

1987 CATALOG

Test, Measurement &

Control Instrumentation

FLUKE

Solutions for

Research & Development,

Manufacturing,

Calibration &

Service Worldwide.





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

Fluke gives customers a business edge through better solutions for test, measurement and control problems in research and development, manufacturing, calibration and service applications. Customers around the world depend on us for instrumentation and services to speed product development and evaluation, increase yield in manufacturing, predict performance through expert calibration, and minimize downtime.

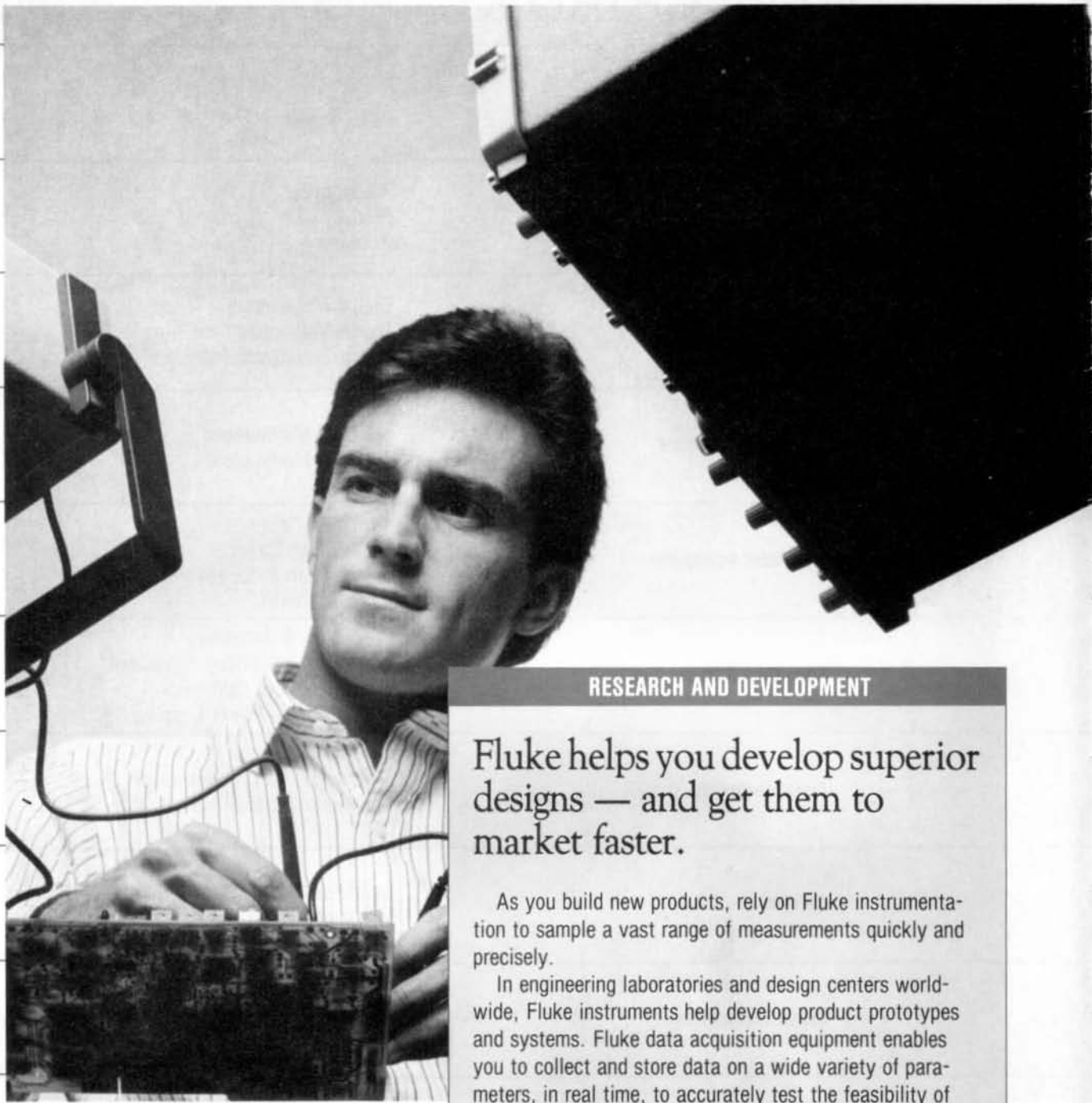
In 1948, we advanced the frontiers of measurement with our first product, an innovative power meter. Since then, we've diversified to offer a wide range of industrial products, often exceeding current demands of accuracy.

Our reputation for quality products is founded on intensive research and rigorous testing from design through manufacturing. Stringent quality programs assure impressive results — giving you a clear competitive advantage. We continue to strive for even more efficient solutions, because our customers expect Fluke instrumentation to grow with them into the future.

Fluke is a world leader in test, measurement and control instrumentation — with headquarters in Everett, Washington, and sales and service to customers in 85 countries.

All our instruments reflect the Fluke commitment to high performance and competitive prices. And we make it easy to buy, rent or lease, with representatives only a phone call away, ready to match our products to your applications.

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Design engineers rely on Fluke for complete solutions to their research and development problems.

RESEARCH AND DEVELOPMENT

Fluke helps you develop superior designs — and get them to market faster.

As you build new products, rely on Fluke instrumentation to sample a vast range of measurements quickly and precisely.

In engineering laboratories and design centers worldwide, Fluke instruments help develop product prototypes and systems. Fluke data acquisition equipment enables you to collect and store data on a wide variety of parameters, in real time, to accurately test the feasibility of R&D ideas. And Fluke's advanced, but economical, bench and system digital multimeters, thermometers, and signal generators confirm design performance on new hardware prototypes.

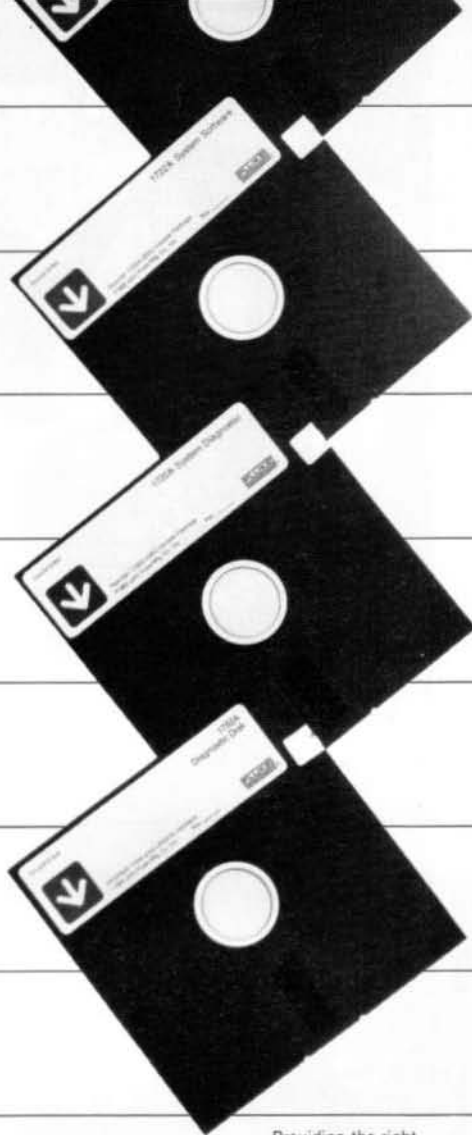
Using Fluke instruments to troubleshoot and verify hardware integrity greatly facilitates the software-hardware integration process, and helps ensure project design schedules are met.

The test philosophy embodied by our Micro-System Troubleshooter also encourages engineers to design for testability, benefiting manufacturing and service operations alike.

There's more to Fluke than just equipment, too. Our worldwide support network assists you in solving problems along the way, ultimately leading you to more precise and more marketable designs.

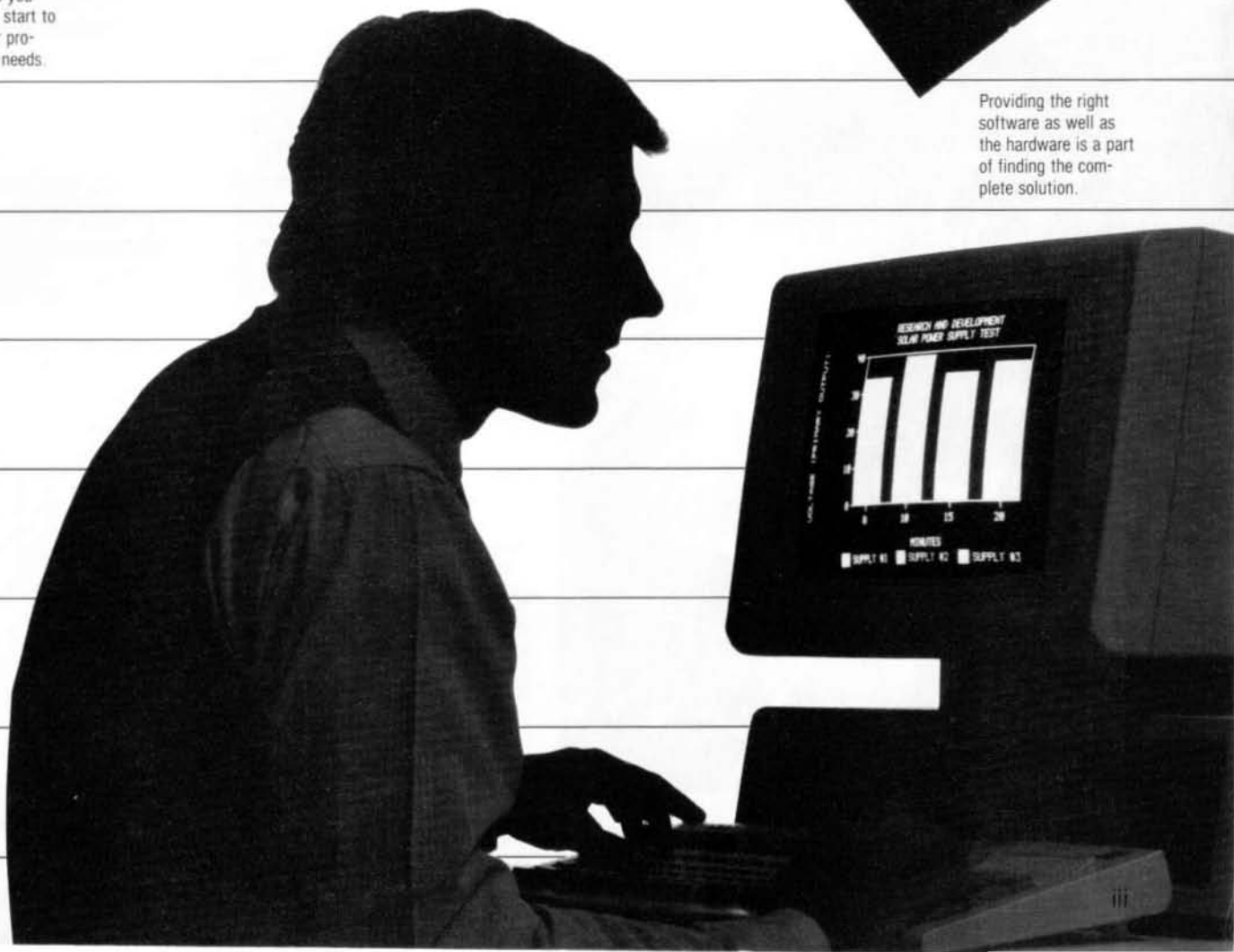


Fluke Customer Support Services can provide you with both applications and maintenance training for your Fluke products.



Our Sales Engineers will work with you right from the start to make sure our products fit your needs.

Providing the right software as well as the hardware is a part of finding the complete solution.





We use our own experience in high quality manufacturing to help you find the right solution for your application.

MANUFACTURING

Fluke brings lab accuracy to the production floor, cutting costs and increasing yield.

At Fluke, we understand the critical nature of manufacturing and are here to help with solutions to give you a better business edge.

You'll find Fluke has the tools you need to precisely measure and regulate a variety of production processes to ensure consistently dependable products. Fluke data loggers and measurement systems gather data on a variety of physical phenomena such as temperature, voltage, current, frequency and pressure to accurately monitor your production line. Our intelligent data acquisition front-ends work with your PC to collect data, perform calculations and then provide control outputs without host computer supervision. And, our innovative Touch Control Screens provide a cost-effective, user-friendly man-machine interface that's easy to use and easy to integrate into your system. For electronics manufacturing, choose from Fluke's variety of instruments to ensure thorough, efficient testing, troubleshooting and quality assurance: from bench instruments for measuring volts, current and resistance to fully automated board test systems for effective digital hardware fault isolation, defects analysis and digital/analog functional testing.

To save you time in program development and system start-up, Fluke also provides software programming services to support your specific application requirements.



Signal generators like the Fluke 6061A are essential for manufacturing marine radio and other communications gear.



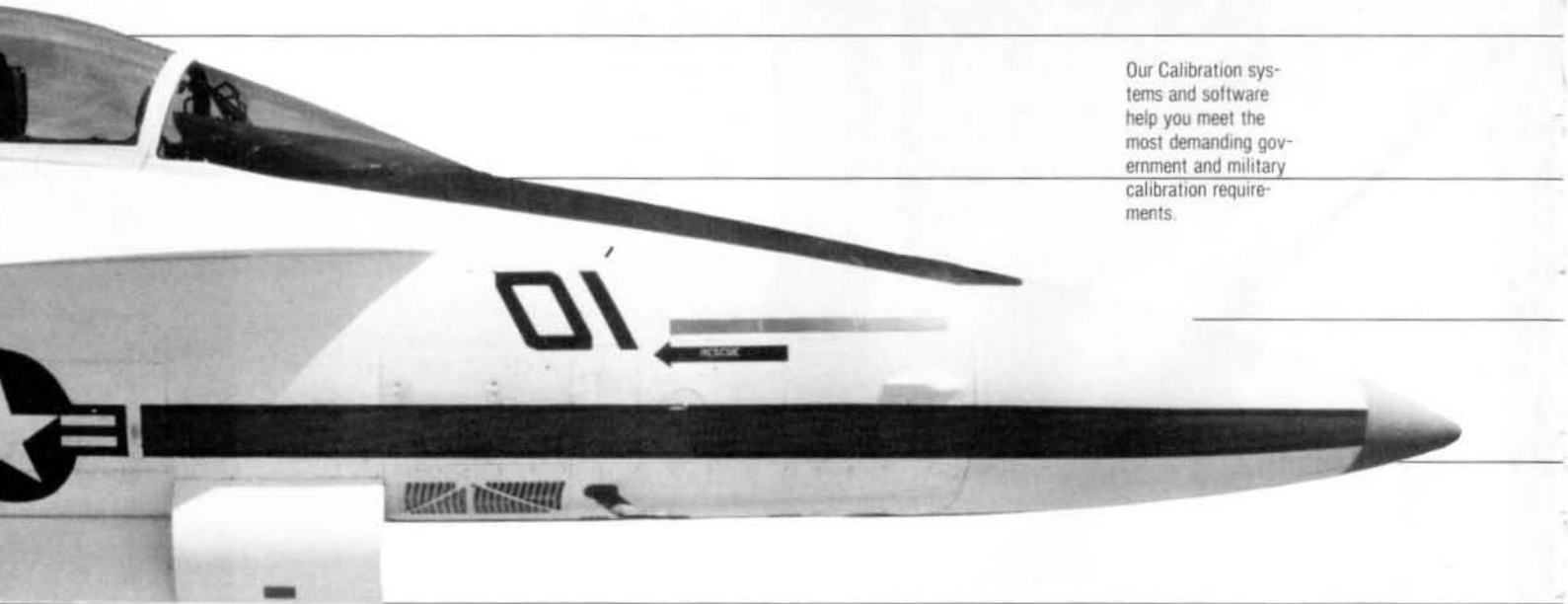
The Fluke 9100 Digital Test System provides you with a low cost method of automated digital troubleshooting, for production test, production troubleshooting, and service.



A final inspection sticker means we're ready to put our name on the product, and back it with the strongest warranty available.



The 1020 Series Touch Control Screen is an ideal operator interface for complex computer-controlled equipment — for everything from industrial applications to critical laboratory work.



Our Calibration systems and software help you meet the most demanding government and military calibration requirements.

Fluke A123 Calibration Systems are custom-configured to exactly meet your calibration needs.



CALIBRATION

Fluke offers you choices for predictable performance —from single calibrators to complete systems and services.

Put the benefits and experience of Fluke calibration to work for you today in your cal lab and on the factory floor. For instruments vital to R&D, production and service, increase the confidence in your calibrations with the known-good accuracy of Fluke calibrators. You'll be assured of high product quality, and lower rework and warranty costs.

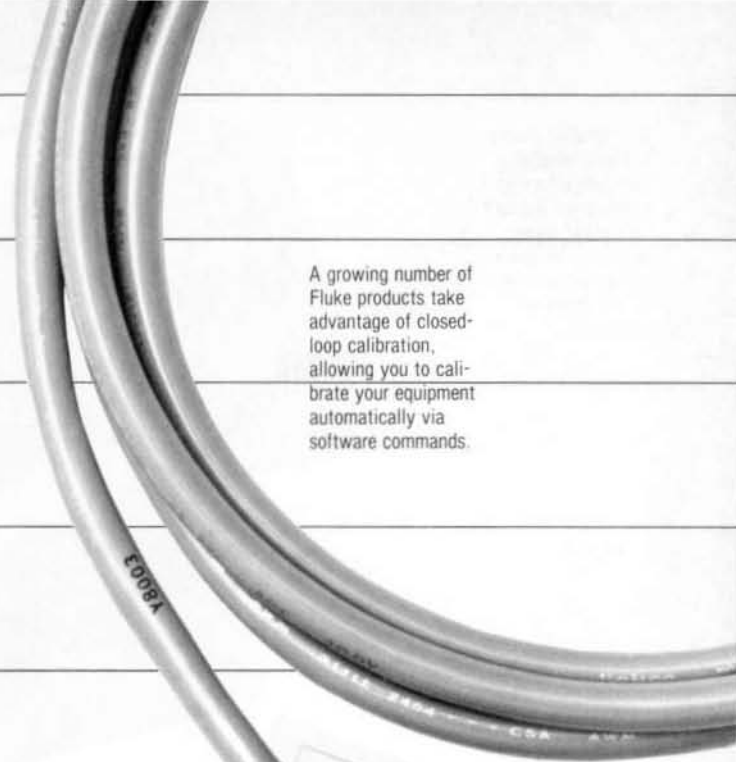
In the future, Fluke's expanded calibration offerings will be compatible to your growing needs, protecting your existing investment in our products, and your calibration procedures.

Fluke calibration products are used worldwide in virtually all major standard and calibration laboratories. And you'll find Fluke's automated calibration clusters and workstations for meter and oscilloscope calibration at work in leading electronic manufacturers.

Our traceability of calibration to NBS is established by the Fluke Standards Laboratory, located at our world headquarters in Everett. This enables us to provide a trustworthy NBS-traceable certificate of calibration with our calibrators.

Fluke's leadership in electrical metrology is also clearly evident in the high level of service and support provided for our customers. Our Direct Voltage Maintenance Program is a cost-effective means to put highly accurate, yet rugged, dc voltage traceability to work for you at your site. Our worldwide Technical Service Centers provide traceable calibration for your equipment. And Fluke seminars and training courses help you use and service our products to their fullest potential.

A growing number of Fluke products take advantage of closed-loop calibration, allowing you to calibrate your equipment automatically via software commands.



Fluke provides you with thorough documentation for all calibration services, traceable to the National Bureau of Standards.



The 5440B is representative of Fluke's commitment to high-accuracy, easy-to-use calibrators.

The Fluke 37 Analog/Digital bench meter gives you advanced measurement capabilities, plus convenience features like a storage compartment for test leads and accessories.



Fluke's 50 Series Digital Thermometers are used in a variety of applications from process monitoring and verification to preventive maintenance.



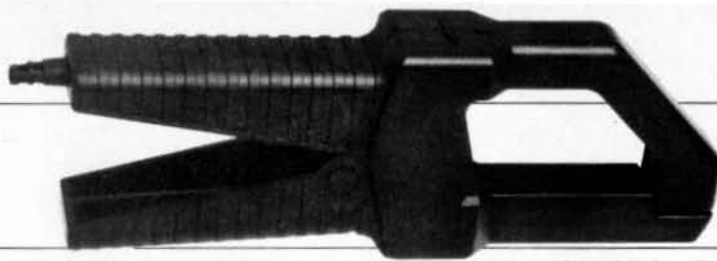
Fluke service tools provide convenience, portability, speed and accuracy.

Used in service depots, industrial plants and in the field, Fluke's durable service equipment performs dependably to reduce downtime and return machinery to top production levels. Our popular digital multimeters, thermometers and accessories give you the accurate tools necessary to do the job right the first time. Fluke signal generators are ideal for telecommunications service. And, for complex applications in service depots, Fluke board testers and troubleshooters minimize the time it takes to repair complex circuit boards.

Fluke is a world leader in instrumentation to solve tough service problems over a wide range of varied applications such as heavy industrial motor controls troubleshooting, automotive and marine electronics service, TV/video/PC repair, and telecommunications. These industrial grade products are also extensively used in educational programs and institutions, and find broad acceptance by hobbyists.

We go to great effort to make our products readily available to all user categories through an extensive network of direct sales offices and authorized industrial distributors worldwide.

Fluke service tools offer premium performance at low cost, and are backed by the longest warranties in the industry.



Over 40 high quality multimeter and thermometer accessories expand the capabilities of our products.



Fluke low-cost products are stocked at leading electronic and electrical distributors worldwide.



The Fluke 70 Series, the first handheld meter with both digital and analog displays, is now used by over 1,000,000 customers.



The Fluke 9000 Series provides you with an efficient, low-cost method of troubleshooting microprocessor-based circuit boards.



CUSTOMER SUPPORT SERVICES

Extending the quality.

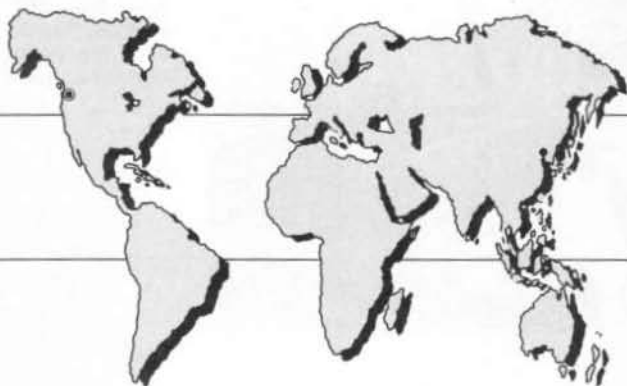
Fluke's Customer Support Services are dedicated to a single goal — providing the best possible service for both our products and our customers. To achieve this goal, we have expanded our range of services to offer you more solutions and flexibility.

Our services include repair and N.B.S. traceable calibration, applications and maintenance training, software and systems integration, and consulting to ensure successful product performance in your application.

In addition, we offer a team we call Fluke Cooperative Services, a network of independent specialists with specialized hardware, software and systems integration expertise that can provide solutions to your unique application problems.

Fluke's worldwide support is based on teamwork and responsiveness in providing professional services that meet your needs.

Your problems are our problems, and we offer consulting services to help you solve them.



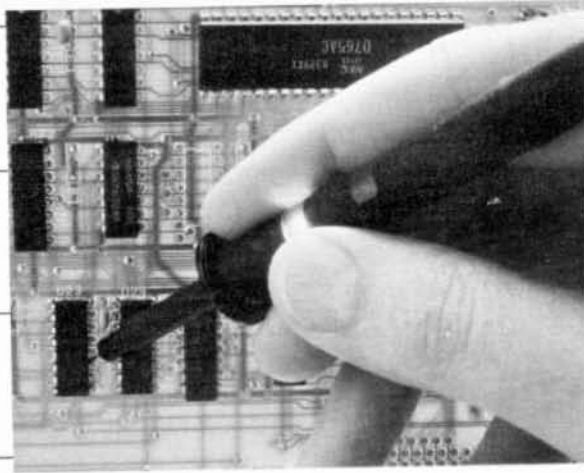
Our maintenance, training and support network reaches around the world, any place and every place that Fluke equipment is sold.



You can get replacement parts within 24 hours using our Modular Exchange Program.



Certificates of Accomplishment are presented to graduates of each Fluke training program.



Maintenance and training courses provide technicians with valuable hands-on experience.



Classroom instruction helps you become acquainted with new test techniques and products, such as the Fluke 9100 Digital Test System.

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Bench/System Multimeters



This category of digital multimeters (DMMs) features all but the Fluke handheld multimeter 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. Also featured is the popular Fluke 8840 Series of 5½-digit multimeters for bench and systems use.

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

For recording measured data, many can also be equipped with output interfaces. See the selection guide on the following page for a comparison of basic specifications and features.



Bench/System Multimeters

Selection Guide

Models	Basic Features			Special Features				Interfaces			DC Volts			AC Volts			AC/DC Amps		Ohms, Etc.			Page		
	Max Number of Digits	Display	Autorangeing	Burst Memory	dB, dBm Readout	Offset/Relative Ref	Touch-Hold	IEEE-488	RS-232-C	Parallel/BCD	Basic 90 Day Accuracy, %	Max Resolution, μ V	Max Voltage, w/o Probe	True-RMS	Basic 90 Day Accuracy, %	Max Resolution, μ V	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, m Ω	Max Resistance, M Ω		Diode Test	Conductance (Low) >20 M Ω
Bench / System Multimeters																								
8505A	7½	LED	(1)	—	—	•	—	▷	▷	▷	0.001	0.1	1200	▷	0.1	1.0	1M	0.1	1.28	0.01	265	—	—	12
8506A	7½	LED	(1)	—	—	•	—	▷	▷	▷	0.001	0.1	1200	•	0.016	1.0	1M	0.1(5)	1.28	0.01	265	—	—	12
8502A	6½	LED	(1)	—	—	•	—	▷	▷	▷	0.001	1.0	1280	▷	0.1	10	1M	1.0	1.28	0.1	262	—	—	18
8520A	5½	LED	(1)	•	▷	•	—	•	—	—	0.005	1.0	1000	•	0.1	10	1M	—	(3)	0.1	20	—	•	21
8522A	5½	LED	(1)	•	•	•	—	—	—	•	0.005	1.0	1000	•	0.1	10	1M	—	(3)	0.1	20	—	•	21
8840A	5½	VF*	(1)	—	—	•	—	▷	—	—	0.004	1.0	1000	▷	0.14	1.0	100k	10k	2.0	1.0	20	—	—	7
8842A	5½	VF*	(1)	—	—	•	—	▷	—	—	0.0025	0.1	1000	▷	0.07	1.0	100k	1k	2.0	0.1	20	—	—	3
8840A/AF	5½	VF*	(1)	—	—	•	—	▷	—	—	0.004	1.0	1000	•	0.14	1.0	100k	10k	2.0	1.0	20	—	—	9
Bench / Portable Multimeters																								
8600A	4½	LED	(1)	—	—	—	—	—	—	▷	0.02	10	1200	—	0.2	10	100k	10	2.0	10	20	—	—	25
8050A	4½	LCD	—	—	•	•	(4)	—	—	—	0.03**	10	1000	•	0.5	10	50k	10	2.0	10	20	•	•	30
8010A	3½	LCD	—	—	—	—	(4)	—	—	—	0.1**	100	1000	•	0.5	100	50k	100	10	100	20	•	•	33
8012A	3½	LCD	—	—	—	—	(4)	—	—	—	0.1**	100	1000	•	0.5	100	50k	100	2.0	1.0	20	•	•	33
Fluke 37	3½	LCD	(1)	—	—	•	•	—	—	—	0.1**	100	1000	—	0.5	100	30k	100	10.0	100	32	•	•	36
Wideband True-RMS AC Digital Voltmeters																								
8920A	3½	LED	(1)	—	•	•	—	▷	—	▷	(2)	(2)	(2)	•	0.5	1.0	20M	—	(3)	—	—	—	—	27
8921A	3½	LED	(1)	—	•	•	—	▷	—	▷	(2)	(2)	(2)	•	0.5	1.0	20M	—	(3)	—	—	—	—	27
8922A	3½	LED	(1)	—	•	•	—	▷	—	▷	(2)	(2)	(2)	•	0.5	1.0	11M	—	(3)	—	—	—	—	27

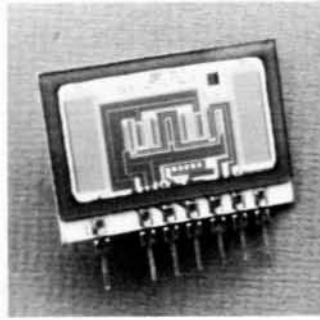
• Standard
▷ Optional
* Vacuum fluorescent

(1) Or manual ranging
(2) Will measure dc in ac-dc mode
** 1-year accuracy

(3) Use 80J-10 or A90 Shunt for up to 10A
(4) Use 80T-H Probe
(5) DC only

See also Handheld Multimeters beginning on page 39

8840 Series



Exclusive Hermetically-Sealed Thin-Film Resistors. Unique to the 8842A are newly designed Hermetically-sealed Thin-Film Resistor Networks,* which give the new 8842A greater resolution, accuracy and stability over time. This significant technological advance has made it possible to increase the instrument's calibration cycle and warranty period to two years.

By changing the design of the resistor network, temperature induced drift has been reduced by a factor of five. A new process now makes it possible to reduce long-term aging effects by a factor of three. Hermetically sealing the resistor networks makes them impervious to change induced by moisture or humidity.

*Patent pending

IEEE-488

2

Designed for both system and benchtop applications, the Fluke 8840 Series delivers new standards of accuracy, autoranging, speed, resolution and convenience in 5½-digit DMMs. Fluke has made these products easy to use by incorporating bright, readable vacuum-fluorescent displays. Plus, the uncluttered front panels have been designed for one-button-per function and one-button-per range operation. The 8840A and 8842A autorange faster than other DMMs in their class, and both utilize a special Fluke-patented recirculating-remainder A/D converter to compare input voltage to a stable voltage reference for high speed, accurate measurements.



8842A

8840A Series: 5½-Digit Multimeters

- Basic 1-year dc accuracies to 0.003%
- Ohms and dc current standard
- Ac voltage and current optional
- Full system capability with optional 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 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 new 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 rack-mount 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 design 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.

Digital Multimeters

8840 Series

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



8842A

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 TFRs make possible:

- **Increased measurement power:**
100 nV resolution with a 20 mV range
1 μ A resolution with a 200 mA range
100 $\mu\Omega$ resolution with a 20 Ω 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
0.008% basic Ω accuracy at 1 year
- **Extended at cal cycles, with 2 year specifications**
0.005% basic dc accuracy at 2 years
- **Two year warranty**
See next page for detailed 8842A specifications.



