A voltage generated when two dissimilar metals joined together are heated. This is often an error source in calibration and measurement processes when lower quality terminals and connections are used.

Time Base. A voltage generated by the sweep circuit of a cathode ray tube indicator. Its wave shape is such that the trace is either linear with respect to time, or if nonlinear, is still at a known timing.

Touch Cell. An individual physical switch on the touch panel.

Glossary of Terms

Touchkey. A group of one or more touch cells in conjunction with a visual target that work together as a command entry point for the user. All touch cells in the group are defined by the programmer as a touchkey, so the program recognizes an input from any of the touch cells as the same entry.

Touchkey Programming. All screen-dependent attributes and controls associated with the use of the touch panel and targets.

Touch Panel. The transparent overlay residing in front of the display. The touch panel detects the location of a physical touch against areas of the display.

Traceability. The ability to relate individual measurement results to legally defined national standards through an unbroken chain of comparisons. Traceability requires evidence produced on a continuing basis, such as calibration records, that the measurement process is producing results for which the total measurement uncertainty relative to national standards is quantified.

Transfer Error. Error induced by the process of comparing one standard or instrument with another.

Transfer Standard. Any standard used to intercompare one measurement or source device with another. Note that a transfer standard needs only to be stable for the duration of the transfer. It does not need an assigned value.

Trigger. To cause, by means of one circuit, action to start in another circuit, which then functions for a certain length of time under its own control. A pulse that starts an action.

Trigger Level. The instantaneous level of a triggering signal at which a trigger is to be generated. Also the name of the control which selects the level.

True RMS Option. A circuit used for measuring ac signals to obtain the effective heating value. The rms value of an ac waveform is equivalent to the dc value which would produce the same heating in a purely resistive load. A True RMS circuit makes accurate measurements even if the waveform is nonsinusoidal.

Uncertainty. The range of values, usually centered on the indicated or requested value, within which the true, accepted, or consensus value is expected to lie with stated probability or confidence. Fluke uses 99% confidence limits unless other limits are specified. Uncertainty is a quantification of inaccuracy.

Verification. The comparison of a measurement or source device (UUT) with a measurement or source device of known and lesser uncertainty, to report variation from required performance. Verification does not include adjustment or reassignment of values to UUT, and is often done to determine whether adjustment is necessary. Aslo see **Calibration.**

Vertical Resolution. Minimum change in amplitude that can be detected and captured. Measured in bits, percent of full scale, or absolute.

Video Modulation. Wideband (several Megahertz) amplitude modulation, suitable for simulating television signals.

Volatile Memory. In computers, any memory which can return information only as long as energizing power is applied. The opposite of nonvolatile memory.

Voltage Guard. A floating shield around voltage measurement circuitry inside an instrument. The voltage guard provides a low-impedance path to ground for common-mode noise and ground currents, thereby eliminating errors introduced by such interference.

Zero Error. See **Offset Error.**

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