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

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. See page 7 for detailed specifications.



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

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
- DC/DC ratio capability in lieu of front/rear inputs
- True rms ac voltage/current capability is standard
- 1000V rms ac maximum allowable input
- Enhanced EMI/RFI protection.

National Stock Number is 6625-01-196-0014. Fluke's one year warranty applies. See page 9 for detailed specifications.

8842A Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½ Digits*	
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	1.99999V	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 Rate: ±(% 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 ⁴	Analog & Digital	>98 dB	20V or 2 x FS ⁴	>140 dB
M	20 ⁶	Digital	>45 dB	1 x FS	>100 dB
F	100	None	—	1 x FS	>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 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 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 20 mV, 20 Ω, 200 mA dc ranges.

True-RMS AC Voltage (Option 8842A-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		5½ Digits	4½ Digits*	
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	

*4½-digits at the fastest reading rate.

Accuracy

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

For sinewave inputs ≥10,000 counts¹

Frequency (Hz)	24 Hours ² 23±1°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
(2V-200V)	0.05 + 80	0.07 + 80	0.08 + 80	0.15 + 80
(700V)	0.06 + 100	0.08 + 100	0.10 + 100	0.20 + 100
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200	0.25 + 250
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400	0.5 + 500

¹ For sinewave inputs between 1,000 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

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 and 20 kHz to 50 kHz	0.2	0.7	1.5

Operating Characteristics

Maximum Input: 700V rms, 1000V peak or 2 x 10⁷ Volts-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		
	20-20k	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

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 Digits*
200 mA	199.999 mA	1 µA	10 µA
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)

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

Digital Multimeters

8840 Series

AC Accuracy (Requires Option 8842A-09)

Normal (S) Reading Rate: \pm (% of Reading + Number of Counts)
23 \pm 5°C, for sine wave inputs \geq 10,000 counts

	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 sine wave inputs \geq 1000 4½ digit counts and frequencies >100 Hz, the accuracy is \pm (0.2% of reading + 30 counts)

Nonsinusoidal Inputs: For nonsinusoidal inputs \geq 10,000 counts with frequency components \leq 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 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 specification 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 ¹	
20 Ω ²	19.9999 Ω	0.1 m Ω	1 m Ω	1 mA
200 Ω	199.999 Ω	1 m Ω	10 m Ω	1 mA
2 k Ω	1.99999 k Ω	10 m Ω	100 m Ω	1 mA
20 k Ω	19.9999 k Ω	100 m Ω	1 Ω	100 μ A
200 k Ω	199.999 k Ω	1 Ω	10 Ω	10 μ A
2000 k Ω	1999.99 k Ω	10 Ω	100 Ω	5 μ A
20 M Ω	19.9999 M Ω	100 Ω	1 k Ω	0.5 μ A

¹ 4½ digits at the fastest reading rate

² 4-wire ohms only

Accuracy

Normal (S) Reading Rate: \pm (% of Reading + Number of Counts)¹

Range	24 Hour ² 23 \pm 1°C	90 Day 23 \pm 5°C	1 Year 23 \pm 5°C	2 Year 23 \pm 5°C
20 Ω ³	0.007 + 30	0.009 + 40	0.012 + 40	0.015 + 40
200 Ω	0.0040 + 3	0.007 + 4	0.010 + 4	0.012 + 4
2 k Ω	0.0025 + 2	0.005 + 3	0.008 + 3	0.010 + 3
20 k Ω	0.0025 + 2	0.005 + 3	0.008 + 3	0.010 + 3
200 k Ω	0.0025 + 2	0.006 + 3	0.010 + 3	0.012 + 3
2000 k Ω	0.023 + 3	0.025 + 3	0.027 + 3	0.030 + 3
20 M Ω	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 200 Ω through 200 k Ω ranges, 3 counts for the 2000k Ω and 20 M Ω ranges, and 20 counts for the 20 Ω range. In fast

reading rate, use three 4½ digit for the number of counts for the 200 Ω range, 20 4½ digit counts for the 20 Ω 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 (20 Ω range is 4-wire only)

Open Circuit Voltage: Less than 6.5V on the 20 Ω through 200 k Ω ranges. Less than 13V on the 2000 k Ω and 20 M Ω 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, 20 Ω , 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.

General Specifications

Option -05 IEEE-488 Interface Function: 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

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 to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac \pm 10% (250V ac maximum), switch selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type II, Class 3, Style E equipment

Safety: ANSI C39.5 and IEC 348, Class I

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: Two years

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide and instrument performance verification record

Model

8842A* Digital Multimeter

*Option -09 needed to measure ac

Options

8842A-05 IEEE-488 Interface

8842A-05K Field Installable IEEE-488 Interface

8842A-09 True-RMS AC

8842A-09K Field Installable True-RMS AC

Accessories (Also see page 63)

Y8834 Single Rack Mount Kit

Y8835 Dual Rack Mount Kit

Y8836 Center Rack Mount Kit

Y8021 1m IEEE-488 Shielded Cable

Y8022 2m IEEE-488 Shielded Cable

Y8023 4m IEEE-488 Shielded Cable

Y8077 Four Terminal Short

A90 6-Range Current Shunt

8840A Specifications

DC Voltage Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½ Digits	
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.99999V	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 Rate: ±(% of Reading + Number of Counts)

Range	24 Hour* 23±1°C	90 Day 23±5°C	1 Year 23±5°C
200 mV**	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

*Relative to calibration standards.

**Using Offset control

Medium and Fast Rates: In medium rate, add 2 counts to number of 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, 60 or 400 Hz

Rate	Readings/Second ¹	Filter	NMRR ²	Peak NM Signal	CMRR ³
S	2.5	Analog & Digital	>98 dB	20V or 2 x FS ⁴	>140 dB
M	20	Digital	>45 dB	1 x FS	>100 dB
F	100	None	—	1 x FS	>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 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 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 (8840A-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		5½ Digits	4½ Digits*	
200 mV	199.999 mV	1 µV	10 µV	1 MΩ
2V	1.99999V	10 µV	100 µV	shunted by
20V	19.9999V	100 µV	1 mV	<100 pF
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 Rate: ±(% of Reading + Number of Counts)

For sinewave inputs ≥10,000 counts¹

Frequency (Hz)	24 Hours 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
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400

¹ For sinewave inputs between 1,000 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 Reading 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		
	20-20k	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

Digital Multimeters

8840 Series

Nonsinusoidal Inputs: For nonsinusoidal inputs $\geq 10,000$ counts with frequency components ≤ 100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	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 and 20 kHz to 50 kHz	0.2	0.7	1.5

*Crest Factor

Maximum Input: 700V rms, 1000V peak or 2×10^7 Volts-Hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 k Ω in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution	
		5½ Digits	4½ Digits*
2000 mA	1999.99 mA	10 μ A	100 μ A

*4½ digits at the fastest reading rate.

DC Accuracy

Normal (S) Reading Rate: \pm (% of Reading + Number of Counts)

Current	90 Days 23 \pm 5°C	1 Year 23 \pm 5°C
≤ 1 A	0.04 + 4	0.05 + 4
>1 A	0.1 + 4	0.1 + 4

Medium and Fast Reading Rates: In medium reading rate, *add* 2 counts to number of counts. In fast reading rate, *use* two 4½ digit counts for number of counts

AC Accuracy (Requires Option 8840A-09)

Normal (S) Reading Rate: \pm (% of Reading + Number of Counts)

1 Year, 23 \pm 5°C, for sine wave inputs $\geq 10,000$ counts

Frequency in Hertz		
20-45	45-100	100-5k*
2.0 + 200	0.5 + 200	0.4 + 200

*Typically 20 kHz

Medium and Fast Reading Rates: In medium rate, *add* 50 counts to number of counts. In fast reading rate, for sine wave inputs ≥ 1000 4½ digit counts and frequencies >100 Hz, the accuracy is \pm (0.2% of reading + 30 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

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*	
200 Ω	199.999 Ω	1 m Ω	10 m Ω	1 mA
2 k Ω	1.99999 k Ω	10 m Ω	100 m Ω	1 mA
20 k Ω	19.9999 k Ω	100 m Ω	1 Ω	100 μ A
200 k Ω	199.999 k Ω	1 Ω	10 Ω	10 μ A
2000 k Ω	1999.99 k Ω	10 Ω	100 Ω	5 μ A
20 M Ω	19.9999 M Ω	100 Ω	1 k Ω	0.5 μ A

*4½ digits at the fastest reading rate

Accuracy

Normal (S) Reading Rate: \pm (% of Reading + Number of Counts)¹

Range	24 Hour ² 23 \pm 1°C	90 Day 23 \pm 5°C	1 Year 23 \pm 5°C
200 Ω	0.004 + 3	0.011 + 4	0.014 + 4
2 k Ω	0.0028 + 2	0.01 + 3	0.013 + 3
20 k Ω	0.0028 + 2	0.01 + 3	0.013 + 3
200 k Ω	0.0028 + 2	0.01 + 3	0.013 + 3
2000 k Ω	0.023 + 3	0.027 + 3	0.028 + 3
20 M Ω	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 200 Ω through 200 k Ω ranges and 3 counts for the 2000 k Ω and 20 M Ω ranges. In fast reading rate, *use* for the number of counts three 4½ digit counts for the 200 Ω 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 200 Ω through 200 k Ω ranges. Less than 13V on the 2000 k Ω and 20 M Ω ranges

Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency ¹		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

¹Sensed automatically at power-up

General Specifications

Option -05 IEEE-488 Interface Function: 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

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 to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac \pm 10% (250V ac maximum), switch selectable at rear panel; 50, 60, 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 x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: One year

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, instrument performance verification record, and serialized/dated calibration certification sheet

Model

8840A* Digital Multimeter

*Option -09 needed to measure ac

Options

8840A-05 IEEE-488 Interface

8840A-05K Field Installable IEEE-488 Interface

8840A-09 True-RMS AC

8840A-09K Field Installable True-RMS AC

Accessories (Also see page 63)

- Y8834** Single Rack Mount Kit
- Y8835** Dual Rack Mount Kit
- Y8836** Center Rack Mount Kit
- Y8021** 1m IEEE-488 Shielded Cable
- Y8022** 2m IEEE-488 Shielded Cable
- Y8023** 4m IEEE-488 Shielded Cable
- Y8077** Four Terminal Short
- A90** 6-Range Current Shunt

Also see page 284 for more accessory information.

Service & Support

Operating Characteristics

Temperature Coefficient: $\pm(0.0006\%$ 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	Analog & Digital	>98 dB	20V or 2 x FS ⁴	>140 dB
M	20	Digital	>45 dB	1 x FS	>100 dB
F	100	None	—	1 x FS	>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 or 60 Hz $\pm 0.1\%$. The NMRR for 400 Hz $\pm 0.1\%$ is 85 dB in S rate and 35 dB in M rate

³ Common Mode Rejection Ratio at 50 or 60 Hz $\pm 0.1\%$, with 1 k Ω 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

DC Voltage Ratio Input Characteristics

Range	Full Scale 5 1/2 Digits	Input Voltage		Reference Voltage	
		Full Scale	Input Resistance	Range	Input Resistance
200m*	199.999m DC*	199.999mV dc	$\geq 10,000 \text{ M}\Omega$	From +1V dc to +19.999V dc	$\geq 10,000 \text{ M}\Omega$
2	1.99999 DC	1.99999V dc	$\geq 10,000 \text{ M}\Omega$		
20	19.9999 DC	19.9999V dc	$\geq 10,000 \text{ M}\Omega$		
200	199.999 DC	199.999V dc	$\geq 10 \text{ M}\Omega$		
1000	1000.00 DC	1000V dc	$\geq 10 \text{ M}\Omega$		

*The "m" (milli) annunciator lights to indicate a 10^{-3} multiplier. Divide the displayed number by 1000 to obtain the actual ratio of the two voltages.

Accuracy:

\pm (Percentage of Reading + Number of Counts) for 1 year

Reference Voltage	Temperature	
	20°C to 30°C	0°C to 55°C
+10V <VREF <+20V	0.01 + 5	0.04 + 15
+1V \leq VREF \leq +10V	$(0.01 + 5) \times \frac{10V}{VREF}$	$(0.04 + 15) \times \frac{10V}{VREF}$

Operating Characteristics

Maximum Input: 1000V dc or rms ac on any range

Note: The INPUT LO terminal must be connected to the REFERENCE LO terminal. If these terminals are not connected together, inaccurate readings may result. These terminals are not connected together internally.

Reading Rates: Readings Per Second (With Internal Trigger)

Rate	Power Line Frequency		
	50 Hz	60 Hz	400 Hz
S	1	1.2	1.1
M	5.4	6.5	6.1
F	12.6	12.6	12.6

True-RMS AC Voltage Input Characteristics

Range	Full Scale 5 1/2 Digits	Resolution		Input Impedance
		5 1/2 Digits	4 1/2 Digits*	
200 mV	199.999 mV	1 μ V	10 μ V	1 M Ω
2V	1.99999V	10 μ V	100 μ V	shunted by
20V	19.9999V	100 μ V	1 mV	by
200V	199.999V	1 mV	10 mV	<100 pF
1000V	1000.00V	10 mV	100 mV	

*4 1/2-digits at the fastest reading rate.

8840A/AF Specifications

DC Voltage Input Characteristics

Range	Full Scale 5 1/2 Digits	Resolution		Input Resistance
		5 1/2 Digits	4 1/2 Digits*	
200 mV	199.999 mV	1 μ V	10 μ V	$\geq 10,000 \text{ M}\Omega$
2V	1.99999V	10 μ V	100 μ V	$\geq 10,000 \text{ M}\Omega$
20V	19.9999V	100 μ V	1 mV	$\geq 10,000 \text{ M}\Omega$
200V	199.999V	1 mV	10 mV	10 M Ω
1000V	1000.00V	10 mV	100 mV	10 M Ω

*4 1/2-digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: \pm (% of Reading + Number of Counts)

Range	24 Hour* 23 \pm 1°C	90 Day 23 \pm 5°C	1 Year 23 \pm 5°C
200 mV**	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

*Relative to calibration standards

**Using Offset control

Medium and Fast Rates: In medium rate, add 2 counts to number of counts. In fast rate, use two 4 1/2 digit counts

Digital Multimeters

8840A Series

Accuracy

Normal (S) Reading Rate: $\pm(\%$ of Reading + Number of Counts)

For sinewave inputs $\geq 10,000$ counts¹

Frequency (Hz)	24 Hour ² 23 \pm 1 $^{\circ}$ C	90 Day 23 \pm 5 $^{\circ}$ C	1 Year 23 \pm 5 $^{\circ}$ 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
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400

¹ For sinewave inputs between 1,000 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 Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥ 1000 4 $\frac{1}{2}$ digit counts and >100 Hz

Operating Characteristics

Temperature Coefficient: $\pm(\%$ of Reading + Number of Counts) per $^{\circ}$ C, 18 $^{\circ}$ C to 0 $^{\circ}$ C and 28 $^{\circ}$ C to 50 $^{\circ}$ C

For Inputs	Frequency in Hz		
	20-20k	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

Crest Factor

Nonsinusoidal Inputs: For nonsinusoidal inputs $\geq 10,000$ counts with frequency components ≤ 100 kHz, and the following % of reading to the accuracy specifications

Fundamental Frequency	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 and 20 kHz to 50 kHz	0.2	0.7	1.5

Maximum Input: 1000V rms, or 2 x 10⁷ Volts-Hertz product (whichever is less) for any range

Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 k Ω in either lead

Current

Input Characteristics

Range	Full Scale 5 $\frac{1}{2}$ Digits	Resolution	
		5 $\frac{1}{2}$ Digits	4 $\frac{1}{2}$ Digits*
2000 mA	1999.99 mA	10 μ A	100 μ A

*4 $\frac{1}{2}$ -digits at the fastest reading rate

DC Accuracy

Normal (S) Reading Rate: $\pm(\%$ of Reading + Number of Counts)

Current	90 Days 23 \pm 5 $^{\circ}$ C	1 Year 23 \pm 5 $^{\circ}$ C
≤ 1 A	0.04 + 4	0.05 + 4
>1 A	0.1 + 4	0.1 + 4

Medium and Fast Reading Rates: In medium reading rate, add 2 counts to number of counts. In fast reading rate, use two 4 $\frac{1}{2}$ digit counts for number of counts

AC Accuracy

Normal (S) Reading Rate: $\pm(\%$ of Reading + Number of Counts)

1 Year, 23 \pm 5 $^{\circ}$ C, for sinewave inputs $\geq 10,000$ counts

Frequency in Hertz		
20-45	45-100	100-5k*
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 counts and frequencies >100 Hz, the accuracy is $\pm(0.2\%$ of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per $^{\circ}$ C from 18 $^{\circ}$ C to 0 $^{\circ}$ C and 28 $^{\circ}$ C to 50 $^{\circ}$ 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	Resolution			Current Through Unknown
	Full Scale 5 $\frac{1}{2}$ Digits	5 $\frac{1}{2}$ Digits	4 $\frac{1}{2}$ Digits*	
200 Ω	199.999 Ω	1 m Ω	10 m Ω	1 mA
2 k Ω	1.99999 k Ω	10 m Ω	100 m Ω	1 mA
20 k Ω	19.9999 k Ω	100 m Ω	1 Ω	100 μ A
200 k Ω	199.999 k Ω	1 Ω	10 Ω	10 μ A
2000 k Ω	1999.99 k Ω	10 Ω	100 Ω	5 μ A
20 M Ω	19.9999 M Ω	100 Ω	1 k Ω	0.5 μ A

*4 $\frac{1}{2}$ -digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: $\pm(\%$ of Reading + Number of Counts)¹

Range	24 Hour ² 23 \pm 1 $^{\circ}$ C	90 Day 23 \pm 5 $^{\circ}$ C	1 Year 23 \pm 5 $^{\circ}$ C
200 Ω	0.004 + 3	0.011 + 4	0.014 + 4
2 k Ω	0.0028 + 2	0.01 + 3	0.013 + 3
20 k Ω	0.0028 + 2	0.01 + 3	0.013 + 3
200 k Ω	0.0028 + 2	0.01 + 3	0.013 + 3
2000 k Ω	0.023 + 3	0.027 + 3	0.028 + 3
20 M Ω	0.023 + 3	0.043 + 4	0.044 + 4

¹Using Offset control

²Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200 Ω through 200 k Ω ranges and 3 counts for the 2000 k Ω and 20 M Ω ranges. In fast reading rate, use for the number of counts three 4 $\frac{1}{2}$ digit counts for the 200 Ω range and two 4 $\frac{1}{2}$ digit counts for all other ranges

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per $^{\circ}$ C from 18 $^{\circ}$ C to 0 $^{\circ}$ C and 28 $^{\circ}$ C to 50 $^{\circ}$ C

Measurement Configuration: 2-wire or 4-wire

Open Circuit Voltage: Less than 6.5V on the 200 Ω through 200 k Ω ranges. Less than 13V on the 2000 k Ω and 20 M Ω 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

General Specifications

IEEE-488 Interface Function: Option allows complete control of functions and ranges except DC ratio and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

Common Mode Voltage: 1000V dc or 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% -0%

EMI: Complies with CE01 (relaxed 20 dB), CE03 (relaxed 10 dB), CS01, CS02, CS06, and RE02 (relaxed 10 dB) 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: 100, 120, 220, or 240V ac $\pm 10\%$ (250V ac maximum), switch selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type II, Class 3, Style B equipment

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.47 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Included: 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

Model

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

Options

8840A-05 IEEE-488 Interface

8840A-05K Field Installable IEEE-488 Interface

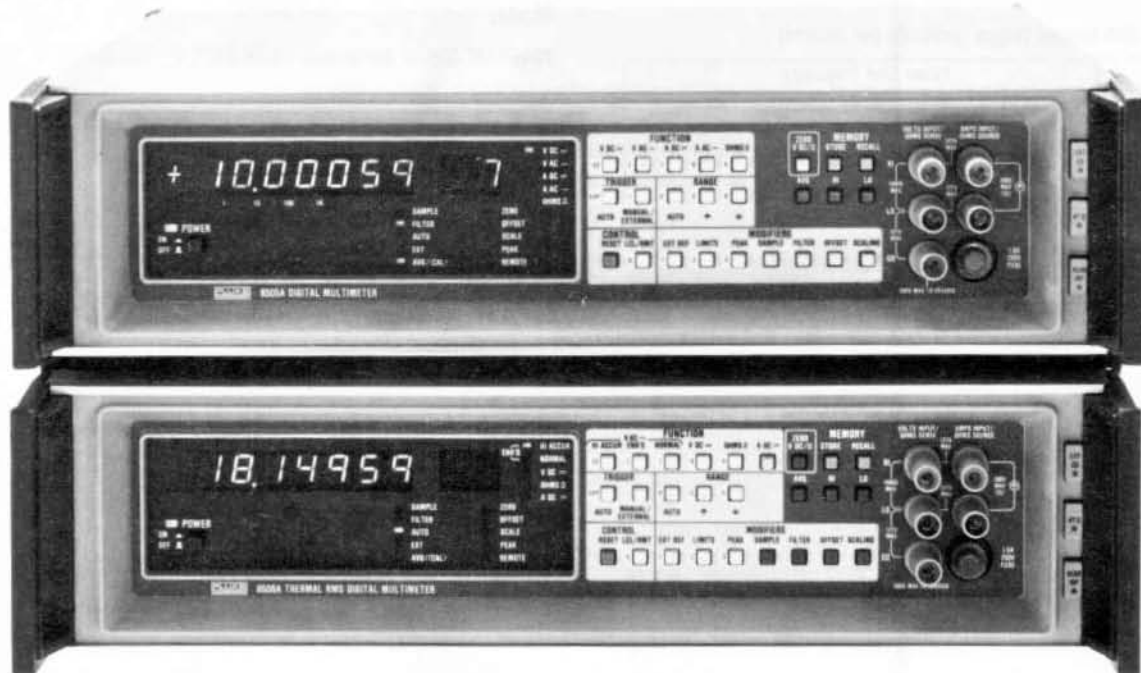
Service & Support

Digital Multimeters

8506A/8505A

IEEE-488

RS-232



8506A (NSN 6625-01-234-4134)

8506A/8505A

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 hour 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.

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
- 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

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 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 \pm 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 \pm offset, and

Y = the numerical result

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

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 (6½ Digits)	Resolution		Input Resistance
		7½ Digits*	6½ Digits	
100 mV	200.0000 mV	—	100 nV	$\geq 10,000 \text{ M}\Omega$
1V	2.000000V	—	1 μV	$\geq 10,000 \text{ M}\Omega$
10V	20.00000V	1 μV	10 μV	$\geq 10,000 \text{ M}\Omega$
100V	128.0000V	—	100 μV	10 M Ω
1000V	1200.000V	—	1 mV	10 M Ω

*In AVG operating mode

Accuracy, Normal Mode, 6½ Digits: \pm (% of Rdg + Counts)

Range	24 Hours* 23°C $\pm 1^\circ\text{C}$	Long Term, 18°C to 28°C	
		Up to 90 Days	Add per Month 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 four-hour warm-up and within 1 hour of zeroing dc

**Whichever is greater

Accuracy, AVG Mode, 6½ Digits: \pm (% of Rdg + Counts)

Range	24 Hours* 23°C $\pm 1^\circ\text{C}$	Long Term, 18°C to 28°C	
		Up to 90 Days	Add per Month Over 90 Days
100 mV	0.0010 + 8	0.0020 + 8	0.0001 + 0.1
1V	0.0005 + 4	0.0012 + 6	0.0001 + 0.1
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 and within 1 hour of zeroing dc

**7½-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	
	6½ Digits	7½ 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: \pm (% of Rdg + Counts)/°C

Range	18°C to 0°C and 28°C to 50°C	
	6½ Digits	7½ Digits
100 mV	0.0003 + 5	0.0003 + 50
1V	0.0003 + 1	0.0003 + 10
10V	0.0002 + 0.5	0.0002 + 5
100V	0.0003 + 1	0.0003 + 10
1000V	0.0003 + 0.5	0.0003 + 5

Input Bias Current

At Time of Adjustment	1 Year 23°C $\pm 1^\circ\text{C}$	Temperature Coefficient
$< \pm 5 \text{ pA}$	$< \pm 30 \text{ pA}$	$< \pm 1 \text{ pA}/^\circ\text{C}$

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 k Ω 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
Bypassed	F1	2 ms	20 ms
Fast	F0 or F3	40 ms	50 ms
Slow	F or F2	400 ms	500 ms

Digital Multimeters

8506A/8505A

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: $\pm 1200V$ 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: $>10,000 M\Omega$ between Ext Ref HI and LO and between either Ext Ref HI or LO and Ohms Guard or Sense LO

Max. Reference Voltage: $\pm 40V$ between Ext Ref HI and LO terminals providing neither terminal is greater than $\pm 20V$ relative to the Sense LO or Ohms Guard terminal

Min. Reference Voltage: $\geq 0.0001V$ when comparing voltage or current, and $\geq 0.0001V$ 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) $<4 k\Omega$. Total resistance to Sense LO from either Ext Ref HI or LO $<20 k\Omega$

Overload Voltage: $\pm 180V$ dc or peak ac relative to Ohms Guard or Sense LO. $\pm 360V$ 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
$\pm 20V$ to $\pm 40V$	$\pm(A + B + 0.001\%)$
$\pm V_{min}$ to $\pm 20V$	$\pm(A + B + (0.02\% \div V_{xref}))$

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

$|V_{xref}|$ = 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.

Input Characteristics

Range	Full Scale (5½ Digits)	Resolution		Input Impedance
		6½ Digits*	5½ Digits	
100 mV	125.000 mV	—	1 μV	1 M Ω $\pm 1\%$ shunted by <180 pF
300 mV	400.000 mV	—	1 μV	
1V	1.25000V	1 μV	10 μV	
3V	4.00000V	1 μV	10 μV	
10V	12.5000V	10 μV	100 μV	
30V	40.0000V	10 μV	100 μV	
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.

Autorangeing: Upranges when input is higher than full scale. Downranges when reading is less than approximately 28% of full scale.

Accuracy, High-Accuracy Mode: \pm (% of Reading)

24 Hours, 23°C $\pm 1^\circ C$

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	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
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*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	>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

Stability: 40 Hz to 20 kHz, $<1^\circ C$ Temperature Change

Range	\pm (% of Rdg + Counts)*	
	24 Hours	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

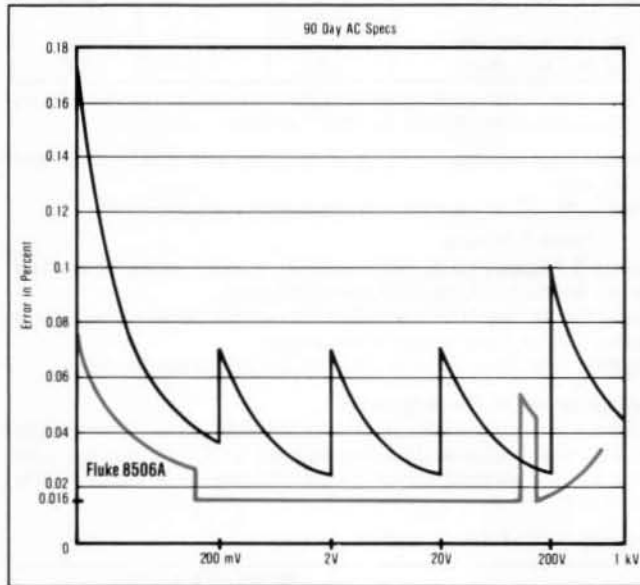
*For 5½-digit resolution

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 1x10⁷ volt-hertz product

DC-Coupled (AC+DC) Accuracy: ±(1.1 times the appropriate ac-coupled specifications + a calculated "Adder" from the following table)



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.

Range	Adder
100 mV to 1V	±(150 μV x (dc volts/total rms volts))
3V and 10V	±(1 mV x (dc volts/total rms volts))
30V and 100V	±(10 mV x (dc volts/total rms volts))
500V	±(50 mV x (dc volts/total rms volts))

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

Notes:

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.

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 (5½ Digits)	Resolution*		Current Through Unknown
		6½ Digits	5½ Digits	
10Ω	20.0000Ω	10 μΩ	100 μΩ	10 mA
100Ω	200.000Ω	100 μΩ	6½ Digits Only	10 mA
1 kΩ	2.00000 kΩ	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, 5½ or 6½ digits depending on range. In AVG operating mode, 6½ digits on all ranges.

Open Circuit Voltage: 7V maximum from 10Ω through 100k 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, 5½ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term, 18°C to 28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Days Add to % of Rdg	
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 6½-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 (5½ Digits)	Resolution		Voltage Burden
		6½ Digits*	5½ Digits	
100 μA	250.000 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 5½ digits only

Digital Multimeters

8506A/8505A

Accuracy, 5½ Digits: $\pm(\% \text{ of Rdg} + \text{Counts})^{**}$

Range	24 Hours 23°C $\pm 1^\circ\text{C}$	Long Term, 18°C to 28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Days Add to % of Rdg	
100 μA	0.02 + 10	0.03 + 10	0.0022	0.0025 + 0.6
1 μA	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 μA	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 6½-digit display, multiply number of counts by 10

Overload: 1.5A maximum, $\pm 140\text{V}$ 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 a DEC PDP11 minicomputer interfaces (DRIIC and DRVII). 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

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

Input Characteristics (-09A and -01)

Range	Full Scale (5½ Digits)	Resolution		Input Impedance
		6½ Digits*	5½ Digits	
1V	2.50000	1 μV	10 μV	M Ω
10V	20.0000	10 μV	100 μV	shunted
100V	160.000	100 μV	1 mV	by
1000V	1000.00	1 mV	10 mV	<100 pF

* In AVG operating mode

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.

Accuracy: $\pm(\% \text{ of Rdg} + \% \text{ of Full Scale})^*$

Frequency	90 Days, 18°C to 28°C		
	% of Rdg	% Full Scale	
		(AC)	(AC + DC)
DC	0.1	—	0.03
10 Hz to 20 Hz	1.0	0.04	0.06
20 Hz to 50 Hz	0.5	0.012	0.03
50 Hz to 10 kHz	0.1	0.012	0.03
10 kHz to 30 kHz	0.2	0.04	0.06
30 kHz to 50 kHz	0.3	0.1	0.12
50 kHz to 100 kHz	1.0	0.3	0.3
100 kHz to 300 kHz	2.0	0.5	0.5
300 kHz to 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: $(200 + \text{reading}) \div 2000$

Common Mode Rejection: >120 dB, dc to 60 Hz, with 100 Ω unbalance in either lead

Crest Factor: >7 at full scale, increasing down scale by

$$7x \sqrt{V_{\text{Range}} \div V_{\text{Reading}}}$$

Voltage & Frequency Limits: 1×10^7 volt-hertz product for the 1V and 10V ranges and 2×10^7 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 voltages. See 8506A specifications

Average-Sensing AC Voltage Option (-01)

All average-sensing ac voltage accuracy and stability specifications apply to a 5½-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.

Accuracy: $\pm(\% \text{ of Rdg} + \text{Counts})^*$

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 Hz to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 kHz to 40 kHz	—	0.15 + 5
10 kHz to 50 kHz**	0.1 + 5	—
50 kHz to 100 kHz**	0.5 + 5	—

* Slow filter must be used below 400 Hz. For 6½-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 100 Ω inbalance in either lead

Voltage and Frequency Limits: 1000V rms (1400V peak) or 2×10^7 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 step change within a range

Digitizing Time: Same as for dc voltages. See 8506A specifications

Resistance Option (-02A)

Same specifications as for 8506A

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: \pm (% of Rdg + Counts)*

Range	Frequency	90 Days, 23°C \pm 5°C	
		Option -01	Option -09A
100 μ A	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 kHz-100 kHz	0.24 + 55	—
1A	10 Hz-20 Hz	—	1.0 + 160
	20 Hz-50 Hz	0.5 + 65	0.5 + 90
	50 Hz-10 kHz	0.24 + 65	0.26 + 90

* With 5½ digit display. For 6½-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

$$4.5 \times \sqrt{I \text{ Range} \div I \text{ Reading}}$$

Maximum Overload: 1.5A maximum, \pm 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 dc volts

IEEE-488 Interface Option (-05)
Same specifications as for 8506A

RS-232 Interface Option (-06)
Same specifications as for 8506A

Bi-Parallel Interface Option (-07A)
Same specifications as for 8506A

General Specifications, 8506A & 8505A

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, \pm 30V maximum, factory wired for falling edge; may be rewired for rising edge. Pulse width $\geq 10 \mu$ s

Scanner Advance Pulse: TTL level, $\geq 3 \mu$ s 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: $\leq 80\%$ to 18°C, $\leq 75\%$ to 40°C, $\leq 45\%$ to 50°C

Size: 10.8 cm H x 43.2 cm W x 42.5 cm D (4.25 in x 17 in x 16.75 in)

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: Manual, power cord, serialized and dated calibration certification sheet

Models

8506A Thermal RMS Digital Multimeter
8505A Digital Multimeter

Options for 8506A & 8505A**

8505A-02A* Ohms Converter
8500A-03*** Current Converter
8500A-05 IEEE-488 Interface
8500A-06 RS-232-C Interface
8500A-07A Parallel Interface (for DEC PDP11, DR11C, DRV11)

*Cannot install both -02A and -03 in 8506A at the same time

**All options are customer installable

***Provides dc current only when installed in 8506A

Options for 8505A only

8500A-01* AC Converter (Average)
8500A-09A* AC Converter (True-RMS)

*Cannot install both -01 and -09A at the same time

Accessories (Also see page 63)

MIS-7011K Extender Card
MIS-7013K Bus Interconnect and Monitor
MIS-7190K Static Test Controller
MIS-7191K Test Module
M00-260-610 18" Rack Slide Kit (needs M04-205-600)
M00-270-610 20" Rack Slide Kit (needs M04-205-600)
M00-280-610 24" Rack Slide Kit (needs M04-205-600)
M04-205-600 5¼" Rack Adapter
Y8021 1m, IEEE-488 Shielded Cable
Y8021 2m, IEEE-488 Shielded Cable
Y8021 4m, IEEE-488 Shielded Cable
Y8077 Four Terminal Short
Y8133 Universal Test Leads

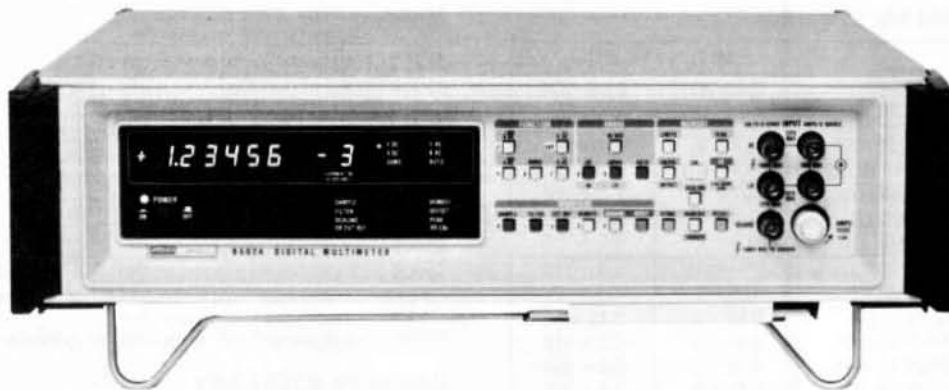
Service & Support

Digital Multimeters

8502A

IEEE-488

RS-232



(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: IEEE-488, RS-232-C, or Parallel
- Measurement options:
AC volts, true-rms or averaging
Resistance
Current
- Up to 212% overrange

Circuit Card Modules

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.

Peaks, Valleys, Limits, Calculations

The 8502A may be operated to store the highest and the lowest values in a series of measurements for determining deviations, either directly or as a percentage. Or, where measurements are for testing whether certain values are within acceptable limits, preset limits may be entered and stored for comparison. Then, measurements within limits are classified simply as PASS. Measurements that fall outside of limits are classified as either HI or LO, depending on whether they exceed a high limit or fall below a low limit. These classifications appear in the display whether it is operated remotely or operated from the front panel.

Measured values may be multiplied by a factor before a numerical value is displayed. Or, using offset, both multiplied and added (or subtracted) using the general formula: $Y = mx + b$.

Specifications

DC Volts

Range	Normal Full Scale	5½-Digit Resolution	Resistance
100 mV	312 mV	1 μ V	>10,000 M Ω
1V	2.5V	10 μ V	>10,000 M Ω
10V	20V	100 μ V	>10,000 M Ω
100V	160V	1 mV	10 M Ω
1000V	1200V	10 mV	10 M Ω

Reading Rate (Bench Operation)

Fast: 7½ rdgs/s (60 Hz line); 6¼ rdgs/s (50 Hz line)

Slow: 1¾ rdgs/s (60 Hz line); 1½ rdgs/s (50 Hz line)

Accuracy, 6½-Digit: \pm (% of Rdg + Counts)

Range	24 Hours 23°C \pm 1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C ²
100 mV ¹	0.002+4	0.003+5	0.005+8	0.0003+0.5
1V	0.001+6	0.002+8	0.004+9	0.0003+1
10V	0.0006 or 6*	0.001+8	0.002+9	0.0002+0.5
100V	0.001+6	0.002+8	0.004+9	0.0003+1
1000V	0.001+6	0.002+8	0.004+9	0.0003+0.5

* Whichever is greater

¹ 5½-digit accuracy on lowest range

² 18°C to 0°C and 28°C to 50°C

Normal Mode Noise Rejection

Filter	Programmed 4 Samples/rdg	50 Hz 1½ rdgs/s	60 Hz 1¾ rdgs/s
50 Hz, Fast	60 dB	75 dB	—
50 Hz, Slow	85 dB	95 dB	—
60 Hz, Fast	60 dB	—	—
60 Hz, Slow	90 dB	—	100 dB

Common Mode Rejection: 100 dB at 60 Hz with 1 k Ω unbalance

Overload: \pm 1200V dc or 1400V pk ac, may be applied continuously to any range without permanent damage

Common Mode Noise Rejection: \geq 120 db, dc to 60 Hz, with 100 Ω unbalance

Ratio [External DC Reference]

Measurements of dc or ac voltage, dc or ac current, or resistance is divided by the measurement of an externally applied dc voltage and



displayed as a ratio. The measurements are made on two separate isolated sets of terminals but there should be no more than 20,000 ohms between the Sense LO terminal and either the HI or LO Reference input terminal. Input characteristics of the Sense terminals depend on the function selected. Characteristics of the rear panel Ext Ref input are as follows:

Input Resistance: >10,000 MΩ

Max Reference Voltage: 40V dc between Ext Ref HI and LO terminals, providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal

Minimum Ext Reference Voltage: Equal to the input (voltage, current, or resistance) divided by 10X the range selected or 100 μV, whichever is greater

Ratio reading: <10 times the value of the volts, amps, or ohms range selected

Normal Mode Noise Rejection: ≥100 dB for dc and 1X and 2X line frequency

Common Mode Noise Rejection: ≥75 dB for 1X and 2X line frequency

Overload: ±180V peak, 127V rms relative to Sense LO terminal or Ohms Guard terminal

Accuracy: For reference voltages of 20V to 40V, accuracy is ±(A + B + 10 ppm), where A = 10V dc-range accuracy and B = input voltage-, current-, or resistance-range accuracy. For reference voltages less than 20V, accuracy is ±(A + B + (200 ppm ÷ |Vref|))

Option Specifications

True-RMS AC Volts Option (-09A)

Range	Full Scale	5½-Digit Resolution	Impedance
1V	2.5V	10 μV	1 MΩ, <100 pF
10V	20V	100 μV	
100V	160V	1 mV	
1000V	1000V	10 mV	

Accuracy: ±(% of Rdg + % of Full Scale) (5½-Digits)

Frequency	90 Days, 18°C to 28°C		
	% of Input	+% FS (AC)	+% FS (AC + DC)
DC	0.1	—	0.03
10 Hz to 20 Hz	1.0	0.04	0.06
20 Hz to 50 Hz	0.5	0.012	0.03
50 Hz to 10 kHz	0.1	0.012	0.03
10 kHz to 30 kHz	0.2	0.04	0.06
30 kHz to 50 kHz	0.3	0.1	0.12
50 kHz to 100 kHz	1.0	0.3	0.3
100 kHz to 300 kHz	2.0	0.5	0.5
300 kHz to 1 MHz	3.3	1.8	1.8

1. Filter must be used for full accuracy below 400 Hz. For 6½-digit display, multiply number of counts by 10
2. Volt-Hertz product not to exceed 2×10^7 ; 300 kHz to 1 MHz, not to exceed 1×10^7
3. For inputs above 500V, multiply accuracy by $(2000V + V_{in}) \div 2000V$

Common Mode Noise Rejection: ≥120 dB, dc to 60 Hz, with 100Ω unbalance
Crest Factor: >7 at full scale, increasing down scale by:

$$7\sqrt{V} \text{ Range} \div V \text{ Input}$$

Average-Sensing AC Volts Option (-01)

Range	Full Scale	5½-Digit Resolution	Impedance
1V	2.5V	10 μV	1 MΩ, <100 pF
10V	20V	100 μV	
100V	160V	1 mV	
1000V	1000V	10 mV	

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 Hz to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 kHz to 40 kHz	—	0.15 + 5
10 kHz to 50 kHz**	0.1 + 5	—
50 kHz to 100 kHz**	0.5 + 5	—

* Slow filter must be used below 400 Hz. For 6½-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 Noise Rejection: ≥120 dB, dc to 60 Hz, with 100Ω unbalance

Resistance Option (-02)

Range	Full Scale	5½-Digit Resolution	Current Through Unknown
10Ω	31.25Ω	100 μΩ	10 mA
100Ω	250Ω	1 mΩ	10 mA
1 kΩ	2 kΩ	10 mΩ	1.25 mA
10 kΩ	32 kΩ	100 mΩ	78 μA
100 kΩ	256 kΩ	1Ω	9.8 μA
1MΩ	4.096 MΩ	10Ω	4.9 μA
10 MΩ	32.768 MΩ	100Ω	0.61 μA
100 MΩ	262.144 MΩ	1 kΩ	76 nA

Accuracy: ±(% of Rdg + Counts) (5½-Digits)

Range	24 Hours 23°C ±1°C	90 Days 23°C ±1°C	1 Year 23°C ±1°C
10Ω	0.003 + 20	0.005 + 20	0.01 + 20
100Ω	0.002 + 2	0.003 + 2	0.006 + 2
1 kΩ	0.002 + 1	0.003 + 1	0.006 + 1
10 kΩ	0.002 + 1	0.003 + 1	0.006 + 1
100 kΩ	0.002 + 1	0.003 + 1	0.006 + 1
1 MΩ	0.002 + 1	0.003 + 1	0.006 + 1
10 MΩ	0.01 + 1	0.02 + 1	0.04 + 1
100 MΩ	0.03 + 1	0.05 + 1	0.1 + 1

Open Circuit Voltage

Range	Voltage	Configuration
10Ω to 100 kΩ	7V max	4-terminal
1 MΩ to 100 MΩ	25V max	2-terminal

Overload: ±400V dc to 60 Hz, or 560V peak above 60 Hz max, continuous on any range with no damage

Reading Rate (Bench Operation)

Filter	Approximate Rdgs Per Second			
	60 Hz		50 Hz	
	Fast	Slow	Fast	Slow
Fast	4	1-1/2	3-1/3	1-1/4
Slow	1-1/4	5/6	1	3/4

Current Option (-03)

Range	Full Scale	Resolution	Voltage Burden
100 μA	312 μA	1 nA	<100 mV
1 mA	2.5 mA	10 nA	<100 mA
10 mA	20 mA	100 nA	<200 mV
100 mA	160 mA	1 μA	<200 mV
1A	1.28A	10 μA	<500 mV

Overload: Fused at 1.5A, $\pm 140V$ ac or peak ac to 60 Hz, 200V peak ac above 60 Hz with no damage

Settling and Digitizing Time: Same as dc volts

Direct Current Accuracy: \pm (% of Input + Digits) (5½-Digits)

Ranges	24 Hours 23°C ± 1 °C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
100 μA	0.02 + 10	0.03 + 10	0.05 + 10
1 mA	0.02 + 10	0.03 + 10	0.05 + 10
10 mA	0.02 + 10	0.03 + 10	0.05 + 10
100 mA	0.03 + 20	0.05 + 20	0.1 + 10
1A	0.03 + 20	0.05 + 20	0.1 + 20

Alternating Current Accuracy: \pm (% of Rdg + Counts) (5½-Digits)

Range	Frequency	90 Days, 18°C to 28°C	
		Avg-Res Current	True RMS Current
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 Hz	0.5 + 65	0.5 + 90
	50 Hz - 10 kHz	0.24 + 65	0.26 + 90

*Applies from 0.1% of full scale to full scale

Crest Factor (True-RMS): > 4.5 at full scale, increasing down scale by

$$4.5 \sqrt{\text{range} \div \text{input}}$$

Calibration Memory Option (-04)

Allows correction factor to be entered and stored for any or all ranges of any or all measurement functions, quickly and conveniently. Prevents downtime in calibration laboratory.

Control: Via front panel pushbuttons

Storage Time: 1 year if not used. Up to five years if used

Calibration Points: Decade value for each range

IEEE Interface Option (-05)

The IEEE Interface provides I/O compatibility per IEEE Std 488-1978. Order 1m, 2m, or 4m cable separately (Y8021, Y8022, Y8023)

RS-232 Interface Option (-06)

This bit serial asynchronous interface option provides either voltage loop (EIA Standard RS-232-B or -C) or current loop (20 mA for Teletype) for interfacing to such things as computers, CRT displays, DEC writers, Teletypes, etc. Eight baud rates are available from 110 to 9600 and either one or two stop bits can be set up. Selection is made via rear panel logic switches.

Parallel Interface Option (-07A)

This 16-bit parallel, character-serial interface option allows the 8502A to interface to PDP11 mini-computers at a full 500 readings/second. Can be used for interfacing to 8-bit multiplex microcomputers or controllers. Both ASCII and binary (2's complement) coding are selected via command codes.

General Specifications

Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating

Overload: LO to guard is 100V max; guard to chassis is 1000V max

Power: 100, 120, 220 or 240 Volt, 47-63 Hz $< 25W$ with all options

Warmup: 1 hr to rated accuracy

Dimensions: 10.8 cm H x 42.5 cm L x 43.2 cm W (4.25 in H x 16.75 in L x 17 in W)

Weight: Basic is 9.1 kg (20 lb). All options are 11.3 kg (25 lb)

Included: Manual and power cord. (Order Y8133 or Y8140 test leads separately.) Serialized and dated calibration certification sheet

Model

8502A DMM

Options*

8500A-01 Average Converter

8500A-02 Ohms Converter

8500A-03 Current Converter

8500A-04 Cal Memory

8500A-05 IEEE-488 Interface

8500A-06 RS-232-C Interface

8500A-07A Parallel Interface (for DEC PDP11, DR11C, DRV11)

8500A-09A RMS Converter

8500A-16 Switchable Front/Rear Inputs

*All options except -16 are customer installable

Accessories (Also see page 63)

MIS-7011K Extender Card

MIS-7013K Bus Interconnect and Monitor

MIS-7190K Static Test Controller

MIS-7191K Test Module

M00-260-610 18" Rack Slide Kit (needs M04-205-600)

M00-270-610 20" Rack Slide Kit (needs M04-205-600)

M00-280-610 24" Rack Slide Kit (needs M04-205-600)

M04-205-600 5¼" Rack Adapter

Y8021 1m, IEEE-488 Shielded Cable

Y8022 2m, IEEE-488 Shielded Cable

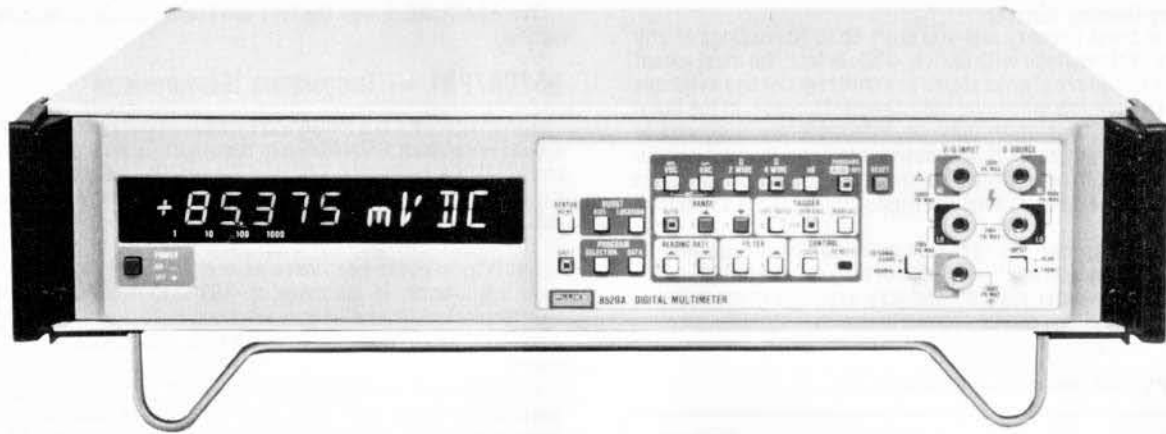
Y8023 4m, IEEE-488 Shielded Cable

Y8133 Universal Test Leads

Y8140 Slim Test Leads

Also see page 284 for more accessory information.

Service & Support



(NSN 6625-01-123-0028) 8520A

2

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: IEEE-488
- 8522A: Parallel and BCD
- New 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 IEEE Std 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.

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 also standard on the 8520A/AS-1 and 8522A 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 ($X = \text{measurement} \text{ minus offset} \text{ times scale} \text{ divided by ratio}$) 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) Standard in 8520A/AS-1 & 8522A

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.

Digital Multimeters

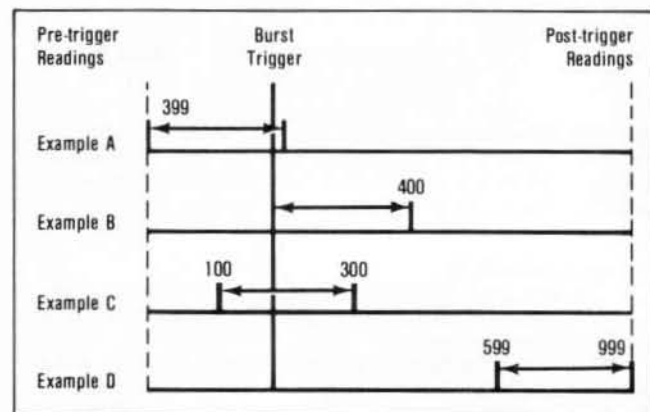
8520A/8522A/8520A/AS-1/8520A/PRT

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, below.

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 8520A device dependent IEEE-488 commands.

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 special Rosemount 162N Platinum Resistance Thermometer probe (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 -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. See page 179 for more specifications.

Specifications

DC Voltage

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 μ V	$\geq 10,000$ M Ω
1V	1.99999	10 μ V	$\geq 10,000$ M Ω
10V	16.0100	100 μ V	$\geq 10,000$ M Ω
100V	130.100	1 mV	10 M Ω
1000V	1024.00	10 mV	10 M Ω

Accuracy: \pm (% of Input + Digits)

Range	24 Hours 23°C \pm 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: \pm (% of Input + LS Bit)*

Range	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temperature Coefficient Per °C
100 mV	0.01 + 1	0.015 + 1	0.001 + 0.1
1V-1000V	0.01 + 1	0.015 + 1	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 k Ω unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR

Maximum Input: ± 1000 V peak, High to Low or Guard to chassis terminals, and ± 200 V peak, Guard to Low terminals, for any range
Bias Current: ≤ 50 pA

Digital Multimeters

8520A/8522A/8520A/AS-1/8520A/PRT

Resistance

Range	\pm (% of Input + Digits)
10 Ω	0.0030 + 5
100 Ω	0.0020 + 2
1000 Ω	0.0020 + 2
10 k Ω	0.0020 + 2
100 k Ω	0.0020 + 2
1 M Ω	0.0050 + 2
10 M Ω	0.0100 + 1

Conductance (100 nS range): \pm (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: The 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-operating; 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: \leq 95% to 25°C, \leq 75% to 40°C, \leq 45% to 50°C

Shock & Vibration: Meets MIL-T-28800C for Type III, Class 5, Style E

Power: 100, 120, 220, or 240V ac, \pm 10%, 50 to 60 Hz, \leq 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: Manual, power cord, rear panel mating connector for analog input, serialized and dated calibration certification sheet

Models

8520A DMM with IEEE-488 Interface

8522A DMM with BCD and Parallel Interface

8520A/AS-1 DMM for MATE

8520A/PRT Temperature Measurement System w/Probe

Option

8520A-010* Extended Software Package

**Included with 8520A/AS-1 and 8522A*

Factory or Service Center installation only

Accessories (Also see page 63)

Y9111 0.93m, 3 ft Trigger Cable

Y9112 1.85m, 3 ft Trigger Cable

Y8133 Test Lead Set

Y2037 100 Ω RTD Temperature Probe

Y8021 1m, IEEE-488 Shielded Cable

Y8022 2m, IEEE-488 Shielded Cable

Y8023 4m, IEEE-488 Shielded Cable

Y8597 Adapter for 8375A, 8400A

Y8598 3½" Rack Adapter with 22" Slides

Y8599 3½" Rack Adapter only

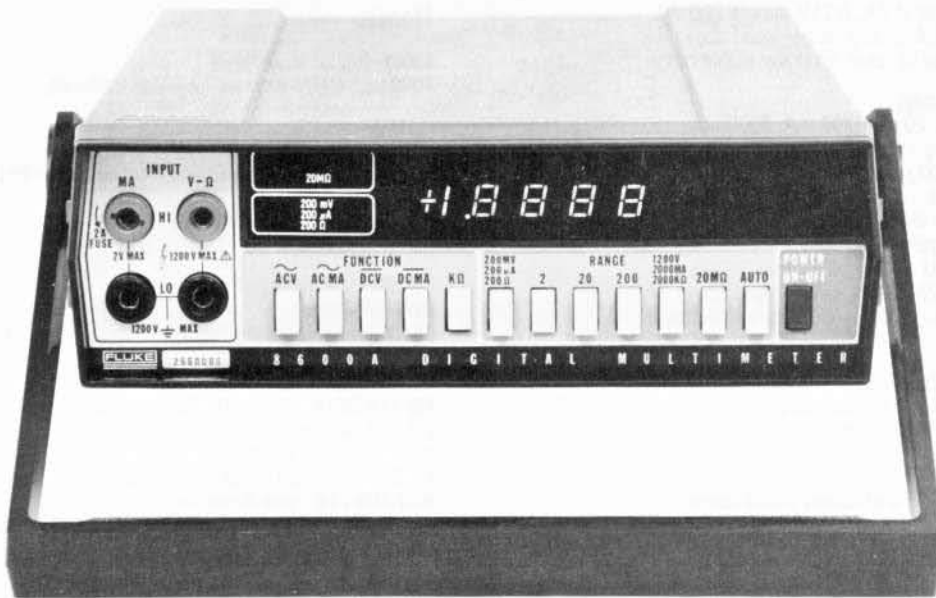
Also see page 284 for more accessory information.

Conversion of 8520A/AS

Conversion of 8520A/AS to 8520A/AS-1 is available from your Fluke Service Center. Order 8520A/AS/AS1. The price of the conversion is \$950.

Service & Support





(NSN 6625-01-010-0088) 8600A

8600A, Autoranging

- 4½-digit resolution
- ±0.02% 6 month basic dc accuracy
- LED display
- Dc and ac voltage ranges to 1200V
- Dc and ac current ranges to 2 amps
- Resistance to 20 MΩ
- Rechargeable battery version
- Data output options

The 8600A is a 4½-digit multimeter featuring high accuracy and full autoranging capability except for current. Measurement functions include ac volts, dc volts, ac current, dc current, and resistance. Available options include a rechargeable battery pack (-01) for portable operation and a parallel BCD printer output (-02). Superior reliability is assured through a high impact plastic case, LSI construction, dual slope measurement techniques and extensive input overload protection on all ranges. All dc voltage ranges will withstand ±1200V dc or 1700V peak ac without damage. Similarly, all ac voltage ranges will endure 1200V rms without damage. The resistance ranges can handle continuous 250V rms or dc inputs without damage. All current ranges are protected by a 2A fuse which is replaceable from the front panel.

Specifications

All accuracy specifications are for 6 months with a room temperature of 15°C to 35°C.

DC Voltage

Ranges: ±200mV, ±2V, ±20V, ±200V, ±1200V

Ranging: Full autoranging or manual ranging

Polarity: Automatic, + and — displayed

Resolution: 10 μV on 200 mV range

Accuracy: ±(0.02% of input +0.005% of range) for 2, 20, 200V ranges; ±(0.02% of input +0.008% of range) for 1200V range; ±(0.04% of input +0.01% of range) for 200 mV range

DC Input Resistance: >1000 MΩ on 200 mV and 2V ranges. 10 MΩ on 20V, 200V, and 1200V ranges

Zero Stability: Autozero on all ranges

Overload Protection: ±1200V dc or ±1700V peak ac applied continuously to any range

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz

Common Mode Noise Rejection: ≥120 dB (with 1 kΩ in either lead) at dc, 50 Hz, and 60 Hz

Response Time: 1.0s max to rate accuracy, within range

AC Voltage (Average-Sensing)

Ranges: 200 mV, 2V, 20V, 200V, 1200V

Ranging: Full autoranging or manual ranging

Resolution: 10 μV on 200 mV range

Accuracy: ±(% of Input + % of Range)

Range	30 Hz	50 Hz	10 kHz	20 kHz	50 kHz	100 kHz
200 mV (1% to 100%)	0.5+0.1	0.2+0.08		0.5+0.1	0.5+0.5	
2V, 20V, 200V (1% to 100%)	0.5+0.025	0.2+0.015		0.5+0.025	1.0+0.05	
1200V					Not Specified	
10V-500V	0.5+0.08	0.2+0.03	0.5+0.08			
500V-1200V	0.5+0.08	0.37+0.03	0.5+0.08			

Input Impedance: 2 MΩ shunted by <100 pF

Overload Protection: 1200V rms maximum, not to exceed 2 x 10⁷ volt-hertz product

Response Time: 1.5s max to rated accuracy within range

DC Current

Ranges: 200 μA, 2 mA, 20 mA, 200 mA, 2000 mA

Ranging: Manual ranging

Resolution: 10 nA on 200 μA range

Accuracy: ±(0.1% of input +0.01% of range) on all ranges

Bench Portable Digital Multimeter

8600A

Voltage Burden: 0.5V max at 2A, 0.25V max to 200 mA
Overload: Protected to 2A on any range; fused above 2A
Response Time: 1.0s max to rated accuracy within range

AC Current (Average-Sensing)

Ranges: 200 μ A, 2 mA, 20 mA, 200 mA, 2000 mA
Ranging: Manual ranging
Resolution: 10 nA on 200 μ A range
Accuracy: 50 Hz-10 kHz, $\pm(0.3\%$ of input + 0.08% of range) all ranges, except 50 Hz-5 kHz on 2000 mA range; 30 Hz-50 Hz $\pm(0.6\%$ of input + 0.1% of range) all ranges

Voltage Burden: 0.5V max at 2A, 0.25V max to 200 mA
Overload: Protected to 2A on any range; fused above 2A
Response Time: 1.5s max to rated accuracy within range

Resistance

Ranges: 200 Ω , 2 k Ω , 20 k Ω , 200 k Ω , 2000 k Ω , 20 M Ω

Ranging: Full autoranging or manual ranging

Resolution: 10 m Ω on 200 Ω range

Configuration: 2 wire

Accuracy:

- $\pm(0.1\%$ of input + 0.15% of range) 200 Ω range
- $\pm(0.1\%$ of input + 0.005% of range) 2 k Ω range
- $\pm(0.05\%$ of input + 0.005% of range) 20 k Ω to 2000 k Ω range
- $\pm(0.2\%$ of input + 0.005% of range) 20 M Ω range

Open Circuit Voltage: ≤ 5 V

Overvoltage Protection: 250V rms or dc, applied continuously

Response Time: 1.0s max to rated accuracy within range, (200 Ω range to 2000 k Ω range), 4s max on 20 M Ω range

Current Through Unknown

200 Ω	2 k Ω	20 k Ω	200 k Ω	2000 k Ω	20 M Ω
1 mA	1 mA	100 μ A	10 μ A	1 μ A	0.1 μ A

Option Specifications

Digital Output Version (8600A-02)

Isolated parallel BCD output, TTL/DTL compatible levels. Not compatible with Version -01.

General Specifications

Function: Selected via front panel controls

Range: Automatic or manual, selected via front panel controls

Autorange Rate: 600 ms max per range change

Display: 7 segments 0.3 LED display, automatic decimal location

Reading Rate: 2½ samples/second within range

Overload Indication: Flashing display of +18888 (built-in segment test of LED display) for out of range indication

Temperature: 0°C to +50°C, operating; -40°C to +75°C, -40°C to +60°C with batteries, non-operating

Relative Humidity: $\leq 80\%$, +5°C to +35°C; $\leq 70\%$, +35°C to +50°C

Shock and Vibration: Meets pertinent requirements of MIL-T-28800C

MTBF: 10,000 hours calculated, minimum

Common Mode Voltage: 1000V dc or peak ac, max

Power: 115 or 230V ac $\pm 10\%$, 50 or 60 Hz, 7 watts line, 10 watts battery

Battery Pack Version (8600A-01): Internal rechargeable battery pack. 8 hours typical operation, rechargeable in 16 hours max. Not compatible with Option -02

Size: Excluding handle, 6.4 cm H x 21.6 cm W x 25.4 cm D, (2.52 in H x 8.5 in W x 9.9 in D)

Weight: 1.6 kg (3.5 lb) line; 2.1 kg (4.5 lb) w/batteries

Included: Line cord, test leads, Instruction/Service Manual, and serialized/dated calibration certification sheet

Models

8600A Digital Multimeter

8600A-01 DMM with rechargeable batteries

Option

8600A-02 Data Output Option (Not customer installable)

Accessories (Also see page 63)

80K-6 High Voltage Probe

80K-40 High Voltage Probe

85RF RF Probe

80T-150U Temperature Probe

80TK Thermocouple Module

80i-400 Clamp-On Current Probe

80i-410 DC/AC Clamp-On Current Probe

80i-600 Clamp-On Current Probe

80J-10 Current Shunt

Y8101 AC Current Probe, 150 Amp

M00-100-714 Panel Protector

M00-200-611 3½" Rack Adapter, Offset

M00-200-612 3½" Rack Adapter, Center

M00-200-613 3½" Rack Adapter, Dual

Also see page 284 for more accessory information.

Service & Support



(NSN 6625-01-081-2638) **8920A**



(NSN 6625-01-203-1314) **8921A**



(NSN 6625-01-126-3884) **8922A**

8920A/8921A/8922A, Wideband

- 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 μ V to 700V

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 50 Ω to 1200 Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 M Ω 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.

2

Digital Voltmeters

8920A/8921A/8922A

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

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 (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									
20V 2V 200 mV	Not Specified	5% or 0.5 dB	1% or 0.15 dB		0.5% or 0.1 dB		0.7% or 0.15 dB		3% or 0.35 dB	
20 mV			2% or 0.25 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			

AC Accuracy: ± % of voltage reading or ±dB (8922A)

Range	FILTER IN				FILTER OUT				
	2 Hz	10 Hz	20 Hz	50 Hz	10 kHz	200 kHz	1 MHz	2 MHz	11 MHz
700V 200V	Not Specified								
20V 2V 200 mV	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	
20 mV		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 $N = 5 \div \text{mV input}$. Or, for dB readings, add N to ±0.5 dB, where $N = 0.5 \div (\text{mV input})^2$

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 1×10^8 on any range

Maximum Common Mode Voltage

8920A and 8922A: 400 mV rms or 600 mV peak

8921A: 500V rms or 700V peak

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 autoranging 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 (4½ 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, on 8922A only

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

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 proportional 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 DVM's 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 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

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 $\pm 10\%$ 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: Manual, power cord, serialized and dated calibration certificate

Models

8920A DVM, BNC Input, 10 Hz-20 MHz
8921A DVM, Banana Jack Input, 10 Hz-20 MHz
8922A DVM, BNC Input, 2 Hz-11 MHz

Options

892XA-03 Counter Output
892XA-04* Logarithmic Output (not for 8921A)
892XA-521 PTI Interface
892XA-521K PTI Interface, field-installable
8XXXA-522K 1120A Interface, field-installable
892XA-529** IEEE-488 Interface

* 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 page 63)

1120A IEEE-488 Translator
Y7203 2 ft PTI Ribbon Cable
Y7204 5 ft PTI Ribbon Cable
Y2014 5/4" Rack Adapter, Single
Y2015 5/4" Rack Adapter, Dual
Y2020 Panel Mount Kit
Y2024 3-Module Power Cord
A90 6-Range Current Shunt
80J-10 10 Amp Current Shunt
Y9100 BNC 50 Ω Attenuator (6 dB)
Y9101 BNC 50 Ω Attenuator (14 dB)
Y9102 BNC 50 Ω Attenuator (20 dB)
Y9103 50 Ohm Feedthrough Terminator
Y9107 BNC "T"
Y9109 Banana to BNC Adapter
Y9111 3-foot BNC to BNC Cable
Y9112 6-foot BNC to BNC Cable
 Also see page 284 for more accessory information.

Service & Support



(NSN 6625-01-115-2141) 8050A

8050A, High Performance Value

- 4½ digits (20,000 counts)
- Nine functions including —
Relative reference, dB, dBm, dBV, dBW (8Ω),
Conductance, Diode test
- 0.03% basic dc accuracy
- True-rms from 20 Hz to 50 kHz
- Microcomputer-based
- Extensive overload protection
- Rechargeable battery version (-01)
- Touch-hold probe compatibility (80T-H)
- Probes for rf, high voltage, high current
- Factory Mutual approved

The 8050A provides superior performance and measurement capabilities in a low-cost, benchtop instrument. The 4½-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 low-pass 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 a scrolling memory lets you select the reference impedance needed.

A resolution of 0.01 dB (above 1 mV) and accuracy specifications 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 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 80 T-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 an ordinary 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 600A, or high voltage to 40 kV.

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, and ±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: 260 dB at 50 Hz or 60 Hz

Common Mode Noise Rejection: 290 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 2V 20V 200V	10 μV 100 μV 1 mV 10 mV	1% + 10	0.5% + 10	1% + 10	5% + 30	
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	
0.77 mV-2 mV 2 mV-2V	-60 to -52 -52 to +8	200 mV*	±0.5 dBm					**N/S
0.1V-2V 1V-20V 10V-200V	-18 to +8 +2 to +28 +22 to +48	2V* 20V 200V	±0.25 dBm	±0.15 dBm	±0.25 dBm	±0.75 dBm		
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: 260 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 10⁷ (e.g., 200V at 50 kHz)

Response Time: 2 seconds max to rated accuracy within a range

DC Current

Range	Resolution	Accuracy (5% to 100% of Range)	Burden Voltage
200 μA 2 mA 20 mA 200 mA	10 nA 100 nA 1 μA 10 μA	±(0.3% of rdg + 2 digits)	0.3V max
2000 mA	100 μA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuse in series

AC Current (True-RMS, AC Coupled)

Range	Resolution	Accuracy: ±[% of Rdg + Digits]*						
		20 Hz**	45 Hz	2 kHz	10 kHz	20 kHz		
200 μA 2 mA 20 mA 200 mA	10 nA 100 nA 1 μA 10 μA	2% + 10	1% + 10	2% + 10	2% + 10			
2000 mA	100 μA					Not specified		

*5% to 100% of range

**Typically 3 to 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 2 kΩ*	0.01Ω 0.1Ω	±(0.1% reading +2 digits +0.02Ω)	0.19V 1.2V
20 kΩ 200 kΩ*	1Ω 10Ω	±(0.05% reading +2 digits)	0.2V 2V
2000 kΩ 20 MΩ*	100Ω 1 kΩ	±(0.25% reading +3 digits)	0.2V 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 200 nS	0.1 μS 0.01 nS	±(0.1% of reading + 5 digits) ±(0.5% of reading + 20 digits)

Digital Multimeter

8050A

Equivalent Resistance

2 mS Range: 500 Ω to 10 M Ω

200 nS Range: 5 M Ω to 100,000 M Ω

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 \pm 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: $\leq 70\%$ to 50°C or $\leq 90\%$ to 35°C, except 2000 k Ω , 20 M Ω , and 200 nS ranges where it is $\leq 80\%$ to 35°C

Safety: IEC 348, Protection Class 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 max 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: Manual, line cord, test leads (Y8132) and statement of calibration practice

Models

8050A DMM

8050A-01 DMM with rechargeable batteries

Accessories (Also see page 63)

Y8132 Replacement Test Leads

TL70 Test Lead Set

Y8134 Deluxe Test Lead Set

Y8140 Slim Test Leads, w/needle points

Y8205 Soft Carrying Case w/shoulder strap

80K-6 High Voltage Probe

80K-40 High Voltage Probe

83RF 100 MHz RF Probe

85RF 500 MHz RF Probe

80T-150U Temperature Probe

80i-400 AC Current Probe

80i-410 DC/AC Current Probe

80i-600 AC Current Probe

Y8100 DC/AC Current Probe

Y8101 AC Current Probe

80J-10 Current Shunt

80T-H Touch-Hold Probe

80TK Thermocouple Module

C86 Ruggedized Carrying Case

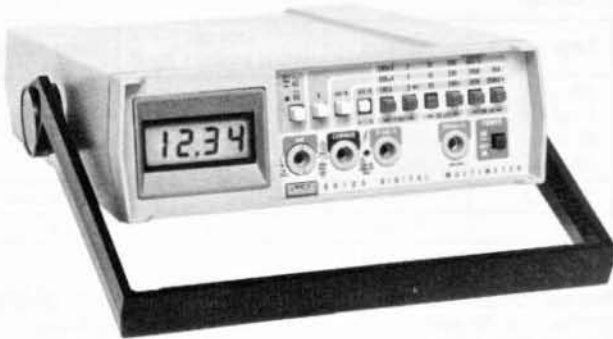
M00-200-611 3½" Rack Adapter, Offset

M00-200-612 3½" Rack Adapter, Center

M00-200-613 3½" Rack Adapter, Dual

Also see page 284 for more accessory information.

Service & Support



(NSN 6625-01-018-2544) **8010A**



(NSN 6625-01-140-0221) **8012A**

8010A & 8012A, Measurement Versatility

- 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 3½-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 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 square-waves (crest factor of 1 to 1). The 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 MΩ 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

All accuracy specifications are for one year after purchase or recalibration when operated in a temperature 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

Bench Portable Digital Multimeters

8010A/8012A

Normal Mode Noise Rejection: ≥ 60 dB at 60 Hz or 50 Hz
Common Mode Noise Rejection: ≥ 90 dB at dc, 50 Hz, and 60 Hz, with 1 k Ω 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: \pm (% of Reading + Digits)*				
		45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV	100 μ V	0.5% + 2	1.0% + 2	5% + 3		
2V	1 mV					
20V	10 mV					
200V	100 mV					
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 M Ω in parallel with < 100 pF
Common Mode Noise Rejection: ≥ 60 dB at 50 and 60 Hz with 1 k Ω 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: \pm (% of Reading + Digits)	Full Scale Voltage	Max Test Current
2 Ω	1 m Ω	1.0% + 2	0.02V	10 mA
20 Ω	10 m Ω	0.5% + 2	0.2V	10 mA
Note: ...above ranges in 8012A only				
200 Ω	0.1 Ω	0.2% + 1	< 0.25 V	1.30 mA
2 k Ω *	1 Ω		> 1.0 V	1.30 mA
20 k Ω	10 Ω		< 0.25 V	10.0 μ A
200 k Ω *	100 Ω		< 1.0 V	35.0 μ A
2000 k Ω	1 k Ω	0.5% + 1	< 0.25 V	0.10 μ A
20 M Ω *	10 k Ω		> 1.5 V	0.35 μ A

*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 k Ω 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: < 3.5 V on all ranges except < 16 V on 2 Ω and 20 Ω ranges
Input Protection: To 300V dc or rms on 2 Ω and 20 Ω ranges. 500V dc on all other ranges
Response Time: 1 second on all ranges except 2000 k Ω and 20 M Ω where time is 4 seconds, maximum

Conductance

Conductance is the inverse of ohms (1/ Ω) and is expressed in Siemens (S), formerly mhos

Range	Resolution	Accuracy: \pm (% of Reading + Digits)	Open Circuit Voltage	Max Test Current
2 mS	1 μ S	0.2% + 1	< 3.5 V	1.3 mA
20 μ S	10 nS	0.2% + 1	< 1.0 V	10 μ A
200 nS	0.1 nS	1.0% + 10	< 1.0 V	0.1 μ A

Equivalent Resistance

2 mS Range: 500 Ω to 1 M Ω
 20 μ S Range: 50 k Ω to 100 M Ω
 200 nS Range: 5 M Ω to 10,000 M Ω

Input Protection: To 500V dc or rms on all ranges

DC Current

Range	Resolution	Accuracy: \pm (% of Reading + Digits)	Burden Voltage
200 μ A	0.1 μ A	0.3% + 1	0.3V max
2 mA	1 μ A		
20 mA	10 μ A		
200 mA	100 μ A		
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 internal fuse. 10 ampere range in 8010A not fused, 12A maximum
Response Time: 1 second maximum

AC Current (True-RMS, AC Coupled)

Range	Accuracy: \pm (% of Reading + Digits)*			Burden Voltage
	45 Hz	2 kHz	10 kHz 20 kHz	
200 μ A	1% + 2		2% + 2	0.3V max
2 mA				
20 mA				
200 mA				
2000 mA	1% + 2	Not specified		0.9V max
10A**				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 Specifications: Same as for dc current

General Specifications

Display: 3½ 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 momentarily 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 k Ω , 20 M Ω , and 200 nS ranges where it is ≤ 80 % to 35°C
Power: 90 to 132V 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 ½ hour of operation remains. Fifteen to thirty hours of operation typical on 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: Manual, line cord, test leads (Y8132), statement of calibration practice

Models

- 8010A** DMM w/10A Range
- 8010A-01** DMM w/Batteires
- 8012A** DMM w/2 Ω and 20 Ω Range
- 8012A-01** DMM w/Batteires

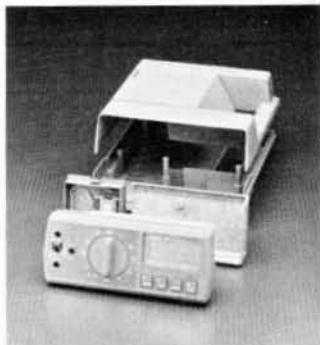
Accessories (Also see page 63)

- Y8131** Replacement Test Leads
 - Y8133** Deluxe Test Lead Set
 - Y8140** Slim Test Leads w/needle points
 - Y8205** Soft Carrying Case
 - 80K-6** High Voltage Probe
 - 80K-40** High Voltage Probe
 - 83RF** 100 MHz RF Probe
 - 85RF** 500 MHz RF Probe
 - 80T-H** Touch and Hold Probe
 - 80T-150U** Temperature Probe
 - 80TK** Thermocouple Module
 - 80i-600** AC Current Probe
 - Y8100** DC/AC Current Probe
 - Y8101** AC Current Probe
 - 80J-10** Current Shunt
 - C86** Ruggedized Carrying Case
 - M00-200-611** 3½" Rack Adapter, Offset
 - M00-200-612** 3½" Rack Adapter, Center
 - M00-200-613** 3½" Rack Adapter, Dual
- Also see page 284 for more accessory information.

Service & Support

Benchtop Multimeter

Fluke 37



Shielding against EMI. The new Fluke 37 makes impressive use of unique construction techniques and materials that provide exceptional shielding against Electromagnetic Interference (EMI). The design incorporates an aluminum-flake-filled plastic shield to protect the meter from external noise interference that could affect accuracy or generate an erratic display.

The meter's superior EMI shielding makes it extremely well-suited to environments where radiated interference from switching motors, radar, transmitters, and other devices is a problem.

The Fluke 37 sets new standards for low cost bench/portable DMMs. It exceeds performance specs and feature offerings of any 3½-digit benchtop DMM on the market. This unit includes both an analog bar graph and digital display, has exceptional EMI shielding, and a number of automatic features that speed up the measurement process. It also has more extensive overload protection than any similar bench meter. The meter is protected from serious damage from overloads at all inputs.

Whether in the lab, on the service bench, or in the classroom, the Fluke 37 is designed to work where you work. Its innovative case includes a built-in carrying handle and a convenient storage bin. From any angle, the new 15-degree sloping face offers optimum visibility and switch access. Included in each Fluke 37 is a 9V battery for portable use. With an inexpensive A-81 battery eliminator, it may be operated indefinitely from your ac power line.



Fluke 37

High Performance Measurement Features In A Unique, Functional Bench Style Package

- 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 test leads, small accessories and 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

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	0.1% + 1
3.200V	1 mV	
32.00V	10 mV	
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

AC Voltage

Range	Resolution	Accuracy		
		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.

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: 10⁷ Volt-Hertz maximum. 1000V, 500V on 320 mV range

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: 20A/600V 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

Ohms

Range	Resolution	Accuracy
320.0	0.1Ω	0.3% + 2
3.200K	1Ω	0.2% + 1
32.00K	10Ω	
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

Benchtop Multimeter

Fluke 37

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 150 Ω

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 M Ω 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: 3.8 in H x 8.5 in W x 9.1 in L (97 mm H x 216 mm W x 231 mm L)

Weight: 2.9 lb (1.31 kg)

Included: TL70 Test leads, spare fuse, battery and instruction manual

Model

Fluke 37 Multimeter

Accessories (Also see page 63)

A81 Battery Eliminator

Y8134 Deluxe Test Lead Kit

Y8140 Test Lead Set

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

80T-150U Temperature Probe

80TK Thermocouple Module

80K-6 High Voltage Probe

80K-40 High Voltage Probe

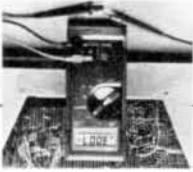
83RF High Frequency Probe

85RF High Frequency Probe

LCA-10 Line Current Test Adapter

Service & Support

Handheld Multimeters



Fluke handheld digital multimeters (DMMs) all operate from small, self-contained 9-volt batteries. Some can also be operated from ac power using an A81 Battery Eliminator.

Many Fluke handheld DMMs rival the performance of more expensive bench models. Others have features that make them uniquely suited for particular applications or industries. For example, the Model 25 and 27 are sealed against rain and moisture and can be used at temperatures well below freezing. The Model 8024B can capture the value of high momentary motor-starting currents. The 8060A can read the frequency of telephone touchtone signals and display ac voltages as decibel levels with respect to 1 milliwatt.

All Fluke handheld multimeters are designed to take electrical and physical abuse with little or no damage.



Handheld Multimeters

Selection Guide

Models	Basic Features		Special Features								DC Volts**		AC Volts				AC/DC Amps		Ohms, etc.			Page		
	Max Display Counts*	Autorangeing	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	Basic Accuracy, %	Max Resolution, μ V	Max AC Voltage, w/o Probe (RMS)	True-RMS	Basic Accuracy, %	Max Resolution, μ V	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, m Ω		Max Resistance, M Ω	Diode Test
Handheld Multimeters																								
Fluke 73	3200	●	●	—	—	—	—	—	—	—	0.7	100	750	—	3.0	1k	1k	10M	10	100	32	●	—	47
Fluke 75	3200	(1)	●	—	—	—	●	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	10	100	32	●	—	47
Fluke 77	3200	(1)	●	—	—	—	●	—	●	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	●	—	47
Fluke 21	3200	(1)	●	—	—	—	●	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	0.32	100	32	●	—	41
Fluke 23	3200	(1)	●	—	—	—	●	—	●	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	●	—	41
Fluke 25	3200	(1)	●	—	—	—	●	—	●	●	0.1	100	1000	—	0.5	100	30k	100	10	100	32	●	●	44
Fluke 27	3200	(1)	●	—	—	●	●	—	●	●	0.1	100	1000	—	0.5	100	30k	100	10	100	32	●	●	44
8025A	3200	(1)	●	—	—	—	●	—	●	●	0.2	100	1000	—	0.5	100	30k	100	10	100	32	●	●	50
8024B	2000	—	—	—	—	—	●	●	(4)	—	0.1	100	750	—	0.75	100	5k	1k	2	100	20	●	●	52
8026B	2000	—	—	—	—	—	●	—	—	—	0.1	100	750	●	0.5	100	10k	1k	2	100	20	●	●	55
8020B	2000	—	—	—	—	—	●	—	—	—	0.1	100	750	—	0.75	100	5k	1k	2	100	20	●	●	55
8021B	2000	—	—	—	—	—	●	—	—	—	0.25	100	750	—	1.0	100	450	1k	2	100	20	●	—	57
8060A	20,000	—	—	(2)	●	●	●	—	—	—	0.04	10	750	●	0.2	10	100k	10	2	10	300	(3)	●	59
8062A	20,000	—	—	—	●	●	—	—	—	—	0.05	10	750	●	0.5	10	30k	10	2	10	300	(3)	—	59

● Standard

— Not applicable

* All displays LCD

** Max DC Voltage w/o Probe 1000V

(1) Or manual ranging

(2) For frequencies from 12 Hz to 200 kHz

(3) 1 mA constant current mode

(4) Use Peak-Hold Mode

For other multimeters see page 1.

Fluke 21/23



Built-to-survive. Built into every Fluke 21 and 23 DMM is extensive overload protection. The current inputs are fused for high-energy circuits and exceed the most rigorous safety standards. This helps protect the meter and assures operator safety in potentially high-risk situations.

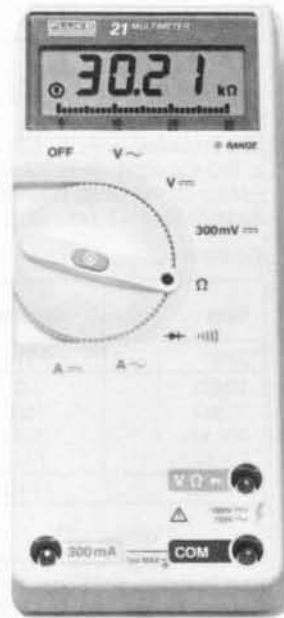
All ac voltage ranges meet the power line surge tests for major power line feeders as defined in IEEE-587-1980, Category B, which include simulated lightning and load switching transient pulses up to 6 kV superimposed on 660V power lines.

For overvoltage protection when measuring voltage or resistance, the 23 uses a 430 volt MOV in series with a spark gap, while the 21 uses a 1300V MOV.

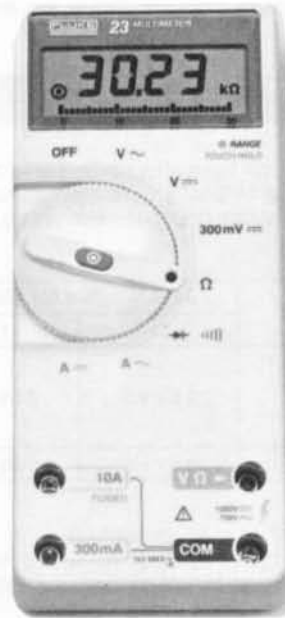
Two recent additions to the 20 Series industrial-grade handheld DMMs, the Fluke 21 & 23, offer extensive overload protection like the sealed Fluke 25 & 27, at about half the cost. They're an excellent general-purpose multimeter for use in potentially risky environments, such as industrial electrical troubleshooting.

For safety and maximum visibility these DMMs are housed in bright yellow high-impact ABS plastic. They offer all the latest features: digital/analog display, fast autoranging, auto polarity, and beeper for continuity and diode tests. You simply select a function with the single rotary dial and proceed to test.

For added safety and convenience, the Fluke 23 includes Fluke's unique Touch Hold™ feature which allows operators to take readings in dense circuitry or areas of high voltage while keeping their eyes directly on the probes. The meter automatically beeps and locks the reading on the display, even after the probes are removed.



Fluke 21



Fluke 23



Low-Cost, High-Accuracy Multimeters that are High-Energy Protected

- 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
- Continuity beeper
- 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.

Handheld Multimeters

Fluke 21/23

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, 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

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	0.1 mV		
3.2V	1 mV	0.5% + 1	0.3% + 1
32V	10 mV		
320V	100 mV		
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	10 mV	2% + 2**	2% + 2**
320V	100 mV		
750V	1V		

*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	0.01 mA	1.5% + 2	1.5% + 2
320 mA	0.1 mA	2% + 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; 20A/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	0.01 mA	3% + 2*	3% + 2*
320 mA	0.1 mA		
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; 20A/600V fuse for 10A input

Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320Ω	0.01Ω	0.7% + 2	0.5% + 2
3200Ω	1Ω	0.7% + 1	0.5% + 1
32 kΩ	10Ω		
320 kΩ	100Ω		
3.2 MΩ	1 kΩ	2.5% + 1	2.0% + 1
32 MΩ	10 kΩ		

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 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"

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: $\leq 70\%$ to 50°C , $\leq 90\%$ to 35°C except $\leq 80\%$ using $32\ \text{M}\Omega$ range

Safety: Protection 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. 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 x 2.95 in x 1.12 in)

Weight: 0.28 kg (0.63 lb)

Included: TL 70 Test Leads, manual, warranty card, battery, spare fuse (installed), and alligator clips.

Models

Fluke 21 DMM w/beeper, w/3-year warranty

Fluke 23* DMM w/Touch-Hold, w/3-year warranty

**Includes C70 Multipurpose Holster*

Accessories (Also see page 63)

C70 Multipurpose Holster

C50 Softcase

TL70 Replacement Test Leads

Y8134 Deluxe Test Lead Kit

Y8140 Test Lead Set

83RF RF Probe

85RF RF Probe

80K-6 HV Probe

80K-40 HV Probe

Y8101 AC Current Probe

80i-400* AC Current Probe

80i-410 DC/AC Current Probe

80i-600* AC Current Probe

Y8100 DC/AC Current Probe

80T-150U Temperature Probe

80TK Thermocouple Module

LCA-10* Line Current Test Adapter

**Limited to ≤ 320 Amps with Fluke 21*

Also see page 284 for more accessory information.

Service & Support



Handheld Multimeters

Fluke 25/27



Fluke 25 STD



Fluke 27 STD

Fluke 25 & 27 Analog/Digital & Rugged

- 0.1% basic dc accuracy and 30 kHz ac response
- 3½-digit, 3200 count display
- 31 segment bar graph for peaking, nulling, capacitor checking, and other changing signals
- Auto or manual range selection
- "Touch Hold" to capture and display readings
- Tests insulation resistance to over 10,000 MΩ
- 1000 hour battery life
- Continuity beeper
- LCD symbols annunciate range and modes
- Overload protection including a fused 10A input
- 2 year warranty
- Rugged "O" ring sealed case withstands harsh environments
- Separate sealed battery/fuse door gives easy access
- 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 specifications of MIL-STD-28800 for Style A, Class 2 Instruments, the Fluke 25 and 27 third generation 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.

Safe

Electrical and safety protection exceeds the world's toughest safety standards.

Autorangeing

With autorangeing, 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 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.

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 or 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	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			

Input Impedance: 10 MΩ in parallel with <100 pF

Common Mode Noise Rejection: >60 dB from dc to 60Hz; ≤1 kΩ unbalance

Overload Protection V ac: 1000V rms (10⁷ volt-hertz max)

Overload Protection mV ac: 500V rms (10⁷ volt-hertz 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

*40-1000 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% + 1
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

Handheld Multimeters

Fluke 25/27

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 RE02 (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 and VDE 0411 licensed. Meets MIL-STD-810C, Method 511.1, Procedure/Explosive Atmosphere Test

Size: 2.2 in H x 3.75 in W x 8 in L (56mm x 95mm x 203mm)

Weight: 1.6 lb (0.75 kg)

C20 Case Size: 4 in H x 6 in W x 10.3 in L (102mm H x 152mm W x 262mm L)

Note: Case is 13 in (330mm) L including handle

Warranty: 2 years; calibration guaranteed for one year

Includes: Battery, TL70 Test Leads, two insulated alligator clips, spare fuse, and Operator's manual

Available in dark amber (STD model) or yellow (YEL model).



Models

Fluke 25 STD Multimeter

Fluke 25 YEL Multimeter

Fluke 27* STD Multimeter

Fluke 27* YEL Multimeter

*MIN/MAX recording and Relative Mode

Accessories (Also see page 63)

C20 Hard Carrying Case

C25 Soft Carrying Case

TL70 Replacement Test Leads

Y8134 Deluxe Test Lead Kit

Y8140 Test Lead Set

83RF 100 MHz RF Probe

85RF 500 MHz RF Probe

80K-6 High Voltage Probe

80K-40 High Voltage Probe

Y8101 AC Current Probe

80i-400 AC Current Probe

80i-410 DC/AC Current Probe

80i-600 AC Current Probe

80J-10 Current Shunt

80T-150U Temperature Probe

80TK Thermocouple Module

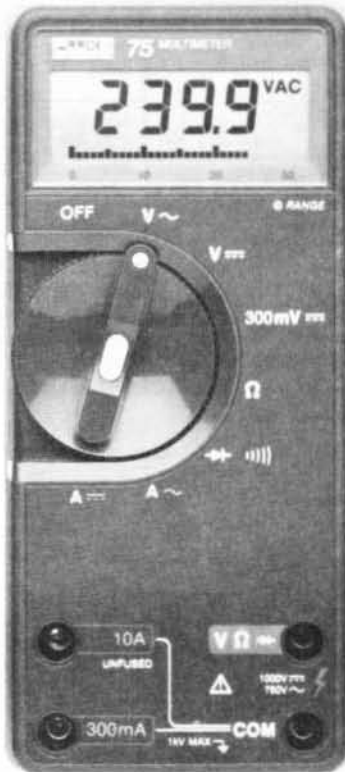
LCA-10 Line Current Test Adapter

Also see page 284 for more accessory information.

Service & Support



Fluke 73



Fluke 75



Fluke 77

The Fluke 73

- 3½ digit, 3200 count display
- 31 segment analog bar graph
- 0.7% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hours on a single 9-volt battery
- One current range: 10A
- "Sleep Mode" if battery not switched off
- Tough textured case resists grime
- 3 year warranty, 1-year calibration cycle
- UL 1244 listed, VDE listed

Fluke 75 (NSN 6625-01-243-6683)
 Fluke 77 (NSN 6625-01-168-6856)

The Fluke 75

- 3½ digit, 3200 count display
- 31 segment analog bar graph
- 0.5% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hours on a single 9-volt battery
- Three current ranges: 10A, 320 mA, and 32 mA (ideal for 4-20 mA current measurements)
- "Sleep Mode" if battery not switched off
- Tough textured case resists grime
- 3 year warranty, 1-year calibration cycle
- UL 1244 listed, VDE listed

Plus

- Continuity beeper
- "Range Hold" manual range selection

The Fluke 77

- 3½ digit, 3200 count display
- 31 segment analog bar graph
- 0.3% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hours on a single 9-volt battery
- Three current ranges: 10A, 320 mA, and 32 mA
- "Sleep Mode" if battery not switched off
- Tough textured case resists grime
- 3 year warranty, 1-year calibration cycle
- UL 1244 listed, VDE listed

Plus

- "Touch Hold" (patent pending) to capture readings
- Multipurpose protective holster
- Continuity beeper
- Range Hold

Handheld Multimeters

Fluke 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

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 passing about 500 microamps.

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 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

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

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)		
		73	75	77
320 mV	0.1 mV	0.7% + 1	0.5% + 1	0.3% + 1
3.2V	1 mV			
32V	10 mV			
320V	100 mV			
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	10 mV	3% + 2**	2% + 2**	2% + 2**
320V	100 mV			
750V	1V			

* 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: 0.2V 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; 10A input unfused

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	—	3% + 2*	3% + 2*
320 mA	0.1 mA			
10A	10 mA			

* 45 Hz to 1 kHz

Voltage Burden: 0.2V 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; 10A input unfused

Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: \pm (% of Rdg + Digits)		
		73	75	77
320 Ω	0.1 Ω	1% + 2	0.7% + 2	0.5% + 2
3200 Ω	1 Ω			
32 k Ω	10 Ω	1% + 1	0.7% + 1	0.5% + 1
320 k Ω	100 Ω			
3.2 M Ω	1 k Ω			
32 M Ω	10 k Ω	3% + 1	2.5% + 1	2.0% + 1

Open Circuit Voltage: \leq 3V

Full Scale Voltage: \leq 440 mV on all ranges except \leq 1.4V on 32 M Ω range

Input Protection: 500V dc or rms ac

Response Time: \leq 1s up to 320 k Ω , \leq 2s up to 3.2 M Ω , \leq 10s up to 32 M Ω 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 μ A 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"

Fluke 77 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 $^{\circ}$ C to 50 $^{\circ}$ C operating; -40 $^{\circ}$ C to 60 $^{\circ}$ C non-operating

Temperature Coefficient: 0.1 x specified accuracy per $^{\circ}$ C from 18 $^{\circ}$ C to 0 $^{\circ}$ C or 28 $^{\circ}$ C to 50 $^{\circ}$ C

Relative Humidity: \leq 70% to 50 $^{\circ}$ C, \leq 90% to 35 $^{\circ}$ C except \leq 80% using 32 M Ω range

Safety: Protection 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. Sleep mode activates after approximately 1 hour (15 min in diode test)

Size: 166 mm L x 75 mm W x 28 mm H (6.55 in x 2.95 in x 1.12 in)

Weight: 0.28 kg (0.63 lb)

Included: TL70 Test Leads, manual, warranty card, plus battery and spare fuse (installed). Also C70 Holster included with Fluke 77.

Models

Fluke 73 DMM w/3-year warranty

Fluke 75 DMM w/beeper, w/3-year warranty

Fluke 77* DMM w/Touch-Hold, w/3-year warranty

*Includes C70 Multipurpose Holster

Accessories (Also see page 63)

C70 Multipurpose Holster

C50 Soft Carrying Case

TL70 Replacement Test Leads

Y8134 Deluxe Test Lead Kit

Y8140 Test Lead Set

83RF RF Probe

85RF RF Probe

80K-6 HV Probe

80K-40 HV Probe

Y8101* AC Current Probe

80I-400* AC Current Probe

80I-410* DC/AC Current Probe

80I-600* AC Current Probe

Y8100 DC/AC Current Probe

80T-150U Temperature Probe

80TK Thermocouple Module

LCA-10 Line Current Test Adapter

*Not applicable to Fluke 73

Service & Support

Handheld Multimeters

8025A



(NSN 6625-01-147-6182) 8025A

8025A Multimeter NSN 6625-01-147-6182

- Designed for MIL-T-28800 Type II, Class 2, Style A requirements
- 3½-digit, 3200 count display
- 31 segment bar graph for peaking, nulling, capacitor checking, and other changing signals
- 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, recessed input jacks
- Rugged sealed construction keeps out dirt, water, and contaminants
- Comes with C20 Ruggedized Hard Case and test leads
- 1000 hour battery life typical
- One year calibration interval
- Two year warranty
- Fast autoranging or manual ranging
- Range hold
- Continuity/diode test beeper

Designed for use in harsh military environments, the 8025A offers the performance and accuracy of a digital multimeter with the speed and dynamic measurement capability of an analog meter. Available through Fluke Sales Offices (see page 243 for listing), the 8025A offers bench instrument performance in a convenient hand-held package.

3200-Count Digital Display

The 8025A 3½-digit (3200 count) display equals the resolution of a 4½-digit meter for readings 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 8025A 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.

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

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.

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 M Ω nominal
Normal Mode Noise Rejection: >60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: >120 dB at dc, 50 Hz and 60 Hz; \leq 1 k Ω unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range
AC Voltage

Range	Resolution	Accuracy: \pm {% of Rdg + Digits}		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV 3.200V 32.00V 320.0V	100 μ V 1 mV 10 mV 100 mV	0.5% + 3	2% + 3	4% + 10
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 M Ω nominal in parallel with \leq 100 pF
Common Mode Rejection Ratio: >60 dB, DC to 50 Hz, \leq 1 k Ω unbalance
Overload Protection: 1000V rms, 500V rms on 320 mV range; 10⁷ volt-hertz maximum
DC and AC Current

Range	Resolution	Typical Burden Voltage	Accuracy: \pm {% of Rdg + Digits}	
			DC Accuracy	AC Accuracy 40 Hz to 1 kHz
320.0 μ A 3200 μ A 32.00 mA 320.0 mA 10.00A	0.1 μ A 1 μ A 10 μ V 100 μ A 10 mA	160 mV 1.6V 180 mV 1.8V 0.5V	0.75% + 2	1.5% + 2

Overload Protection: μ A/mA ranges: 630 mA/250V fuse in series with 3A/600A fuse. Amp range: 20A/600V fuse

Resistance

Range	Resolution	Accuracy: \pm {% of Rdg + Digits}
320.0 Ω	0.1 Ω	0.3% + 2
3.200k 32.00k 320.0k 3.200M	1 Ω 10 Ω 100 Ω 1 k Ω	0.2% + 1
32.00M	10 k Ω	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Full Scale Voltage: <420 mV up to 3.2 M Ω ; <1.3V up to 32 M Ω
Open Circuit Voltage: <2.8V (-15 $^{\circ}$ C to 55 $^{\circ}$ C)

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 $^{\circ}$ C to 55 $^{\circ}$ C)
Overload Protection: 500V rms
Response Time: \leq 2s to rated accuracy except \leq 6s to rated accuracy or lowest and highest resistance ranges, and conductance

General Specifications

Maximum Voltage to be applied to any terminal: 1000V with respect to earth ground
Power Requirements: Single 9V battery NEDA 1604
Battery Life: 1000 hours typical. Battery symbol first displayed when at least 60 hours of battery life remain
Instrument Size: 56mm H x 95mm W x 203mm L (2.2 in H x 3.75 in W x 8 in L)
C20 Case Size: 102mm H x 152mm W x 262mm L (4 in H x 6 in W x 10.3 L)
Note: Case is 330mm L (13 in) including handle
Weight: 8025A alone is 0.75 kg (1.6 lb) with case and accessories 1.5 kg (3.2 lb)
Storage Temperature: -55 $^{\circ}$ C to 85 $^{\circ}$ C
Operating Temperature: -15 $^{\circ}$ C to 55 $^{\circ}$ C; operates to -40 $^{\circ}$ C for 20 minutes when taken from a 20 $^{\circ}$ C environment
Temperature Coefficient: 0.1 x the applicable accuracy specification per $^{\circ}$ C (for temperatures <18 $^{\circ}$ C or >28 $^{\circ}$ C)
Electro-Magnetic Interference (EMI): The 8025A meets 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
Included: Battery, TL70 Test Leads, two insulated alligator clips, Instruction Manual, and C20 Ruggedized Hard Case (includes operator's decal)

Model

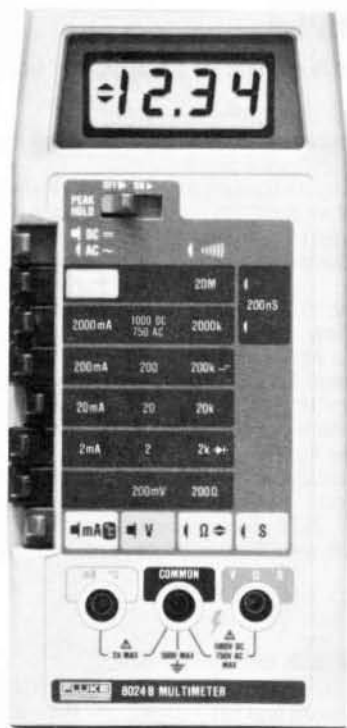
8025A Multimeter (NSN 6625-01-147-6182)

Accessories (Also see page 63)

- C25 Soft Carrying Case
 - TL70 Replacement Test Leads
 - Y8134 Deluxe Test Lead Kit
 - 80K-6 High Voltage Probe
 - 80K-40 High Voltage Probe
 - 83RF 100 MHz RF Probe
 - 85RF 500 MHz RF Probe
 - Y8101 AC Current Probe
 - 80I-400 AC Current Probe
 - 80I-410 DC/AC Current Probe
 - 80I-600 AC Current Probe
 - Y8100 DC/AC Current Probe
 - 80J-10 Current Shunt
 - 80T-150U Temperature Probe
 - 80TK Thermocouple Module
 - LCA-10 Line Current Test Adapter
- Also see page 284 for more accessory information.

Service & Support

8024B



(NSN 6625-01-131-8586) **8024B**

8024B More Than a DMM

- 3½-digits (2000 counts)
- High speed audible continuity (50 μ s response)
- Peak-Hold (10 ms response)
- Temperature (with any K-type thermocouple)
- Logic level detection
- Conductance
- 0.1% basic dc accuracy
- 2-year warranty, 2-year calibration cycle
- Full overload protection
- Fast ac or dc transient capture
- Shock and vibration per MIL-T-28800, Class 5
- Tilt bail with detent position
- UL 1244 listed

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), peak-hold (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.

Continuity Tests

The 8024B indicates circuit continuity in two ways, using either the conductance or resistance ranges. The LCD display shows a \blacktriangle symbol for an open and \blacktriangledown for continuity. Also, an audible "beep" will sound when continuity is detected — useful when you cannot see the LCD display. Both types of indicators use a pulse-stretcher circuit so that even momentary shorts or opens as brief as 50 microseconds can be detected.

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 2 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 600 amps may be measured using the optional current transformer 80i-600 clamp-on ac 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 $+1265^{\circ}\text{C}$ can be measured depending on the K-type thermocouple used. The Y8102 is a sheathed probe, good to $+925^{\circ}\text{C}$, for liquid immersion or penetration measurements. The Y8103 is a bead thermocouple, good to $+260^{\circ}\text{C}$, for air or gas temperature measurements. The Y8104 is a termination kit for attaching any K-type thermocouple to the 8024B.

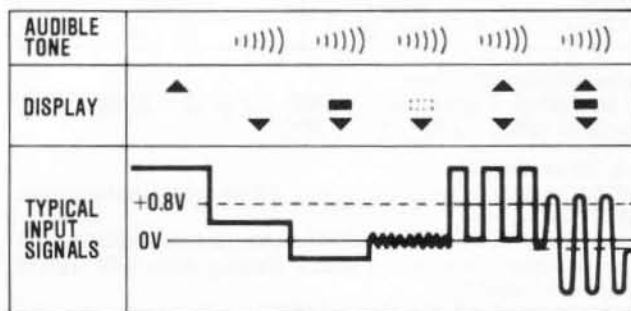
Now you can measure component heat rise, motor temperatures, heating and cooling equipment, etc.

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 $+150^{\circ}\text{C}$ or $+302^{\circ}\text{F}$). 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.



Conductance

This unique Fluke feature enables the user to make high resistance measurements, up to 10,000 M Ω . Conductance is useful for testing high value resistors, leakage in cables, diodes, printed circuit boards, and connectors.

Other Features

Fluke engineers have designed extensive protective circuitry into the 8024B so that it will not be damaged by accidental overloads or operator errors.

The 8024B has a 2-year calibration cycle and is covered by a 2-year warranty on parts and labor. If service is required, there are Fluke authorized service centers around the world to help you.

You can expand the measurement capabilities of the 8024B with optional accessories.

Specifications

All accuracy specifications apply for two years after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90%, unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy
200 mV	100 μ V	$\pm(0.1\%$ of reading + 1 digit)
2V	1 mV	
20V	10 mV	
200V	0.1V	
1000V	1V	

Input Impedance: 10 M Ω on all ranges

Normal Mode Noise Rejection: ≥ 60 dB at 50 and 60 Hz

Common Mode Noise Rejection: 100 dB at dc, 50 Hz, and 60 Hz with 1 k Ω unbalance

Overload Protection: 1000V dc or peak ac on all ranges except 15 seconds max on 200 mV range above 300V dc or rms ac

Response Time: ≤ 1 s, all ranges

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: $\pm(\%$ of Rdg + Digits)		
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz
200 mV	100 μ V	0.75% + 2	1.5% + 3	5% + 5
2V	1 mV			
20V	10 mV			
200V	100 mV	1% + 2	Not Specified	
750V	1V			

Conversion: Calibrated for rms value of sinewaves

Input Impedance: 10 M Ω on all ranges, ≤ 100 pF

Common Mode Noise Rejection: > 60 dB at 50 Hz, 60 Hz, 1 k Ω unbalance

Overload Protection: 1000V dc or 750V rms on all ranges except 200 mV ac range is 15 seconds maximum above 300V ac

Response Time: ≤ 2 s, all ranges

Resistance

Range	Resolution	Accuracy: $\pm(\%$ of Rdg + Digits)	Full-Scale Voltage	Max Test Current
200 Ω	0.1 Ω	0.2% + 3	≤ 0.25 V	0.35 mA
2 k Ω^*	1 Ω	0.1% + 1	≥ 1.0 V	1.1 mA
20 k Ω	10 Ω		≤ 0.25 V	13 μ A
200 k Ω^*	100 Ω		≥ 0.7 V	13 μ A
2000 k Ω	1 k Ω	0.15% + 1	≤ 0.25 V	0.13 μ A
20 M Ω^*	10 k Ω	2% + 1	≥ 0.7 V	0.13 μ A

*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 k Ω range is preferred and is marked with a large 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 1.5V on all ranges, except 2 k Ω range is less than 3.5V

Input Protection: 500V dc or rms on all ranges; 15 seconds maximum above 300V dc or rms ac

Conductance

Conductance is the inverse of ohms (1/ Ω) and is expressed in Siemens (S), formerly mhos. A decrease in conductance is the same as an increase in resistance.

Range*	Resolution	Accuracy: $\pm(\%$ of Rdg + Digits)	Open Circuit	Max Test
200 nS	0.1 nS	2% + 100	< 1.5 V	0.13 μ A

*Equivalent to 5 M Ω to 10,000 M Ω

Input Protection: To 500V dc or rms ac; 15 seconds maximum above 300V dc or rms ac

DC Current

Range*	Resolution	Accuracy: $\pm(\%$ of Rdg + Digits)	Burden Voltage
2 mA	1 μ A	0.75% + 1	0.3V max
20 mA	10 μ A		
200 mA	100 μ A		
2000 mA	1 mA		0.9V max

Input Protection: 2A/250V fuse in series with 3A/600V fuse

Response Time: ≤ 1 s, all ranges

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: $\pm(\%$ of Rdg + Digits)		Burden Voltage (RMS)
		45 Hz to 450 Hz	450 Hz to 1 kHz	
2 mA	1 μ A	4% + 2	Not Spec'd	0.25V max
20 mA	10 μ A	1.5% + 2		
200 mA	100 μ A			
2000 mA	1 mA			
				0.9V max

Overload Protection: 2A/250V fuse in series

Response Time: ≤ 2 s, all ranges

Peak-Hold

Functions: DC or ac-voltage, dc or ac current, all ranges

DC Accuracy: $\pm(3\%$ of reading + 10 digits) square positive pulses of ≥ 10 ms duration (2 ms typical)

AC Accuracy: 48 Hz to 450 Hz, ≥ 150 ms surge duration, $\pm(3\%$ of reading + 10 digits) all ranges, except $\pm(6\%$ of reading + 10 digits) on 2 mA range.

Average-sensing, calibrated to read highest rms value of sinewave

Display Decay Rate: ≤ 1 digit per second

Temperature

Sensor: K-type thermocouple (optional, not included)

Range: -20°C to +1265°C, depending on model of thermocouple

Resolution: 1°C

Accuracy: $\pm(3^\circ\text{C} + 1 \text{ digit})$ from -20°C to +300°C and $\pm 3\%$ of reading from 300°C to 1265°C. Accuracy includes NBS curve conformity, calibration, stability, zero, and reference junction, but excludes thermocouple errors

Input Connections: Banana jacks (COMMON and mA $^\circ\text{C}$) which are reference junction temperature compensated. Fluke K-type thermocouples have dual banana plugs. For any other K-type thermocouples or thermocouple wire, use Y8104 termination accessory

Overload Protection: 2A/250V and 3A/600V fuse in series

Continuity

Ranges: Conductance range and all resistance ranges

Indication: "▲" for open circuit, "▼" for continuity, plus switch-selectable 2 kHz audio tone

Response Time: (2 k Ω range) 50 μ s minimum duration of continuity or open to toggle display and/or audible tone. A pulse-stretcher circuit holds display and produces or interrupts tone for approximately 100 ms when short duration continuity or opens occur.

Input Protection: 500V dc or rms ac all ranges; 15 seconds maximum above 300V dc or rms ac

Level Detection

Reference Level: +0.8V dc, nominal

Display: "▲" for inputs above reference, "▼" for inputs below reference, both for inputs continually crossing reference level. Switch-selectable audio tone coincident with "▼"

Pulse Response Time: (200 k Ω range) \geq 50 μ s for 0 to +3V pulse to toggle display. Pulse stretcher holds display for approximately 100 ms when short pulses are detected

Input Impedance: \geq 100 k Ω , \leq 100 pF

Overload Protection: 500V dc or rms ac; 15 seconds maximum above 300V dc or rms ac

General Specifications

Display: 3½ digits (2000 counts), LCD, autozero, autopolarity

Common Mode Voltage: 500V dc or rms ac, max

Shock and Vibration: Per MIL-T-288800, Class 5

Temperature: 0°C to 50°C, operating; -35°C to +60°C, non-operating

Temperature Coefficient: $<$ 0.1 x the applicable accuracy specification, per °C from 18°C to 0°C and 28°C to 50°C, except temperature function is $<$ 0.02 x accuracy per °C

Relative Humidity: \leq 90% to 35°C, except \leq 80% to 35°C on 2 M Ω , 20 M Ω , and 200 nS ranges; \leq 70% to 50°C

Power: Single 9V battery, NEDA 1604

Battery Life: Alkaline, 100 hours typical

Battery Indicator: "BT" on display lights when approximately 20% of life remains

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: 0.48 kg (1.05 lb)

Included: Manual, test leads (TL70), 9V battery, operator's card, spare fuse, Statement of Calibration Practice

Model

8024B Digital Multimeter

Accessories (Also see page 63)

Y8132 Replacement Test Leads

Y8134 Deluxe Test Lead Set

Y8140 Slim Test Leads, w/needle points

80K-6 High Voltage Probe

80K-40 High Voltage Probe

83RF 100 MHz RF Probe

85RF 500 MHz RF Probe

80T-150U Temperature Probe

Y8102 Sheathed Thermocouple

Y8103 Bead Thermocouple

Y8104 Thermocouple Termination

80T-SP Thermocouple Surface Temperature Probe

80i-400 AC Current Probe

80i-410 DC/AC Current Probe

80i-600 AC Current Probe

80i-1010 AC Current Probe

Y8100 DC/AC Current Probe

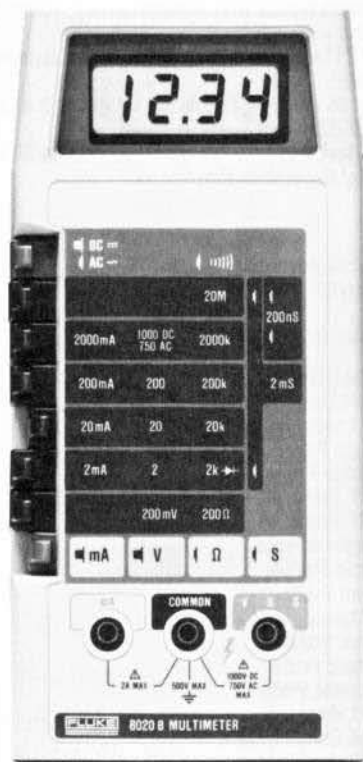
Y8101 AC Current Probe

A81 Battery Charger/Eliminator

C90 Carrying Case

Y8105 Ruggedized Carrying Case

Service & Support



(NSN 6625-01-122-6961) **8020B**

8026B and 8020B Professional Precision

- 3½ digits (2000 counts)
- All basic DMM functions
- Conductance
- Diode Test
- True rms (8026B only)
- 0.1% basic dc accuracy
- High-speed audible continuity testing (beeper)
- Bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-28800, Class 5
- Two year warranty
- Extended measurements with optional accessories

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.

Specifications

All accuracy specifications apply for one year after purchase or recalibration (2 years for 8020B) when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V

Resolution: 100 μV on 200 mV range

Accuracy: ±(0.1% of reading + 1 digit), all ranges

Input Impedance: 10 MΩ, all ranges

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz

Common Mode Noise Rejection: ≥100 dB at dc, 50 Hz, and 60 Hz, with ≤1 kΩ unbalance

Overload Protection: 1000V dc or peak ac on all ranges, except 15 seconds maximum above 300V rms on 200 mV range

Response Time: <1 second

AC Voltage, True-RMS (8026B)

Range	Resolution	Accuracy ±(1% of Rdg + Digits)*			
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz	5 kHz to 10 kHz
200 mV	100 μV	0.5% + 2	0.5% + 2	0.5% + 2	2% + 3
2V	1 mV			1% + 3	
20V	10 mV		1% + 2	Not Specified	
200V	0.1V				
750V	1V				

*For readings >5% of range

AC Voltage, Average-Sensing, RMS-Indicating (8020B)

Range	Resolution	Accuracy ±(1% of Rdg + Digits)		
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz
200 mV	100 μV	0.75% + 2	1.5% + 3	5% + 5
2V	1 mV			
20V	10 mV			
200V	0.1V		Not Specified	
750V	1V	1% + 2		

Input Impedance: 10 MΩ, ≤100 pF, all ranges

Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, with ≤1 kΩ unbalance

Overload Protection: 1000V dc or 750V rms ac, continuous, except 15 seconds maximum above 300V rms on 200 mV range

Response Time: <2 seconds

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Full Scale Voltage	Max Test Current
200Ω	0.1Ω	0.2% + 3	<0.25V	0.35 mA
2 kΩ*	1Ω	0.1% + 1	>1.0V	1.1 mA
20 kΩ	10Ω		<0.25V	13 μA
200 kΩ*	100Ω		>0.7V	13 μA
2000 kΩ	1 kΩ	2% + 1	<0.25V	0.13 μA
20 MΩ*	10 kΩ		>0.7V	0.13 μA

*Diode test ranges

Handheld Multimeters

8026B/8020B

Diode Test: The three diode test ranges have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 k Ω range is preferred and is marked with a diode symbol. The three other ranges will not turn on silicon junctions when making in-circuit resistance measurements
Open Circuit Voltage: Less than 1.5V on all ranges except the 2 k Ω range is 3.5V or less
Overload Protection: 500V dc or rms ac on all ranges, 15 seconds maximum above 300V

Continuity

Resistance Ranges: All. The 2 k Ω range is recommended for lowest resistance threshold
Indication: Audible tone for continuity; no tone for open circuit
Response Time: (2 k Ω range) 50 μ s minimum duration of continuity or open to toggle tone on or off. A pulse-stretcher circuit produces or interrupts the tone for about 200 ms when a short duration continuity or open occurs
Overload Protection: 500V dc or rms ac on all ranges, 15 seconds maximum above 300V

DC Current

Range	Resolution	Accuracy	Burden Voltage
2 mA	1 μ A	+(0.75% of reading + 1 digit)	0.3V max
20 mA	10 μ A		
200 mA	100 μ A		
2000 mA	1 mA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuse in series

AC Current, True-RMS (8026B) Average-Sensing, RMS-Indicating (8020B)

Range	Resolution	Accuracy: \pm [% of Rdg + Digits]*		Burden Voltage
		45 Hz to 450 Hz	450 Hz to 1 kHz	
2 mA	1 μ A	4% + 2	Not Spec'd	0.3V rms max
20 mA	10 μ A	1.5% + 2		
200 mA	100 μ A			
2000 mA	1 mA			0.9V rms max

*For readings >5% of range (8026B)

Overload Protection: 2A/250V and 3A/600V fuse in series

Conductance

Conductance is the inverse of ohms ($1/\Omega$) and is expressed in Siemens (S), formerly mhos. A decrease in conductance is the same as an increase in resistance

Range	Resolution	Accuracy: \pm [1% of Rdg + Digits]	Open Circuit Voltage	Max Test Current
2 mS	10 μ S	0.2% + 1	<3.5V	1.1 mA
200 nS	0.1 nS	2% + 10	<1.5V	0.13 μ A

Equivalent Resistance

2 mS Range: 500 Ω to 1 M Ω
200 nS Range: 5 M Ω to 10,000 M Ω

General Specifications

Display: 3½ digits (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or rms ac, maximum
Shock and Vibration: Per MIL-T-28800, Class 5
Temperature Coefficient: <0.1 x the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Temperature: 0°C to 50°C, operating; -35°C to +60°C, non-operating
Relative Humidity: \leq 90% to 35°C except \leq 80% to 35°C on 2 M Ω and 20 M Ω ranges; \leq 70% to 50°C
Protection Class 2: Relates solely to insulation and grounding properties defined in IEC 348
Power: Single 9V battery, NEDA 1604

Battery Life: 200 hours typical with alkaline battery; 100 hours typical with zinc-carbon battery

Battery Indicator: "BT" appears on LCD display when approximately 20% of battery life remains

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: 0.37 kg (0.82 lb)

Included: Manual, test leads (TL70), 9V battery, spare 2A fuse, operator's card, Statement of Calibration Practice

Models

8026B DMM w/2-year warranty

8020B DMM w/2-year warranty

Accessories (Also see page 63)

Y8132 Replacement Test Leads

Y8134 Deluxe Test Lead Set

Y8140 Slim Test Leads, w/needle points

80K-6 High Voltage Probe

80K-40 High Voltage Probe

83RF 100 MHz RF Probe

85RF 500 MHz RF Probe

80T-150U Temperature Probe

80TK Thermocouple Module

80I-400 AC Current Probe

80I-410 DC/AC Current Probe

80I-600 AC Current Probe

80I-1010 AC Current Probe

Y8100 DC/AC Current Probe

Y8101 AC Current Probe

Y8105 Ruggedized Carrying Case

A81 Battery Eliminator

C90 Carrying Case

Also see page 284 for more accessory information.

Service & Support



8021B

8021B, Rugged & Economical

- 3½ digits (2000 counts)
- Six functions including diode test
- Plus high-speed audible continuity
- 0.25% basic dc accuracy
- 2-year warranty, 2-year calibration cycle
- Bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-28800, Class 5
- Optional accessories for measuring rf, high voltage, high current and temperature
- Battery eliminator (A-81) is also available

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 handheld 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.

Specifications

All accuracy specifications apply for two years after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V

Resolution: 100 µV on 200 mV range

Accuracy: ±(0.25% of reading + 1 digit), all ranges

Input Impedance: 10 MΩ, all ranges

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz

Common Mode Noise Rejection: ≥100 dB at dc, 50 Hz, and 60 Hz, with ≤1 kΩ unbalance

Overload Protection: 1000V dc or peak ac on all ranges

Response Time: <1 second

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy 45 Hz to 450 Hz
200 mV	100 µV	±(1% of reading + 3 digits)
2V	1 mV	
20V	10 mV	
200V	0.1V	
750V	1V	

Conversion: Calibrated for rms value of sinewaves

Input Impedance: 10 MΩ, ≤100 pF, all ranges

Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, with ≤1 kΩ unbalance

Overload Protection: 1000V dc or 750V rms ac, continuous, except 15 seconds maximum above 300V rms on 200 mV range

Response Time: <2 seconds

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Full Scale Voltage	Max Test Current
200Ω	0.1Ω	0.3% + 3	<0.25V	0.35 mA
2 kΩ*	1Ω	0.2% + 1	>1.0V	1.1 mA
20 kΩ	10Ω		<0.25V	13 µA
200 kΩ*	100Ω	2% + 1	>0.7V	13 µA
2000 kΩ	1 kΩ		<0.25V	0.13 µA
20 MΩ*	10 kΩ		>0.7V	0.13 µA

*Diode test ranges

Diode Test: The three diode test ranges have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with a diode symbol. The three other ranges will not turn on silicon junctions when making in-circuit resistance measurements

Open Circuit Voltage: Less than 1.5V on all ranges except 2 kΩ range is 3.5V or less

Input Protection: 500V dc or rms ac on all ranges, 15 seconds maximum above 300V

Continuity

Resistance Ranges: All. The 2 kΩ range is recommended for lowest resistance threshold

Indication: Audible tone for continuity; no tone for open circuit

Response Time: (2 kΩ range) 50 µs minimum duration of continuity or open to toggle tone on or off. A pulse-stretcher circuit produces or interrupts the tone for about 200 ms when a short duration continuity or open occurs

Input Protection: Same as for resistance measurements

Handheld Multimeters

8021B

DC Current

Range	Resolution	Accuracy	Burden Voltage
2 mA	1 μ A	$\pm(0.75\%$ of reading + 1 digit)	0.3V max
20 mA	10 μ A		
200 mA	100 μ A		
2000 mA	1 mA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuse in series

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy \pm (% of Rdg + Digits)		Burden Voltage (RMS)
		45 Hz - 450 Hz	450 Hz - 1 kHz	
2 mA	1 μ A	4% + 2	Not Spec'd	0.3V max
20 mA	10 μ A	2% + 2		
200 mA	100 μ A			
2000 mA	1 mA			0.9V max

Conversion: Calibrated for rms value of sinewaves

Overload Protection: 2A/250V and 3A/600V fuse in series

General Specifications

Display: 3½ digits (2000 counts), LCD, autozero, autopolarity

Common Mode Voltage: 500V dc or rms ac, max

Shock and Vibration: Per MIL-T-28800, Class 5

Temperature: 0°C to 50°C, operating; -35°C to +60°C, non-operating

Temperature Coefficient: <0.1 x the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C

Relative Humidity: $\leq 90\%$ to 35°C except $\leq 80\%$ to 35°C on 2 M Ω and 20 M Ω ranges; $\leq 70\%$ to 50°C

Protection Class 2: Relates solely to insulation or grounding properties defined in IEC 348

Power: Single 9V battery, NEDA 1604

Battery Life: 200 hours typical with alkaline battery; 100 hours typical with zinc-carbon battery

Battery Indicator: "BT" appears on LCD display when approximately 20% of battery life remains

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: 0.37 kg (0.82 lb)

Included: Manual, operator's card, test leads (TL70), 9V battery, spare fuse, Statement of Calibration Practice

Model

8021B DMM w/audible continuity

Accessories (Also see page 63)

Y8132 Replacement Test Leads

Y8134 Deluxe Test Lead Set

Y8140 Slim Test Leads, w/needle points

80K-6 High Voltage Probe

80K-40 High Voltage Probe

83RF 100 MHz RF Probe

85RF 500 MHz RF Probe

80T-150U Temperature Probe

80TK Thermocouple Module

80i-400 AC Current Probe

80i-410 DC/AC Current Probe

80i-600 AC Current Probe

80i-1010 DC/AC Current Probe

Y8100 DC/AC Current Probe

Y8101 AC Current Probe

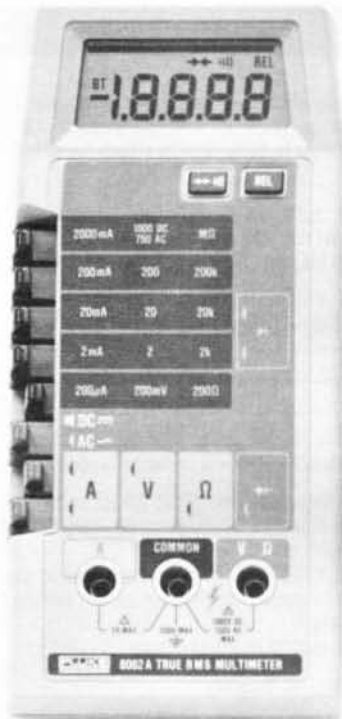
Y8105 Ruggedized Carrying Case

A81 Battery Charger/Eliminator

C90 Carrying Case

Also see page 284 for more accessory information.

Service & Support



(NSN 6625-01-160-4294) **8062A**



(NSN 6625-01-157-2246) **8060A**

8062A, Precision 4½-Digit DMM

- 4½-digit (20,000 count) resolution
- True-rms ac measurements
- Fast audible/visual continuity tests
- Relative reference (offset)
- Low-power ohms on 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

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

The microcomputer lets you automatically subtract lead resistance when measuring ohms and display 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.

8060A World Standard 4½-Digit DMM With Frequency

- 4½-digit (20,000 count) resolution
- True-rms ac measurements
- Fast audible/visual continuity tests
- Relative reference (offset)
- Low-power ohms on 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

Plus

- *Frequency*. . .12 Hz to 200 kHz functional to 700 kHz
- dBm or relative dB measurements
- Conductance 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 are designed using the same rugged case and safety engineered jacks, test leads, and double-fused current inputs found on other Fluke handheld DMMs. And the same extensive overload protection is built in for the other functions and ranges.

Handheld Multimeters

8060A/8062A

Automatic MΩ Range Selection

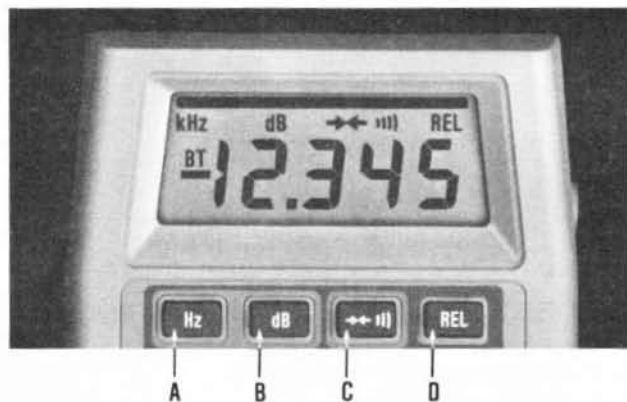
To keep the front panel simple, there is only one manually-selectable position above 200 kΩ. When that position is used, the appropriate 2 MΩ, 20 MΩ, or 300 MΩ range is automatically selected.

Frequency

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, 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

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 10⁷) 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

Input 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		0.2%+10	0.2%+20	0.5%+40	1%+100		
2V	1%+10						
20V		0.5%+10	0.5%+20	1%+40	2%+100		
200V							3%+200
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				5% + 20	5% + 40	
200V						
750V	Not Spec'd	2% + 10	Not Specified			

dBm, 600Ω Reference, 8060A: From 5% to 100% of Range (-50 to +60 dBm)

Range	Accuracy: ±(% of Rdg + Digits)					
	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 Specified	
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 10⁷) 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)		Burden Voltage
		8060A	8062A	
200 μA 2 mA	0.01 μA 0.1 μA	0.2% + 2	0.3% + 2	≤0.3V
20 mA	1 μA	0.3% + 2	0.7% + 2	
200 mA	10 μA			≤0.9V
2000 mA	100 μA			

Input Protection: 2A/250V fuse in series with 3A/600V fuse

Response Time: ≤5 seconds 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 10% 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				Not Specified
2000 mA				

Accuracy, 8062A: ±(% of Rdg + Digits) From 5% to 10% 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				Not Specified
2000 mA	1.5% + 10	1% + 10		

Crest Factor: 1:1 to 3:1

Response Time: ≤3 seconds to rated accuracy

Resistance

Ranges: 200Ω, 2 kΩ, 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	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: 2000 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 Impedance: 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 resistance 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 x 3.4 in x 1.8 in)

Weight: 0.41 kg (0.90 lb)

Included: Manual, TL70 test leads, 9V battery, operator's card, spare fuse, Statement of Calibration Practice

Models

8060A DMM, measures frequency

8062A DMM

Accessories (Also see page 63)

C25 Ruggedized Soft Case

C90 Soft Case

Y8105 Hard Case

TL70 Replacement Test Lead Set

Y8132 Test Lead Set

Y8134 Deluxe Test Lead Kit

Y8140 Test Lead Set

A81 Battery Eliminator

80TK Thermocouple Module

80T-150U Temperature Probe

80i-400 AC Current Probe

80i-410 DC/AC Current Probe

80i-600 AC Current Probe

80J-10 Current Shunt

80K-6 High Voltage Probe

80K-40 High Voltage Probe

83RF High Frequency Probe

85RF High Frequency Probe

Service & Support

Multimeter Accessories

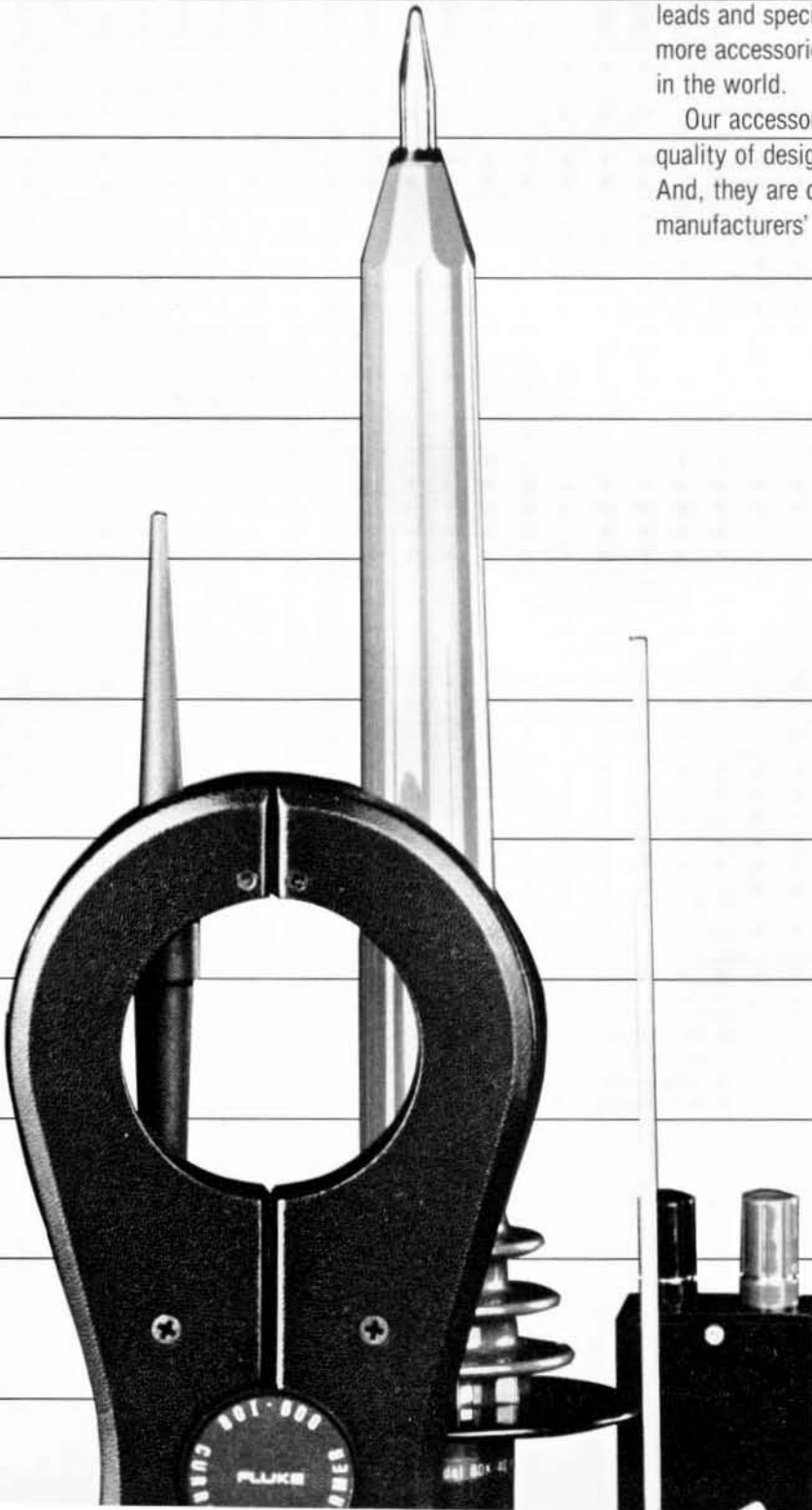


Today's multimeters can become even more powerful tools through the use of accessories. High voltages and currents can be scaled down to levels that are safe to measure with a digital multimeter (DMM).

Temperature modules, probes and thermocouples can convert a DMM into a thermometer. And high frequency probes allow a DMM to be used in situations that might otherwise require an expensive oscilloscope.

Fluke offers a wide assortment of carrying cases, test leads and special accessories, too. In total, Fluke offers more accessories 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.



Multimeter Accessories

Selection Guide

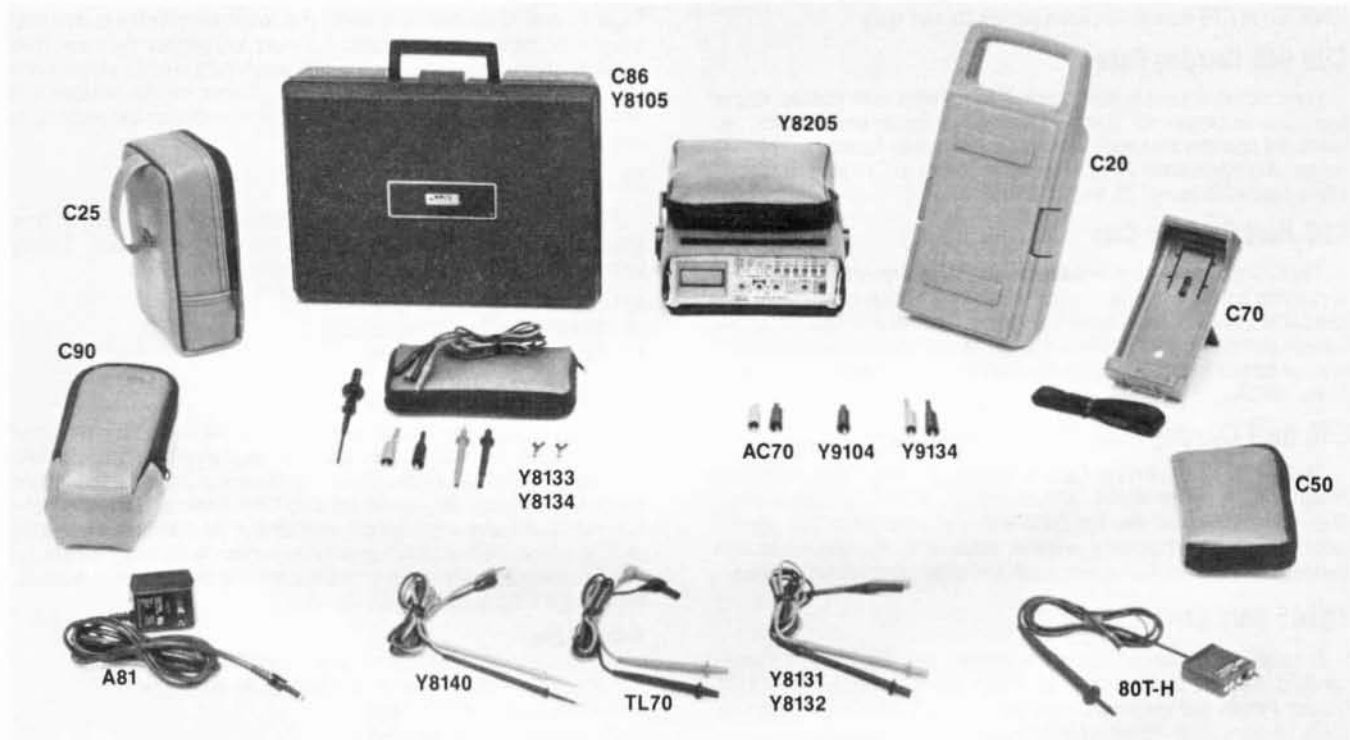
ACCESSORIES	DIGITAL VOLTMETERS and MULTIMETERS																												
	8025A	21	23	25, 27	37	73	75	77	8010A	8012A	8020B	8021B	8024B	8026B	8050A	8060A	8062A	8502A	8505A	8506A	8520A	8522A	8600A	8810A	8840 Series	8920A	8921A	8922A	
TL70 Test Lead Set	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	—	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	(4)	—	—	
Y8131 Test Lead Set	—	—	—	—	—	—	—	—	(4)	(4)	—	—	—	—	—	—	—	—	•	•	•	•	•	•	•	—	(1)	•	(1)
Y8132 Test Lead Set	•	•	•	•	•	•	•	•	—	—	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	—	—	—	—	—	—	—	—	—	—	—
Y8133 Test Lead Set	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	•	•	•	•	•	•	•	—	(1)	•	(1)
Y8134 Test Lead Set	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8140 Test Lead Set	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
C20 Hard Case	(4)	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
C25 Soft Case (9)	•	(6)	(6)	•	—	(6)	(6)	(6)	—	—	•	•	•	•	—	•	•	—	—	—	—	—	—	—	—	—	—	—	—
C50 Soft Case	—	•	•	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C70 Holster	—	•	(4)	—	—	•	•	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C71 Soft Case (See C50)	—	•	•	—	—	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C86 Hard Case	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	•	—	—	—	—	—	—	—	•	—	—	—	—	—
C90 Soft Case	—	(6)	(6)	—	—	(6)	(6)	(6)	—	—	•	•	•	•	—	•	•	—	—	—	—	—	—	—	—	—	—	—	—
Y8105 Hard Case	—	—	—	—	—	—	—	—	—	—	•	•	•	•	—	•	•	—	—	—	—	—	—	—	—	—	—	—	—
Y8205 Soft Case	—	—	—	—	—	—	—	—	•	•	—	—	—	—	•	•	—	—	—	—	—	—	—	•	—	—	—	—	—
A81 Battery Eliminator	—	—	—	—	•	—	—	—	—	—	•	•	•	•	—	•	•	—	—	—	—	—	—	—	—	—	—	—	—
80T-H Touch-Hold Probe	(5)	—	(5)	(5)	(5)	—	—	(5)	•	•	—	—	—	—	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—
83RF R.F. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	•	(1)
85RF R.F. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	•	(1)
80TK Temp. Module	•	•	•	•	•	•	•	•	•	•	•	(5)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-150U Temp. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
80T-SP Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8102 Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8103 Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8104 Temp. Termination	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80K-6 H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	•	(1)
80K-40 H.V. Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	•	(1)
80J-10 Current Shunt	—	•	—	—	—	—	—	—	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
Y8100 Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(1)	•	(1)
Y8101 Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(8)	(3)	(3)	(3)
80i-400 Current Probe	•	(7)	•	•	•	—	•	•	—	—	•	•	•	•	•	•	•	—	—	—	—	—	—	—	(8)	—	—	—	—
80i-410 Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	•	—	—	—	—
80i-600 Current Probe	•	(7)	•	•	•	—	•	•	•	•	•	•	•	•	•	•	•	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(8)	(3)	(3)	(3)	
80i-1010 Current Probe	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	—	—	—	—	—	—	•	—	—	—	—
LCA-10 Line Current Test Adapter	•	—	•	•	•	•	•	•	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y9108 BNC Adapter	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	•	—
Y9109 BNC Adapter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	•	—	—	

• 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 w/o probe
 (6) Accommodates DMM with C70 Holster
 (7) Compatible, 320A maximum
 (8) Requires ac option
 (9) 8020 Series is a loose fit

Convenience accessories simplify circuit connections, probe hard-to-reach places, and protect instruments.



Y8131 Test Lead Set

Four-foot 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.

Y8132 Test Lead Set

Same as Y8131 except safety designed banana plugs are shrouded by an insulating shield. See Selection Guide for compatible DMMs.

Y8140 Test Lead Set

Slim four-foot test leads that have retractable, insulated needle point tips for adjustable lengths. 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. See Selection Guide for compatible DMMs.

TL70 Test Lead Set

Safety-designed right angle plugs shrouded by insulating shield. Strain relief where wire joins probes. See Selection Guide for compatible DMMs.

Y8133 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 and finger guards. 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 Test Lead Kit

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.

Y9134 Alligator Clips

Package of ten insulated alligator clips with banana jack. Five red and five black. For Y8131 through Y8134.

Y9104 Alligator Clips

Package of six black slip-on insulated alligator clips for ground connections. Compatible with pin-tip size probes except TL70.

AC70 Alligator Clips

Package of four slip-on, insulated alligator clips. Two red and two black. Compatible with TL70 or other pin-tip size probes.

Y8205 Soft Carrying Case

A soft vinyl plastic container designed for the storage and transport of either an 8000A, 8010A, 8012A, 8050A, or 8600A 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 pockets. For Fluke 25/27 and 8025A. Also accommodates small accessories and Fluke 21, 23, 73, 75, 77 Meters in C70 holster.

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.

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. Accommodates 20 and 70 Series DMMs in C70 Holster. For all Fluke handhelds except 25 and 27 DMMs.

C20 Hard Carrying Case

The C20 is a heavy duty hard case made of shock resistant hard plastic. 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.

C86 Hard Carrying Case

The Model C86 Carrying Case is a molded polyethylene container designed for either an 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.

Y8105 Hard Carrying Case

A tough, hard plastic 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.

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.

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)

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

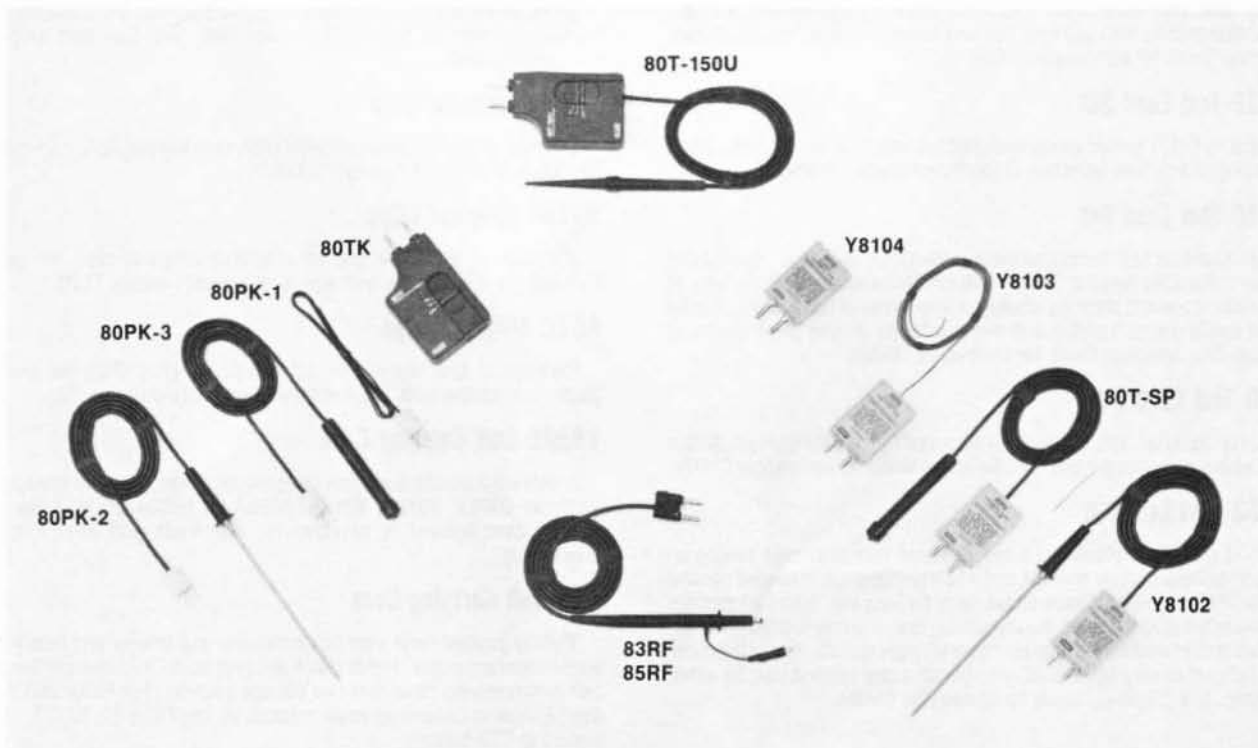
Tip to Common: 1000V dc or peak ac maximum

Common to Ground: 60V dc or 42V peak ac maximum

Input Capacitance: 150 pF maximum

Lead Resistance: 0.5Ω maximum

Extend the measurement capabilities of your DMM to include temperature and high-frequency measurements.



83RF High Frequency Probe

The 83RF converts a 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 M Ω 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

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 High Frequency Probe

The 85RF is designed to convert a 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 probe's 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 M Ω 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 sinewave

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

80T-150U Temperature Probe

The 80T-150U is a universal temperature probe designed to provide virtually all DMMs with temperature 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 3½-digit DMM.

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 maximum

Ambient Temperature Range for Unit: 0°C to +50°C

Relative Humidity: $\leq 80\%$, non-condensing

Accuracy: (Including nominal 0.25% voltmeter error, in +15°C to +35°C ambient)

$\pm 1^\circ\text{C}$ (1.8°F) 0°C to 100°C, decreasing linearly to $\pm 3^\circ\text{C}$ (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: $\pm 2.2^\circ\text{C}$ 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: $\pm 2.2^\circ\text{C}$ from 0°C to 276.7°C and $\pm 0.75\%$ 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: $\pm 2.2^\circ\text{C}$ from 0°C to +260°C

Useable Range: To -40°C (-40°F)

Y8104 Thermocouple Termination

Provides isothermal termination for any Type K thermocouple wire connected to 8024A and 8024B. Maximum wire size is #14 AWG. Ensures no temperature difference between the junctions created by the instrument terminals in contact with the thermocouple terminals.

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 (see page 68).

The output of the 80TK may be read on any DMM having 10 Mohm or greater input impedance and a 3½-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.

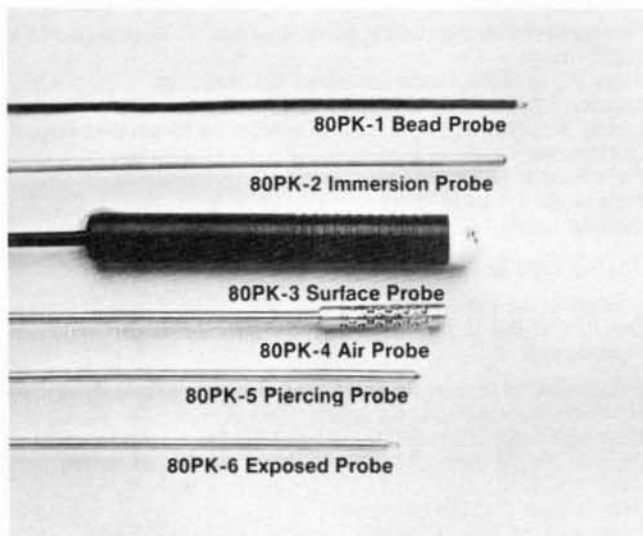
Measurement Range: -50°C to 1000°C (-58°F to 1832°F)

Ambient Operating Range: 0°C to 50°C, 32°F to 122°F

Accuracy:

-20°C to 350°C	0.5% $\pm 2^\circ\text{C}$	500°C to 1000°C	2.0% $\pm 2^\circ\text{C}$
-4°F to 662°F	0.5% $\pm 3.6^\circ\text{F}$	933°F to 1832°F	2.0% $\pm 3.6^\circ\text{F}$
350°C to 500°C	1.75% $\pm 2^\circ\text{C}$	-50°C to -20°C	2.5% $\pm 2^\circ\text{C}$
665°F to 932°F	1.75% $\pm 3.6^\circ\text{F}$	-58°F to -4.0°F	2.5% $\pm 3.6^\circ\text{F}$

Type-K Thermocouple Probes with male mini-connectors for use with 80TK Thermocouple Modules and Fluke 50 Series Handheld Thermometers.



80PK-1 K-Type Bead Probe

Accuracy (with respect to NBS tables): $\pm 1.1^{\circ}\text{C}$ (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 continuous temperature rating is primarily determined by the Teflon insulation

80PK-2 K-Type Immersion Probe

Accuracy (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	$\pm 2\%$ of Rdg
-110°C to -40°C (-166°F to -40°F)	$\pm 2.2^{\circ}\text{C}$ (4°F)
-40°C to 275°C (-40°F to 527°F)	$\pm 1.1^{\circ}\text{C}$ (2°F)
275°C to 927°C (527°F to 1700°F)	$\pm 0.4\%$ of Rdg

Restrictions: The sheath material of the 80PK-2 is Inconel. It should not be used in the presence of sulfur above 537°C (1000°F)

80PK-3 K-Type Surface Probe

Accuracy (with respect to NBS tables): $\pm 1.1^{\circ}\text{C}$ (2.0°F) over the range of -28°C to $+260^{\circ}\text{C}$ (-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-4 K-Type Air Probe

Accuracy (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	$\pm 2\%$ of Rdg
-110°C to -40°C (-166°F to -40°F)	$\pm 2.2^{\circ}\text{C}$ (4°F)
-40°C to 275°C (-40°F to 527°F)	$\pm 1.1^{\circ}\text{C}$ (2°F)
275°C to 816°C (527°F to 1500°F)	$\pm 0.4\%$ of Rdg

Restrictions: The 316 stainless steel baffle should not be exposed to halides or sulfides. The sheath material of the probe is Inconel, and should not be used in the presence of sulfur above 537°C (1000°F)

80PK-5 K-Type Piercing Probe

Accuracy (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	$\pm 2\%$ of Rdg
-110°C to -40°C (-166°F to -40°F)	$\pm 2.2^{\circ}\text{C}$ (4°F)
-40°C to 275°C (-40°F to 527°F)	$\pm 1.1^{\circ}\text{C}$ (2°F)
275°C to 816°C (527°F to 1500°F)	$\pm 0.4\%$ of Rdg

Restrictions: The sheath material of the 80PK-5 is 316 stainless steel. It should not be exposed to halides or sulfides.

80PK-6 K-Type Exposed Junction Probe

Accuracy (with respect to NBS tables)

Range	Max Error
-196°C to -110°C (-320°F to -166°F)	$\pm 2\%$ of Rdg
-110°C to -40°C (-166°F to -40°F)	$\pm 2.2^{\circ}\text{C}$ (4°F)
-40°C to 275°C (-40°F to 527°F)	$\pm 1.1^{\circ}\text{C}$ (2°F)
275°C to 927°C (527°F to 1700°F)	$\pm 0.4\%$ of Rdg

Restrictions: The sheath material is Inconel, an alloy of chromium and nickel. It should not be used in the presence of sulfur above 537°C (1000°F). 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.

80CK-M Male Mini-Connector (not shown)

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.

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 fuse, 5 ea

These fuses are provided to ensure proper protection for Fluke DMMs. These are the only fuses that should be used.

LCA-10 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.

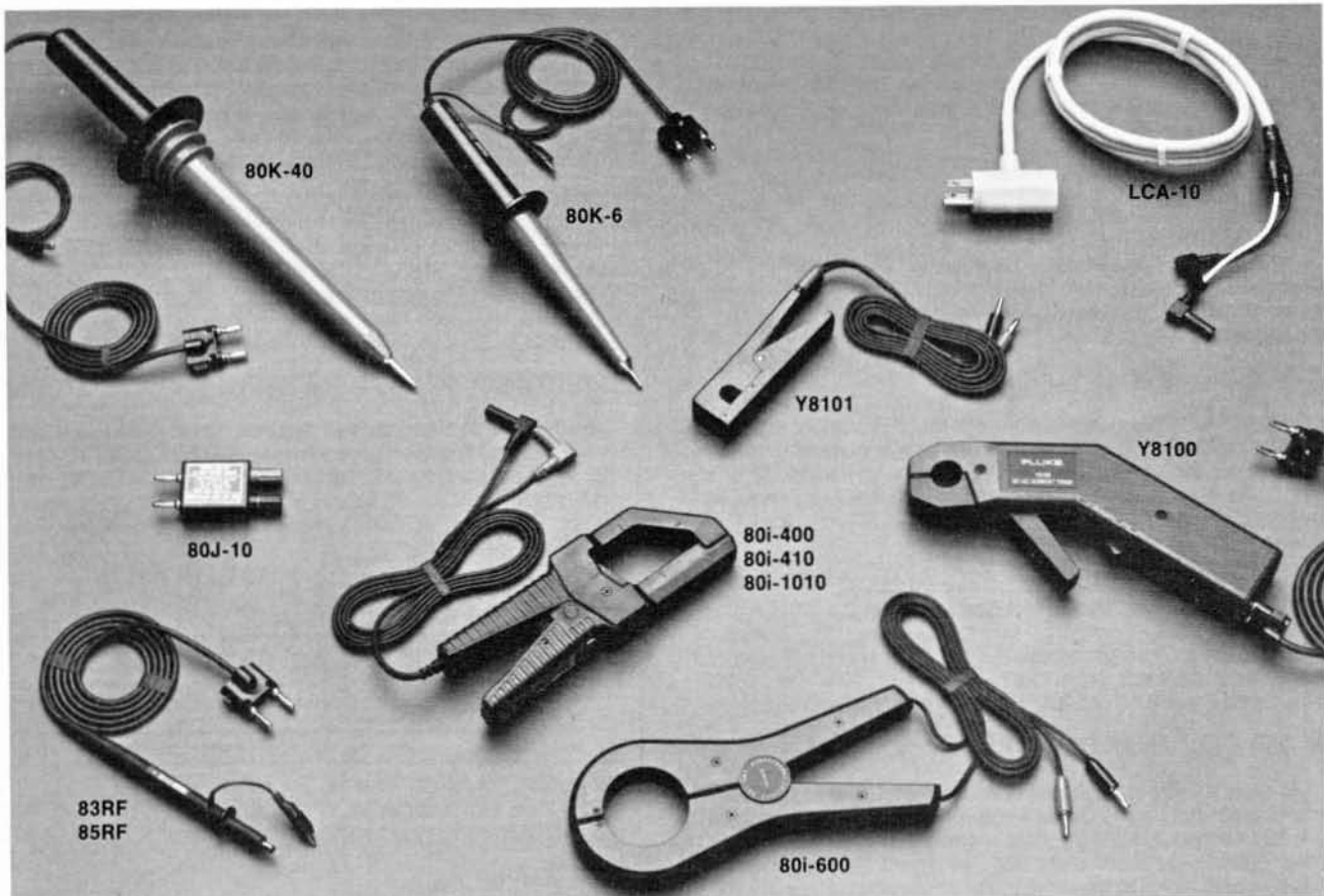
Plug and Receptacle: U.S. NEMA 5-15 compatible (3 wire, straight blade, 15A, 125V ac)

Output Connections: Safety-designed shrouded banana plugs

Maximum Current: 10A ac continuous, 20A ac for 30 seconds

Wire: 5 feet of 16 gauge SJT

These probes and accessories allow your DMM to measure high voltage, high current and high frequency.



4

80K-6 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 M Ω 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 M Ω , nominal

Division Ratio: 1000:1

Accuracy

DC to 500 Hz: $\pm 1\%$

500 Hz to 1 kHz: $\pm 2\%$

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 M Ω $\pm 10\%$.

Caution: These probes are not intended for electric utility applications in which high voltage is also accompanied by high energy. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

80K-40 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 M Ω

Division Ratio: 1000:1

DC Accuracy: $\pm 2\%$ 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: $\pm 5\%$ at 60 Hz

DVM Compatibility: The 80K-40 provides rated accuracy when used with any voltmeter having a 10 M Ω input impedance. When used with voltmeters with other input impedances, a correction factor and/or shunt resistor is used to obtain the correct value.

Caution: These probes are not intended for electrical utility applications in which high voltage is also accompanied by high energy. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

Y8100 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: $\pm 2\%$ of range
 200 Hz to 1 KHz: $\leq 100A$ add $\pm 3\%$ of reading;
 $\geq 100A$ add $\pm 6\%$ of reading

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 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: 48 Hz to 440 Hz $\pm (2.5\%$ of reading +0.15A);
 440 Hz to 1200 Hz $\pm (3\%$ of reading +0.15A)

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 (30mm diameter) conductor or two 500 MCM THHN (25mm diameter each) conductors run in parallel.

Current Range: 1A to 400A

Accuracy: $\pm (3\%$ of reading +0.4A) 48 Hz to 440 Hz
 $\pm (4\%$ of reading +0.4A) 440 Hz to 1000 Hz

Division Ratio: 1000:1

Working Voltage: 660V ac rms maximum

Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25mm (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: $\pm (5\% + 2.5A)$ dc to 62 Hz

Working Voltage: 660V rms

Maximum Conductor Size: 1 ea 30mm (1.18 in) or 2 ea 25mm (0.98 in)

80i-600 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: $\pm (2\%$ of reading) 50 Hz to 1000 Hz

$\pm (3\%$ 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: 1 to 1000A dc, 1 to 700A ac

Accuracy: (% of reading)

	dc	ac, 48 to 62 Hz	ac, 62 to 440 Hz
1 to 100A	2% + 1A	2% + 1A	3% + 1A
100 to 700A	3%	3%	5%
700 to 1000A	5%	Not specified	

Output Signal: 1 mV per amp dc or ac

Working Voltage: 660V rms maximum

Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25 mm (0.98 in)

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 $\frac{3}{4}$ " spacing. Two 5-way binding posts become the current input terminals. The precision, 0.01 Ω 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: 0.01 Ω

Accuracy: $\pm 0.25\%$, from dc to 10 kHz, typically rising to 1 dB at 100 kHz

Series Inductance: 8.3 nH

Overload: $>20A$, not fused

Rack Adapters

See page 286 for rack mounting accessories

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.

M00-100-714 Panel Protector

Dust cover for 8000A, 8600A, 1900A, 1910A, 1911A and 1912A.

Calibrators



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, resistance, or time can be calibrated with Fluke calibrators, standards, and auxiliary equipment. Some of Fluke's equipment and standards are used to calibrate themselves.

For many years, Fluke has been the worldwide leader and principal manufacturer of state-of-the-art 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, electronic counters, oscilloscopes, or other instruments of that kind, study Fluke's complete calibration solutions on the following pages.



What is Calibration?

Calibration is a special, highly-refined measurement process in which you compare test and measurement instruments of unknown status to well-defined standards of greater accuracy in order to detect, eliminate by adjustment, and report any variations in accuracy or capability. In other words, it is a process verifying the operational integrity of instruments. It provides two major benefits. First, it allows you to use your instruments with confidence by minimizing the uncertainties associated with them. Second, it fulfills the requirements for "traceability" to national standards demanded so frequently today.

Calibrators

Model	Direct Voltage (dV)	Alternating Voltage (aV)	Direct Current (dI)	Alternating Current (aI)	Resistance	Wideband	Basic Uncertainty	IEEE-488	Page
335A	To 1110V	—	—	—	—	—	20 ppm	No	88
335D	To 1110V	—	—	—	—	—	10 ppm	No	88
343A	To 1100V	—	—	—	—	—	20 ppm	No	89
515A	To 100V	To 100V	—	—	10Ω to 100 MΩ	—	30 ppm	No	87
5100B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	50 ppm	Option	78
5101B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	50 ppm	Option	78
5200A	—	To 120V	—	—	—	—	200 ppm	Option	82
5440B	To 1100V	—	—	—	—	—	3 ppm	Yes	75
5442A	To 1100V	—	—	—	—	—	4 ppm	Yes	75
5450A	—	—	—	—	1.0Ω to 100 MΩ	—	8 ppm	Yes	86
7105A	To 1100V	—	—	—	—	Resistance Ratio	4 ppm	No	90

Amplifiers

Model	Output Range	Compatible Calibrators	Gain Transcond.	AC-Coupled	DC-Coupled	Page
5205A	1200V rms 1600V dV	5100B 5101B 5102B 5200A 5440B	100	Yes	Yes	93
5215A	1200V rms	5200A	100	Yes	No	95
5220A	To 20A	5100B 5101B 5102B 5440B	1A/V	—	Yes	97

Reference Standards

Model	Stability (Amplitude)	dV	aV	Frequencies	DVMP*	Page
510A	±0.005 % in 30 Days	—	10V rms	50 Hz to 100 kHz	No	108
731B	10 ppm	10V 1V 1.018V ΔV	—	—	No	105
732A	0.5 ppm	10V 1V 1.018V	—	—	Yes	101

*Direct Voltage Maintenance Program

Computer-Aided Calibration

Model	Oscilloscope Calibration	Multimeter Calibration	Bench or Rack	Measurement Capability	Page
7404B	—	Yes	Bench	Yes	117
7410A	Yes	—	Rack	Yes	124
7411B	Yes	Yes	—	Yes	115
7449A	Yes	Yes	Bench	Yes	121
A123	Yes	Yes	Rack	Yes	127

Dividers and Auxiliary Equipment

Model	Basic Uncertainty	Stability	Input Range	Page
Y5020	±0.01%	0.002% in 6 months	0 to 20A	98
720A	0.1 ppm	1.0 ppm/year	0 to 1100V	106
721A	—	—	4000:1 Ratio	104
750A	10 ppm	10 ppm/year	1.1 to 1100V	106
752A	0.2 ppm - 10:1 0.5 ppm - 100:1	—	1100V	100
845AB	2%	0.15 μV/HR	1.0 μV to 1000V	107
845AR	3%	0.15 μV/HR	1.0 μV to 1000V	107

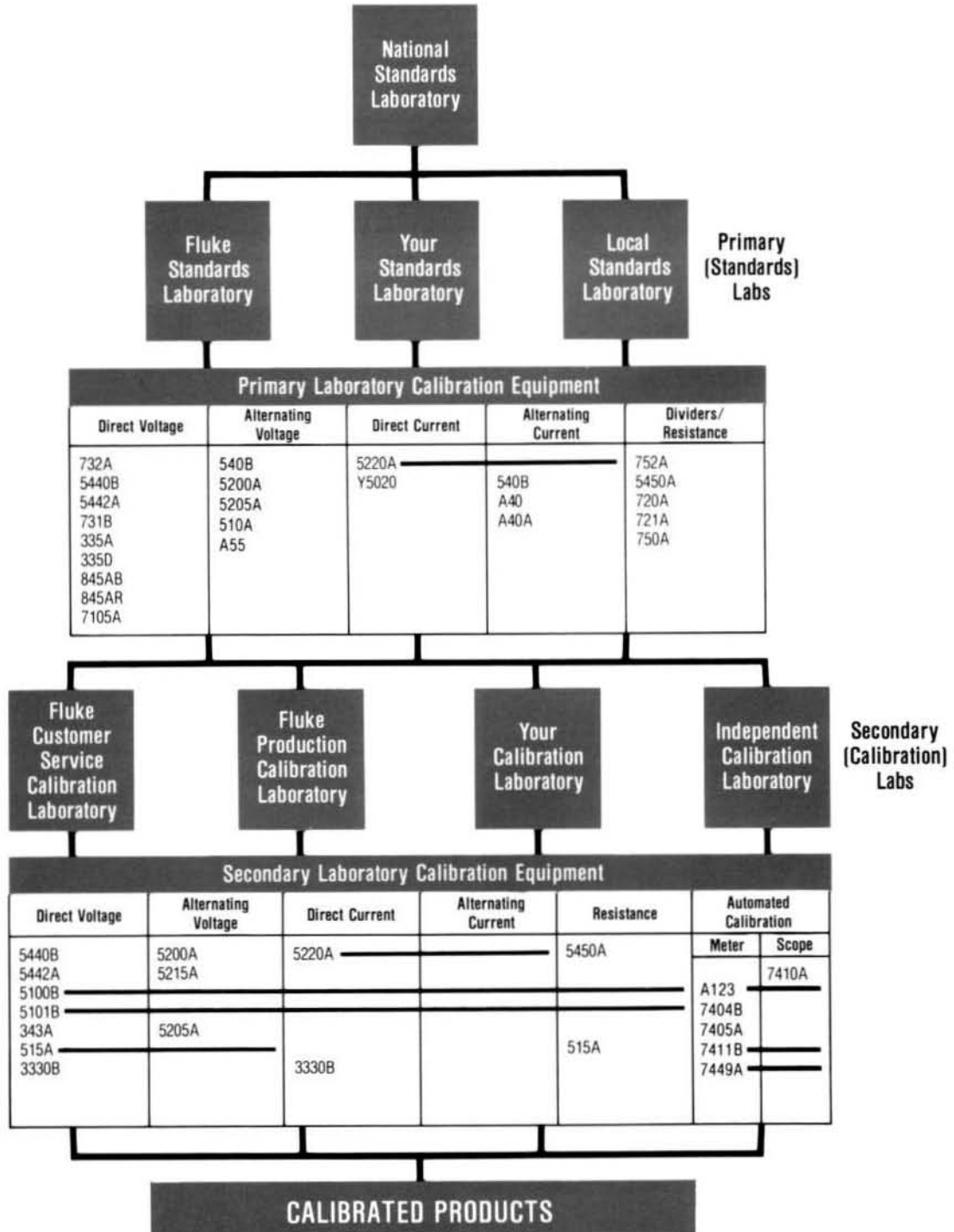
AC/DC Transfer Standards

Model	Volts	Current	AC/DC Difference	Frequency Range	Page
A40	—	10 mA to 5A	0.02% with 540B	5 Hz to 100 kHz	110
A40A	—	10A and 20A	0.03% with 540B	5 Hz to 50 kHz	110
A55	0.5 to 50V	—	0.05% to 0.5%	1 MHz to 50 MHz	110
540B	To 1000V	With A40, A40A	0.01%	5 Hz to 1 MHz	109

Using the Applications Road Map to Calibration

The chart below shows the traceability chain and how Fluke calibration products are used. Products are shown as having applications in primary standards labs, secondary calibration labs,

or both. Fluke also has a variety of automated, computer-aided solutions to your calibration needs. Find the position of your lab on the chart then refer to the box below for the applicable products. Your local Fluke Sales Engineer would be glad to assist you in matching your needs with specific products.



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Selection Guide

	Multimeter Calibration	Direct Voltage Calibration	Alternating Voltage Calibration	Direct Current Calibration	Alternating Current Calibration	Resistance Calibration
5440B		•				
5442A		•				
5100B	•	•	•	•	•	•
5101B	•	•	•	•	•	•
5200A			•			
5450A						•
515A	•	•	•			•
335A		•				
335D		•				
343A		•				
7105A		•				

Accuracy and Uncertainty

Most calibration instruments include a specification called "accuracy." This is a statement of the largest allowable error expressed as a percentage of an absolute value. This number is properly called "uncertainty" because it is the allowed deviation from the nominal; it is a small number, where accuracy would be a large number. (Accuracy could be considered 1 - % uncertainty.)

Uncertainty can be a difficult specification to interpret because there are four accepted accuracy statements that can be combined in several different ways:

- Percent of output
- Percent of full scale
- Number of digits
- Number of units (e.g., microvolts)

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.

Metrology for Technicians General Technology

Metrology for Technicians is a one-week course covering electrical/electronic measurements and calibration for technicians so that they will become more productive in calibrating test instrumentation. The course includes practical tips and exercises to illustrate:

- Loading Errors
- Lead Impedance
- Using Voltage Dividers
- Low Level Measurements
- Thermal EMFs
- Grounding and Guarding
- Measurement System Uncertainties

The student will also be introduced to "Creative Metrology." Creative Metrology is an innovative way of approaching the task of measurement from different points of view and extending the range of NBS traceability. The kind of thinking and techniques required to extend measurement parameters are dealt with in detail. The student will begin to see and use creative techniques for their measurement and calibration requirement.

5440B/5442A



Complete and Easy Calibration. Since all instruments change their calibration with time and temperature, Fluke designed a unique internal cal function into the 5440 Series to make it easy to maintain peak performance under all operating conditions. The completely automatic procedure takes less than 5 minutes, requires no operator assistance, and corrects for most component changes since the last calibration.

A new Quick-Cal procedure lets you calibrate just the 10V range, then correct the remaining ranges by the same amount so all ranges are compensated equally for any change in the internal reference voltage.

Periodic comparison to traceable reference standards is easy too, with a Fluke 732A Direct Voltage Reference Standard, 752A Reference Divider and a null detector.



RS-232

The Fluke 5440 Series provides complete direct voltage calibration support with easy-to-use procedures. Both the 5440B and the 5442A allow you to select the accuracy your application requires. They give 1.5 and 2.5 ppm basic uncertainty, respectively, relative to calibration standards.



5442A (NSN 6625-01-224-9270)

5440B

5

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
- Test procedure memory and Procedure Storage Module for single button test setup (5440B only)
- Completely programmable through the IEEE-488 interface
- RS-232-C interface for printer output of calibration constants and instrument test results
- Simplified Bright vacuum-fluorescent displays for high visibility at all angles and lighting variations

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. 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 $\pm 5^\circ\text{C}$ 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 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 EAROM 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

5440B:

Output Uncertainty Compared to Calibration Standards, $\pm 5^\circ\text{C}$

Range	Uncertainty Specification: \pm (PPM of Output + Microvolts)			
	30 Days	90 Days	180 Days	1 Year
0V to 11V	1.5 + 5 μV	2.0 + 5 μV	2.5 + 5 μV	3.5 + 5 μV
11V to 22V	1.5 + 8 μV	2.0 + 8 μV	2.5 + 8 μV	3.5 + 8 μV
22V to 275V	2.5 + 100 μV	3.5 + 100 μV	4.5 + 100 μV	6.0 + 100 μV
275V to 1100V	2.5 + 400 μV	3.5 + 400 μV	4.5 + 400 μV	6.0 + 400 μV
Divided Output				
0 to 220 mV	4 + 0.5 μV	5 + 0.5 μV	6.5 + 0.5 μV	10 + 0.5 μV
0.22 to 2.2V	3 + 1 μV	4.5 + 1.0 μV	6 + 1.0 μV	8 + 1.0 μV

5442A:

Output Uncertainty Compared to Calibration Standards, $\pm 5^\circ\text{C}$

Range	Uncertainty Specification: \pm (PPM of Output + Microvolts)			
	30 Days	90 Days	180 Days	1 Year
0V to 11V	2.5 + 5 μV	3.0 + 5 μV	4.5 + 5 μV	6.5 + 5 μV
11V to 22V	2.5 + 8 μV	3.0 + 8 μV	4.5 + 8 μV	6.5 + 8 μV
22V to 275V	3.0 + 100 μV	3.5 + 100 μV	5.0 + 100 μV	7.0 + 100 μV
275V to 1100V	2.5 + 400 μV	3.5 + 400 μV	4.5 + 400 μV	6.0 + 400 μV
Divided Output				
0 to 220 mV	6 + 0.5 μV	7 + 0.5 μV	9 + 0.5 μV	12 + 0.5 μV
0.22 to 2.2V	4 + 1 μV	6 + 1.0 μV	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
0.22 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 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 $\pm 1^\circ\text{C}$, constant line voltage, constant load, and measurement bandwidth of 0.1 Hz to 1 Hz.

Range	\pm (PPM of Setting + Floor)		
	10 Minutes	24 Hours	30 Days*
0V to 11V	0.2 + 2 μV	0.3 + 3 μV	0.5 + 3 μV
11V to 22V	0.2 + 3 μV	0.4 + 4 μV	0.5 + 4.5 μV
22V to 275V	0.3 + 40 μV	0.3 + 50 μV	1.0 + 60 μV
275V to 1100V	0.3 + 200 μV	0.3 + 200 μV	1.0 + 300 μV
Divided Output			
0 mV to 220 mV	0.5 + 0.2 μV	0.5 + 0.2 μV	2 + 0.3 μV
0.22V to 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.

Absolute and Relative Uncertainty Specifications

Calibration instrument specifications are related to the accuracy of the standards used to calibrate them. For example, the 5440B and 5442A absolute uncertainty specifications account for the 732A dV Reference Standard. The calibrators have a set of uncertainty specifications relative to the 732A, and the uncertainty specifications of the 732A are relative to national standards. The two uncertainties must be added together to determine the "absolute" uncertainty of the 5440B or 5442A, that is, the uncertainty relative to national standards. Relative uncertainty specifications allow you to determine the absolute uncertainty of a calibrator when it is calibrated with other than the manufacturer's specified standards. If you use a different set of standards, you will need to know what contribution those standards (or process) make.

Temperature Coefficient of Output

These specifications apply for ambient temperatures outside the $\pm 5^\circ\text{C}$ range of the uncertainty specifications listed earlier.

Range	\pm (PPM of Setting) Per $^\circ\text{C}$			
	0-10 $^\circ\text{C}$	10-30 $^\circ\text{C}$	30-40 $^\circ\text{C}$	40-50 $^\circ\text{C}$
0V to 11V	0.15 ppm	0.1 ppm	0.4 ppm	1.0 ppm
11V to 22V	0.15 ppm	0.1 ppm	0.4 ppm	1.0 ppm
22V to 275V	0.2 ppm	0.2 ppm	0.6 ppm	1.5 ppm
275V to 1100V	0.2 ppm	0.2 ppm	1.0 ppm	1.5 ppm
Divided Output				
0 to 220 mV	0.5 ppm	0.5 ppm	0.5 ppm	1.2 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm	0.5 ppm	1.2 ppm

Linearity

These specifications apply for the ambient temperature range of 15 $^\circ\text{C}$ to 30 $^\circ\text{C}$ within $\pm 5^\circ\text{C}$ of the external calibration temperature.

Range	\pm (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 Setting	Maximum Load or Output Resistance
0V to 11V	1 μ V	11.000000V	60 mA
11V to 22V	1 μ V	22.000000V	60 mA
22V to 275V	10 μ V	275.00000V	25 mA
275V to 1100V	100 μ V	1100.0000V	25 mA
Divided Output			
0 to 220 mV	0.01 μ V	220.00000 mV	495 Ω
0.22V to 2.2V	0.1 μ V	2.2000000V	450 Ω

Output Noise

Range	Bandwidth	
	0.1 Hz to 10 Hz	10 Hz to 10 kHz
0 mV to 220 mV	0.1 μ V	5 μ V
0.22V to 2.2V	0.2 μ V	15 μ V
0V to 11V	1.5 μ V	30 μ V
11V to 22V	3.0 μ V	50 μ V
22V to 275V	35 μ V	150 μ V
275V to 1100V	100 μ V	300 μ V

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	\pm 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 $\pm 10\%$ 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: $\leq 90\%$ to 30°C except accuracy is degraded above 80%, $\leq 70\%$ to 40°C, $\leq 40\%$ 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 $\frac{1}{2}$ -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 $\pm 10\%$ or 200V, 220V, 230V, 240V ac $\pm 10\%$, 50 to 60 Hz, 84W Standby, 145W nominal

Size: 61 cm L x 43 cm W x 24 cm H (24 in x 17 in x 9.4 in)

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: 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

Models

5440B Direct Voltage Calibrator

5442A Direct Voltage Calibrator

Accessories (Also see page 284)

5440A-7001 Spare Procedure Storage Module

5440A-7002 Low Thermal Copper EMF Plug-In Cables

732A DC Reference Standard

752A Reference Divider

M08-205-600 8 $\frac{3}{4}$ " Rack Mount Kit

M00-280-610 24" Rack Slide Kit (Requires M08-205-600)

5442A-01 Rear Output Option

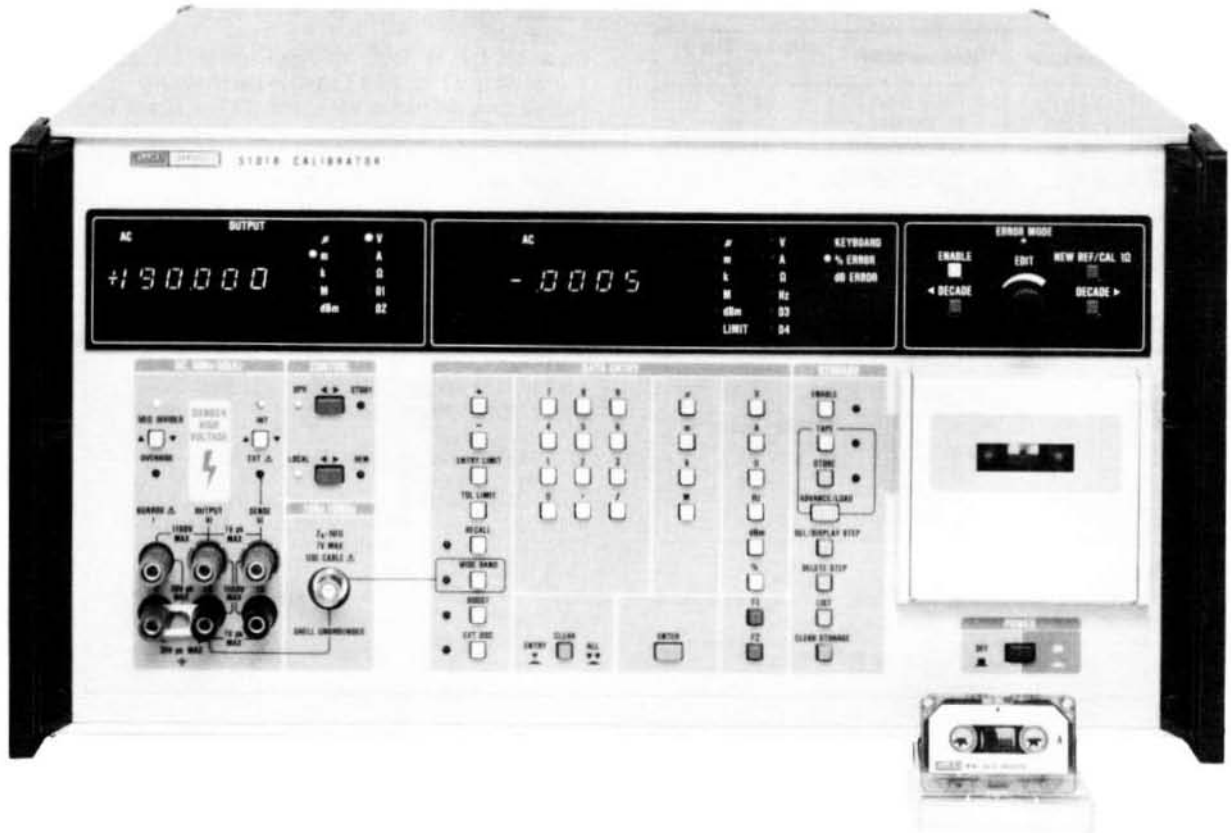
Service & Support

Calibrators

5100 Series B



RS-232



(NSN 6625-01-105-3598)

5101B

5100 Series B Calibrators

- The world standard of multifunction calibrators
- Cost-effective multimeter calibration to 4½-digits
- Five functions: Direct or alternating volts or amps plus ohms
- Cassette tape drive available for storing procedures
- Cluster or workstation capability, 7411B compatible

The 5100 Series B Calibrators offer the convenience of calibrating precision meters that measure direct and alternating voltages and currents and/or resistance. Its microprocessor-based design speeds up repetitive testing — including semi-automated testing using cassette tapes, and automated testing using 7411B software!

5100 Series B Increases Throughput

A large share of the workload of meter calibration laboratories and production lines consists of analog and digital meters with 4½-digit or less resolution. There are hundreds of different meters in this category representing different manufacturers, with no standard format for meter specifications. Even meters from the same manufacturer are often specified differently. This creates a real problem for any cal lab manager.

Until Fluke introduced the 5100 Series, calibration lab and production line managers were forced to write elaborate test procedure to convert the complex specifications into a step-by-step procedure for inexperienced workers. Or they could use expensive, highly-skilled technical people to perform the test without a procedure. These methods sometimes exceeded the initial cost of the instrument by three to five times over a 5-year period.

Operating the 5100 Series B 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 5100 Series B 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 5100 Series B calibrates meters quickly and efficiently. It is no longer necessary to gather together separate calibration instruments requiring complex interconnection and operation. A single 5100 Series B 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 cassette and uses a separate cassette for each procedure. 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 an 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

Both the 5100B and 5101B can be used in computer-aided calibration applications by adding a Fluke 1722A or 1752A Instrument Controller and 7411B Calibration Software. Configurations available include benchtop clusters and mobile workstations. Preprogrammed 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 5100 Series B Calibrators.

Voltage sourcing may be extended from 6 mA maximum to 100 mA maximum at 1100V for direct voltage. And alternating voltage sourcing 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 either a 5100B or 5101B. 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 procedures stored on a 5101B cassette.

Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 μ V	Limited by 50 Ω output resistance or 25 mA using 50 Ω override	0.01% of setting +25 μ V**
200 mV	1 μ V		
2V	10 μ V		
20V	100 μ V	25 mA/1000 pF	0.02% of setting +50 μ V
200V	1 mV	10 mA/400 pF*	0.05% of setting (open to 20 k Ω) 0.1% of setting (20 k Ω 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: \pm (0.005% of setting +0.001% of range +5 μ V) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; \pm (0.005% of setting +0.2 mV) for divider override mode

Temperature Coefficient: Above 30°C and below 20°C, \pm (5 ppm of setting +1 ppm of range +1 μ V)/°C to 200V, \pm (5 ppm of setting +2 ppm of range)/°C, 200V to 1100V

Short Term Stability: (For 10 minutes from 0°C to 50°C) \pm (10 ppm of setting +2 ppm of range +5 μ V) to 500V; \pm 25 ppm of setting, 500V to 1100V

Load Regulation: (External Sense) \pm 10 ppm from 2V to 1100V, no-load to full-load. (Internal Sense) same as external except full-load is 400 Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 μ V	Limited by 50 Ω 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 μ V) rms 10 kHz to 50 kHz: (0.08% of output + 20 μ V) rms
200 mV	1 μ V		
2V	10 μ V	2 k Ω /1000 pF	
20V	100 μ V	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 600 Ω = 0.7746V
**200 mA/1500 pF with 5205A, Y5000 and Y5001

Uncertainty: \pm (0.05% of setting +0.005% of range +50 μ V) from 50 Hz to 10 kHz and \pm (0.08% of setting +0.008% of range +50 μ V) 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	•	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷
20V to 110V	•	•	•	•	•	•	•	•	•	•	•	▷	▷	▷
1 mV to 20V	•	•	•	•	•	•	•	•	•	•	•	•	•	•

▷ With 5205A, Y5000, and Y5001

Frequency Uncertainty: \pm 3%

Temperature Coefficient: Above 30°C and below 20°C \pm (20 ppm of setting +2 ppm of range)/°C for amplitude, \pm 0.1%/°C for frequency

Short Term Stability: \pm (0.01% of range +10 μ V) for 10 minutes from 0°C to 50°C

Load Regulation: External Sense, \pm 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 50 Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 μ A	1 nA	0 to 10V	(0.05% of output +0.01 μ A) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 μ A		
2A*	10 μ A	0 to 2.1V	

*20A with 5220A, Y5000, and Y5002

Uncertainty: \pm 0.015% of setting +0.002% of range +0.01 μ A) 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 \pm (10 ppm of setting +2 ppm of range)/°C

Short Term Stability: \pm (50 ppm of setting +5 ppm of range +0.002 μ A) for 10 minutes from 0°C to 50°C

Load Regulation: \pm 20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion and Noise
200 μ A	1 nA	0 to 7V rms	(0.05% of output +2 μ A) rms
2 mA	10 nA		Distortion, line interference
20 mA	100 nA		
200 mA	1 μ A		+ noise, including random spikes
2A*	10 μ A	0 to 1.4V rms	

*20A with 5220A, Y5000, and Y5002

Uncertainty: $\pm 0.05\%$ of setting $\mp 0.005\%$ of range +0.02 μ A 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 $\pm(25$ ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency

Short Term Stability: $\pm(0.014\%$ of setting +0.002% of range +0.4 μ A) for 10 minutes from 0°C to 50°C

Load Regulation: $\pm(50$ ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1 Ω to 10 M Ω in decade steps

Uncertainty: $\pm 0.003\%$, except $\pm 0.015\%$ (1 Ω), $\pm 0.010\%$ (10 Ω and 1 M Ω), and $\pm 0.030\%$ (10 M Ω) assumes 4 terminal below 100 k Ω . 6 mo 20°-30°C

Power Dissipation: 1W maximum except 100 mW max (1 M Ω) and 10 mW max (10 M Ω)

Temperature Coefficient: Above 30°C and below 20°C, ± 5 ppm/°C except ± 0 ppm/°C (1 Ω and 10 Ω), ± 10 ppm/°C up to 40°C (10 M Ω), and ± 50 ppm/°C above 40°C (10 M Ω)

Extended Specifications

Direct Voltage (with 5205A)

Range: ± 100 V to ± 1100 V, with 10 mV resolution

Maximum Load: 100 mA; 1500 pF

Uncertainty: $\pm(0.07\%$ 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 (with 5205A)

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: $\pm(0.08\%$ of setting +0.1V) for 50 Hz to 10 kHz; $\pm(0.12\%$ 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: $\pm 3\%$

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 (with 5220A)

Range: ± 1 A to ± 19.9999 A, with 100 μ A resolution

Compliance Voltage: 0 to 4V

Uncertainty: $\pm(0.025\%$ 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 (With 5220A)

Current Range: 1A to 19.9999A rms, with 100 μ A resolution

Compliance Voltage: 0 to 3V rms

Current Uncertainty: $\pm(0.07\%$ of setting +1 mA) rms from 50 Hz to 1 kHz, $\pm(0.07\%$ of setting +1 mA) x frequency (in Kilohertz) 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: $\pm 3\%$

Harmonic Distortion and Noise: $\pm(0.07\%$ of setting +1 mA) rms, for bandwidth of 10 Hz to 300 kHz

Option Specifications

Wideband aV Option (-03)

Option -03 is a high accuracy, low noise, extremely flat alternating voltage source which increases the frequency coverage of the 5100 Series B from its standard of 50 Hz to 50 kHz to 10 Hz to 10 MHz. This option enables the 5100 Series B to calibrate wideband meters. A dedicated front panel BNC connector provides ac output from 300 μ V (-57.5 dBm) to 3.1623V (+23 dBm) into 50 Ω 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 50 Ω). 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 50 Ω *

Voltage Range	Approx dBm Range	\pm (% of Setting + % of Range)
1V to 3.1623V	+13 to +23	0.25 + 0.25
0.31624V to 0.99999V	+3 to +13	0.5 + 0.25
0.1V to 0.31623V	-7 to +3	0.75 + 0.25
31.624 mV to 99.999 mV	-17 to -7	1.0 + 0.25
10 mV to 31.623 mV	-27 to -17	1.25 + 0.25
3.1624 mV to 9.9999 mV	-37 to -27	1.5 + 0.25
1 mV to 3.1623 mV	-47 to -37	1.75 + 0.25
300 μ V to 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: $\pm 0.3\%$

30 Hz to 1 MHz: $\pm 0.25\%$

1 MHz to 5 MHz: $\pm 0.25\%$ above 1 mV, $\pm 0.6\% \leq 1$ mV

5 MHz to 10 MHz: $\pm 0.6\%$

*Using 1 foot of RG 58U cable terminated in 50 Ω

Temperature Coefficient: Above 30°C and below 20°C $\pm(0.1$ times basic accuracy)/°C for amplitude; $\pm 0.25\%/°C$ 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: $\pm 3\%$

IEEE-488 Interface Option (-05)

This interface allows the 5100 Series 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 tape cassette) +10°C to +40°C operating; +4°C to +50°C, non-operating. Without cassette: same as 5100B

Relative Humidity: ≤85% 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: Manual, power cord, serialized and dated Calibration Certificate. Also one cassette tape with 5101B

Models

5100B Calibrator

5101B Calibrator, with tape deck

5102B 5100B in portable case (military)

5205A* Power Amplifier

5220A* Transconductance Amplifier

**Y5001 or Y5002 cable and Y5000 interface required when used with 5100 Series B Calibrator*

Options (for 5100B, 5101B, 5102B)

5100A-03 Wideband AC Voltage

5100A-05 IEEE-488 Interface

5100A-06 EIA RS-232-C Interface

Accessories (Also see page 284)

5100A-7003K Fiberglass Case, 5100B/5101B

5100A-7005K Extender Kit

M08-205-600 8¾" Rack Adapter, 5100B/5101B

M00-280-610* 24" Rack Slides

Y5000 Interface Buffer

Y5001 Cable for 5205A/5215A and Y5000

Y5002 Cable for 5220A and Y5000

Y8021 1m Cable for IEEE-488 bus

Y8022 2m Cable for IEEE-488 bus

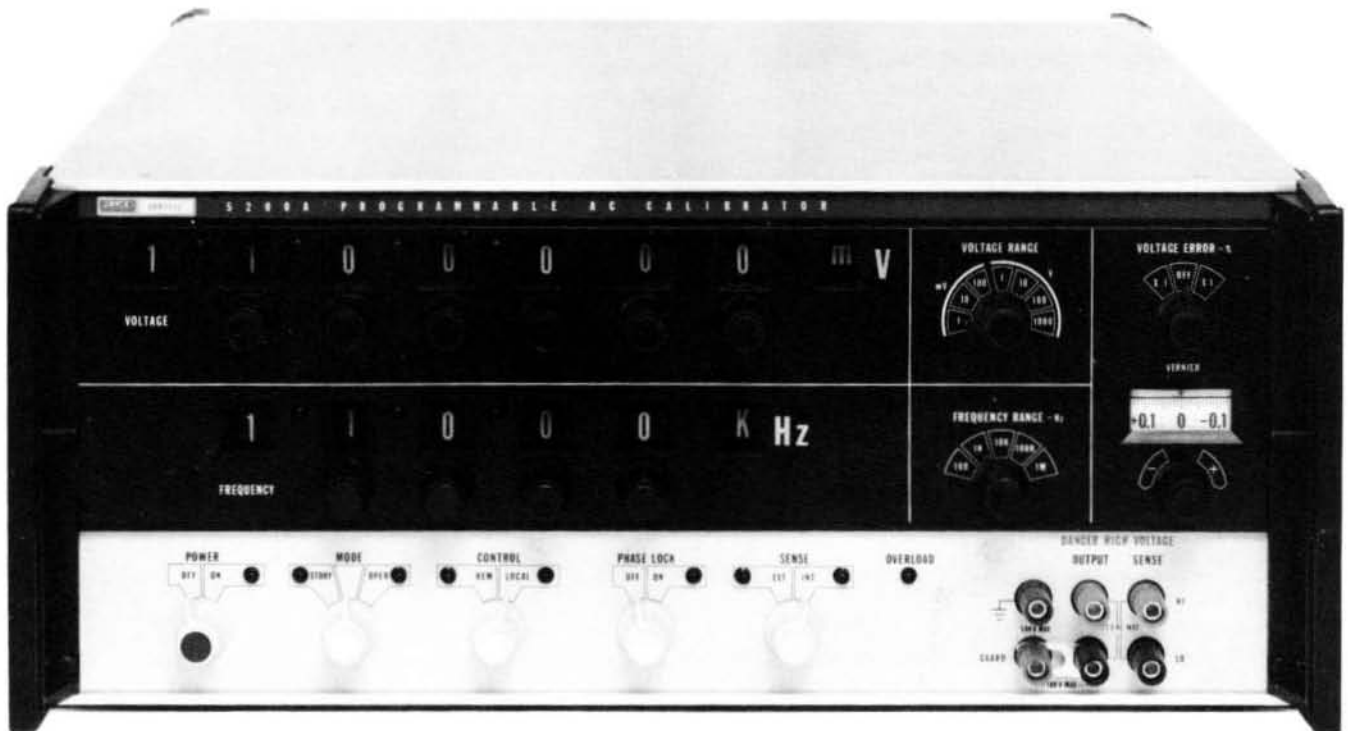
Y8023 4m Cable for IEEE-488 bus

Y8004 1.5m Cable for RS-232-C

Y8007 10-pack of cassettes for 5101B

**Requires M08-205-600*

Service & Support



(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 (1,199,999 counts)
- Output frequencies from 10 Hz to 1 MHz
- Automated characterized operation available
- 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 μ V 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, $\pm 3\%$ and $\pm 0.3\%$. 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 $\pm 1^\circ$ of phase angle, $\pm 0.05^\circ/\text{kHz}$, over a $\pm 2\%$ 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

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 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 = 0 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, TE0, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. It allows complete remote programming of all functions except Power, Remote/Local, and Vernier Voltage Error. In addition, 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.

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 by unskilled operators.

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.

If you know the characteristics of the calibrator design, you can then use mathematical interpolation methods for points other than those selected for characterization. While this will yield 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 Bureau of Standards. 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

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 + μ V)	Frequency Hz	±(ppm setting + μ V)	
				Relative	Absolute
1 mV ³ 10 mV	10-30	1000+10			
	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 10V 100V	10-30	1000+50	50-100	130+20	150+20
	30-20K	200+20	100-20K	125+15	145+15
	20K-100K	500+50	20K-50K	180+20	250+20
	100K-1M	3300+300	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

Notes:

- Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques, 90 days
- 180 days. Requires 5200A-900
- On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth.
- With 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. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques

** With 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 μ V
10V	1.00000V to 11.99999V	10 μ V
100V	10.0000V to 119.9999V	100 μ V
1000*	100.000V to 1199.999V	1 mV

*With 5205A or 5215A Power Amplifier

Stability

Voltage Ranges	Frequency Hz	Stability ¹ (ppm setting + ppm range) ²	
		10 Minutes	180 Days
1 mV 10 mV	10 - 30	70 + 40	300 + 60
	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
1V 10V 100V	50k - 100k	70 + 3	100 + 130
	10 - 30	70 + 40	200 + 20
	30 - 20k	35 + 5 ³	45 + 5
1000V ⁴	20k - 50k	55 + 5	65 + 5
	50k - 100k	70 + 3	220 + 20
	10 - 100	0 + 50	200 + 0
	100 - 20k	70 + 5	200 + 0
	20k - 100k	70 + 5	400 + 0

Notes:

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 range
4. With 5205A or 5215A Power Amplifier

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add $\pm(0.025 \times \text{uncertainty})$ per °C below 18°C or above 28°C; for the 1000V range add $\pm(0.03 \times \text{uncertainty})$ 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, or two ranges: 0 to $\pm 0.3\%$ with 10 ppm resolution; 0 to $\pm 3\%$ 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 $\pm(\% \text{ of input} + \% \text{ of Range})$
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	

*90 days, 18°C to 28°C, after 1-hour warm-up

**100 ppm of range

Total Harmonic Distortion and Line-Related Noise*

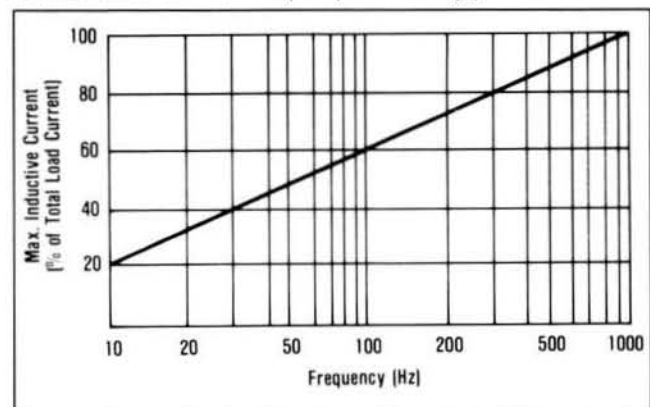
Frequency Hz	$\pm(\% \text{ of setting} + \mu\text{V rms})$
10 - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

*Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A or 5215A specifications

**1V range is $\pm 0.08\%$ 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: $\pm 3^\circ$ below 30 Hz, and $\pm(1^\circ + 0.05^\circ \text{ per kHz})$ over a $\pm 2\%$ band around center frequency

Quadrature Output:

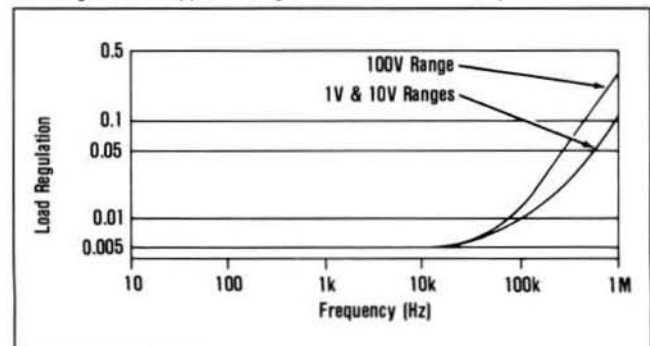
Amplitude: 1V to 10V rms, $\pm 10\%$, proportional to selected output voltage
Phase: 10 Hz-40 Hz, $90^\circ \pm 3^\circ$; 40 Hz to 1.2 MHz, $90^\circ \pm(1^\circ + 0.03^\circ \text{ per kHz})$

Minimum Load: 3 kΩ impedance

Current Limit: Typical transition time, 2 μs. Recovery within specified settling time

Volt-Hertz Product: Output voltage x frequency $\leq 10^7$. 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 x 17 in x 22.5 in)
Weight: 24.1 kg (53 lb)
Includes: Instruction manual, mating connectors, power cord, serialized and dated calibration certificate

Models

5200A Precision Alternating Voltage Calibrator
5205A AC/DC Precision Power Amplifier
5215A Precision Power Amplifier
5200A/5215A Precision Alternating Voltage Calibration System
1722A Instrument Controller

Options

5200A-01* Parallel Remote Control Interface
5200A-03 Logic Level Inversion (for 5200A-01)
5200A-05** IEEE-488 System Bus Interface
5200A-800*** Automated Characterized Operation Software
5200A-900 Characterization of New-Purchase 5200A and 5215A
5200A-902 Characterization of New-Purchase 5200A
 *Cannot be used with 5200A-05
 **Cannot be used with 5200A-01
 ***Requires 1722A, 1752A or 1720A, and 5200A-900 or 5200A-902

Accessories (Also see page 284)

M07-205-600 Rack Mount Kit for 5200A
M10-205-600 Rack Mount Kit for 5215A
M00-280-610 24" Rack Slides for rack adapter
Y1790 Rack Mount Kit with 24" Slides for 1722A
5200A-7015K Extender Board Kit

Service & Support

5450A

IEEE-488



5450A

5450A Resistance Calibrator

- 17 standard resistors in one enclosure
- Decade values from 1.0Ω to 100 MΩ
- .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
- 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. Because full range readings of most digital multimeters start with the digits 19, the accuracy of readings near the full range may be checked using the 19-series resistors.

Each resistor differs from its nominal value by no more than 0.1%. But the precise value of each is known with a much higher degree of certainty. The known value of each is stored in EAROM and used for calibration purposes. Each value displayed has 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 in the EAROM. Recalibration can be accomplished without removing the instrument covers, and may even be done remotely over the 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.

Specifications

The following 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.

Accuracy, 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		Lower	Upper
	24 Hours	90 Days	90 Days	1 Year		
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. Bureau of Standards

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 x 17 in x 21.8 in)

Weight: 9.3 kg (20.4 lb)

Included: Instruction manual, line cord, serialized and dated calibration certificate

Model

5450A Resistance Calibrator

Accessories (Also see page 284)

Y8021 1m Cable for IEEE-488 bus

Y8022 2m Cable for IEEE-488 bus

Y8023 4m Cable for IEEE-488 bus

M00-260-610* 18" Rack Slides

M00-270-610* 20" Rack Slides

M00-280-610* 24" Rack Slides

Y8599 3½" Rack Adapter

Y8598 3½" Rack Adapter with 22" Slides

*Requires Y8599

Service & Support



(NSN 6625-01-086-2041) 515A

515A Portable Calibrator

- Precision, portable, 4½-digit calibration and 5½-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 3½ inches high by 8½ 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:

Functions Checked

- 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

Direct Voltage

Ranges

- μV: 0 to 999 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: Manual, power cord, batteries, serialized and dated calibration certificate

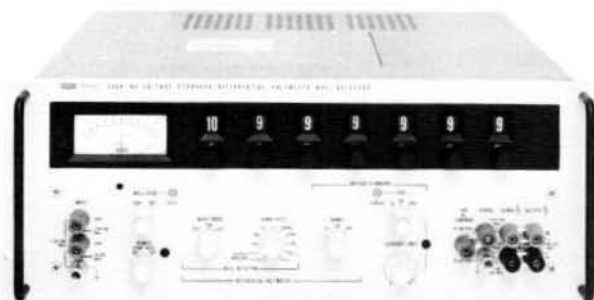
Model

515A Calibrator

Accessories (Also see page 284)

- M03-200-618 3½" Rack Adapter, Dual
- M03-200-619 3½" Rack Adapter, Offset
- M03-200-620 Panel Mounting Kit
- M03-203-700 Panel Protector

Service & Support



(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 μ V steps), 0 to 111.111110 (10 μ V steps), 0 to 1111.1110 (100 μ V steps)

Output Current: 0 to 50 mA

Accuracy of Output: * \pm (% of Setting + μ V)

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

Stability of Output: \pm (% of Setting + μ V)

Range	335A	335D
10V	$\pm(0.001 + 10)/\text{mo}$ $\pm(0.002 + 20)/\text{yr}$	$\pm(0.0005 + 7)/\text{mo}$ —
100V & 1000V	$\pm(0.001 + 20)/\text{mo}$ $\pm(0.002 + 40)/\text{yr}$	$\pm(0.0005 + 30)/\text{mo}$ —

NOTE: The accuracy and stability are absolute, relative to NBS standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C \pm 1°C and up to 70% relative humidity.

Temperature Coefficient: (0.0002% of setting + 1 μ V)/°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, $\leq 20 \mu$ V rms; 100V range, $\leq 30 \mu$ V rms; 1000V range, $\leq 40 \mu$ V rms

Settling Time: Typically within 10 ppm of final output less than 20s after a range change

Regulation: 0.0002% of setting or 10 μ V 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 $\pm 10\%$, 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: Manual, power cord, serialized and dated calibration certificate

Models

335A DC Voltage Calibrator/Null Detector

335D DC Voltage Calibrator/Null Detector

Accessories (Also see page 284)

A60-01 17-20" Rack Slides

Service & Support



(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 μ V on the 10 μ V range.

Cleanliness of the dc output is evident in the combined ripple and noise specifications of 50 μ V 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 μ V on 10V range, 10 μ V on 100V range, 100 μ V on 1000V range

Accuracy, 90 Days

10V Range: $\pm 0.002\%$ of setting or $\pm 0.0002\%$ of range*

100V Range: $\pm 0.002\%$ of setting or $\pm 0.0001\%$ of range*

1000V Range: Same as 100V range

*Whichever is greater

NOTE: The above accuracies are absolute, relative to NBS standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C \pm 1°C and up to 70% relative humidity after 30 minute warm-up. Apply for 90 days.

Stability: $\pm\%$ of Setting or \pm Microvolts*

Time	10V Range	100V Range	1000V Range
Per Hour	0.005% or 5 μ V	0.0005% or 10 μ V	0.0005% or 20 μ V
Per Month	0.0015% or 15 μ V	0.0015% or 25 μ V	0.0015% or 50 μ V
Per 6 Mo.	0.0025% or 30 μ V	0.0025% or 40 μ V	0.0025% or 60 μ V

*Whichever is greater

Temperature Coefficient: \pm (3 ppm of setting +0.1 ppm of range +2 μ V) per degree Celsius from 24°C to 15°C or 25°C to 35°C

Regulation: $<0.0005\%$ of setting +25 μ V 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 $\pm 10\%$, 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: Instruction Manual, power cord, serialized and dated calibration certificate

Model

343A DC Voltage Calibrator

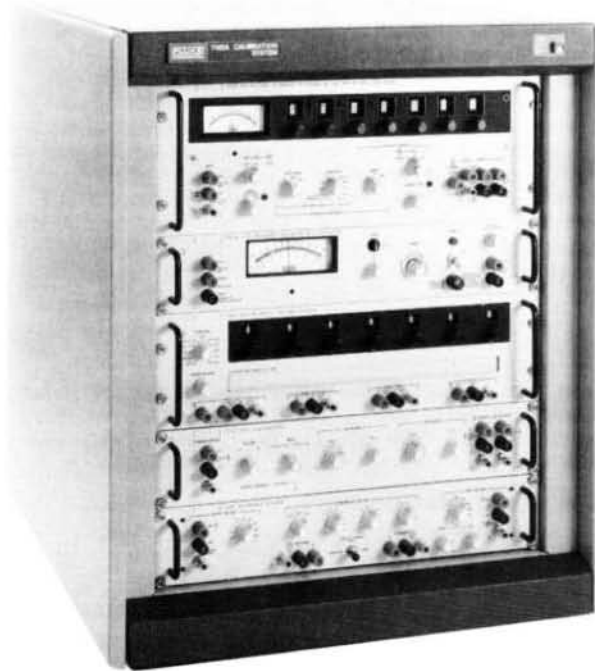
Accessories (Also see page 284)

MEE-7001 3½" Rack Adapter

MEE-8078 18" Rack Slides for rack adapter

MEE-8079 24" Rack Slides for rack adapter

Service & Support



(NSN 6625-00-492-5385) **7105A**

7105A dV Calibration Instrument Cluster

- Cost-effective, high accuracy calibration
- Self-calibrating
- Expandable for aV calibration

The 7105A is a calibration system composed of five Fluke standards-type instruments mounted in a single benchtop cabinet. The system is self-calibrating and lets you achieve calibration accuracy equal to that found in standards laboratories. The 7105A is well known world-wide and is used extensively by electronic and electrical equipment manufacturers and government facilities.

Although the system is strictly for calibrating direct voltage sources, direct voltage meters, and the direct voltage value of resistors and dividers, the dV capabilities may be extended to aV calibration and measurement through the use of Fluke thermal transfer standards 540B, A55, A40, and A40A.

- The instruments comprising the 7105A are:
- Model 335A** DC Voltage Standard/Null Detector
 - Model 845AR** High Impedance Voltmeter/Null Detector
 - Model 750A** Reference Divider
 - Model 720A** Kelvin-Varley Divider
 - Model 721A** Lead Compensator

Calibrate Voltage Sources and Voltmeters

Ultimate accuracy in voltage calibration is easily achieved using a two-step approach:

Step 1. Transfer the accuracy of the standard cells to the 10-volt output of a 732A Direct Voltage Reference Standard using a 720A Kelvin-Varley Divider and a null detector.

Step 1 Error Limits

Number of Standard Cells (n)	Limits of Error*
n = 4	0.6 ppm
n = 5	0.5 ppm
n = 6	0.4 ppm
n = 7	0.4 ppm
n = 8	0.4 ppm
n = 9	0.3 ppm

*Standard cell uncertainty not included

Step 2. Calibrate the output of the 335A DC Calibrator, or any very stable power supply, using the 732A, the 720A, a null detector, and a 750A Reference Divider which has its 10V, 100V, 1000V, and 1100V ratios specially calibrated.

The limits of error for different voltage ranges are shown in the table below for these conditions:

- The 732A was calibrated using nine standard cells.
- The self-calibration of the 720A and the calibration of the 750A at the 10V and 100V, and the 10V, 1000V, and 1100V ratios was performed immediately prior.
- Ambient temperature remains stable within $\pm 1^\circ\text{C}$.

Step 2 Error Limits

Voltage Range	Limits of Error*
$\leq 10\text{V}$	$0.3 + (0.2 \div S)$ ppm
10V to 100V	3.3 to 1.5 ppm
100V to 1100V	4.3 to 2.5 ppm

*Standard cell uncertainty is not included
S = Setting of Fluke 720A division ratio (0 to 1.0)

Below 10V, better accuracy may be achieved by using a different configuration of the 7105A System.

Calibrate Voltage Dividers

Using the 335A as a stable dV source and the 721A to compensate lead errors, a voltage divider may be checked. Specifications for the comparison are listed:

Absolute Linearity	0.1 ppm of input
Resolution	0.1 ppm of input
Inut Taps	1.1 and 1.0
Maximum Input Volts	1.1 kV and 1.0 kV
Input Resistance	110 k Ω and 100 k Ω
Power Coefficient	0.1 ppm of input/W
Temperature Coefficient*	0.1 ppm of input/ $^\circ\text{C}$
Stability*	1 ppm/yr

*720A self-calibration removes linearity deviations caused by time or temperature

Precision Differential Voltmeter

The system may be configured as a differential voltmeter obtaining 0.1 ppm resolution with the 720A Kelvin-Varley Divider. Both null detectors are used, one to compare the input voltage and one to continuously monitor standard cell EMF. Uncertainty is 5 ppm to 100V, to 20 ppm at 1.1 kV.

Model

- 7105A** dV Calibration System (includes 7105A-502)
- 7105A-502K** Cabinet, with gold flashed low thermal leads, accessories, 115V
- 7105A/AA** Cabinet, with gold flashed low thermal leads, accessories, 230V

Selecting Calibrators and Standards

When selecting calibrators and standards, the most important consideration is your application. This would include such things as accuracy (or uncertainty), precision, and stability requirements and factors such as whether you will be doing calibrations on-site or in a lab, whether you need benchtop or rack-mounted instruments, and many other factors, including cost.

Once you know to what level of uncertainty the calibrations must be performed, you can begin to determine which calibrators, standards, and calibration systems are appropriate. This information can be obtained from this catalog, or your local Fluke Sales Engineer will be glad to assist you.

One rule-of-thumb ought to be followed: **the calibration process should be as simple as your application will allow.** The use of primary-level calibration instruments serves no useful purpose when calibrating instruments that don't require primary level calibration, such as a low accuracy handheld DMM.

The next consideration is whether your facility can maintain the environment required by your instruments. You will only be able to achieve specified uncertainty, precision, and stability if you adhere to the environmental constraints of temperature, relative humidity, and main supply voltage for your instruments. And with the growing move to on-site and mobile calibration, you will need to consider whether your instruments will be used only in the controlled environment of a lab, or if they will be going to the production floor and perhaps even further from the lab.

Finally you need to consider your metrology expertise. The lowest level of calibration uncertainty (highest accuracy) is achieved in a primary level lab, using high accuracy, extremely stable, precision single-function calibrators and standards. The metrology techniques required in these situations are extremely refined and sophisticated, and demand either a great deal of expertise or an automated approach.

Fluke can assist you with all these factors in your selection of calibration instruments. Fluke provides you with a broad spectrum of calibrators, standards, computer-aided calibration systems, and other related products so you know Fluke has the instruments that meet your needs.

And Fluke clearly defines the environmental specifications for our instruments so you can match your instrumentation needs to the environment of your calibration facility. Our instruments are very environmentally stable and rugged for using outside the lab. Calibration systems are available mounted in racks with pneumatic wheels so they can handle even the bumps of doorways and the production floor.

Fluke puts extra engineering effort into designing calibration instruments that are user-friendly and ergonomically suited to the calibration process. You will find our calibration instruments easy to learn and, perhaps more important, easy to use on a daily basis.

Fluke recognizes the importance of both manual and automated approaches to calibration, and offers you solutions that will match a need for either or both. Fluke instruments can be used manually or remotely via their IEEE-488 interfaces. The Fluke 7411B provides an approach to automation that lets you start with instruments you may already have in your lab, and add capability as your needs grow and budget becomes available.

Literature Guide

To help you learn more about calibration, Fluke offers a wide variety of literature on calibration and various related subjects. Your Fluke Sales Engineer can provide you with data sheets on specific products. And page 238 of this catalog lists all the technical literature available. Some specific items you may be interested in are described below. Contact your Fluke Sales Engineer for copies.

Fluke Calibration: Building Confidence Into Your Every Measurement describes how calibration fits into your everyday manufacturing environment. This brochure is specifically targeted towards those who are not familiar with calibration.

5440 Series: Complete Direct Voltage Calibration describes Fluke's line of calibrators, standards, and support products for complete direct voltage and resistance calibration. Information is included on how Fluke is traceable to the U.S. National Bureau of Standards (for direct voltage) using solid-state reference standards instead of saturated standard cells.

Computer-Aided Calibration explains how you can automate your lab, one step at a time, using your existing calibration instruments and Fluke calibration software. This brochure also explains how calibration systems can be custom-configured to meet your exact needs.

Calibration: Philosophy in Practice is a 100-page book describing various aspects of cal 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.

Fluke-Equipped Traceable Lab describes how Fluke instruments fit various applications. Traceability charts are included and definitions of basic terminology.

Additional literature is available on financial analysis of your calibration needs, using and servicing specific products, and other special techniques. Consult your Fluke Sales Engineer.

Service & Support

Introduction

Amplifiers can be used with your calibrator to extend the direct and alternating voltage sourcing and current sourcing beyond the basic built-in capabilities of the calibrator. Amplifiers are controlled either from the calibrator's front panel or, in remote control and system applications, via the calibrator's IEEE-488 interface.

Fluke offers two Precision Power Amplifiers, the 5205A and 5215A, and one Transconductance Amplifier, the 5220A. Refer to the diagram below for information on which amplifiers are best suited to which Fluke calibrators.

Amplifier Interfacing Guide

	5100B Meter Calibrator	5200A aV Calibrator	5440B dV Calibrator	5442A dV Calibrator
5205A Precision Power Amplifier	● (1)	●	● (4)	▶
5215A Precision Power Amplifier	● (2)	●	X	X
5220A Transconductance Amplifier	● (3)	▶	● (5)	▶

● Programmable from source ▶ May be manually interconnected X Not suitable for interconnection

(1) With Y5000 interface buffer and Y5001 cable

(2) With Y5000 interface buffer and Y5001 cable, but useable only for alternating voltage

(3) With Y5000 interface buffer and Y5002 cable

(4) With Y5001 cable

(5) With Y5002 cable



(NSN 6625-01-068-6762) **5205A**

5205A Precision Power Amplifier

- Extends range of 5100 Series B, 5200A, 5440B, or 5442A Calibrators
- Output voltages to 1100V rms, $\pm 1500V$ 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
- Short and overload protected

The 5205A Precision Power Amplifier is a dc coupled programmable inverting amplifier with a fixed gain of 100. Designed as a precision calibration amplifier, 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 $\pm 1500V$ 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 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 5205A-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 Bureau of Standards. 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, Calibrator Mode

Amplitude Uncertainty With 5100 Series B Calibrator

Absolute Uncertainty*	
Frequency Hz	$\pm(\text{ppm setting} + \text{mV})$
dc	700 + 20
50 - 10k	800 + 100
10k - 50k	1200 + 150

* Traceable to U.S. NBS Standards. 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**		
Frequency Hz	$\pm(\text{ppm setting} + \text{ppm range})$	Frequency Hz	$\pm(\text{ppm setting} + \text{ppm range})$	
			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

* Traceable to U.S. NBS Standards. 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:* \pm ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

* Traceable to U.S. NBS Standards. 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

Amplitude Uncertainty With 5440B or 5442A Calibrator: Use amplifier-mode gain uncertainty specifications

Output Voltage Range: 100V to 1099.999V, $\pm dV$ 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 $\pm(0.025 \times \text{uncertainty})$ 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
	$\pm(\text{ppm setting} + \text{ppm range})$		
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

5

Specifications, Amplifier Mode

Maximum Output Voltage: 1100V rms aV, ± 1500 V dV
Typical Overload Trip Voltage: 1200V rms aV, ± 1600 V 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
500 Ω , 100 pF	$\pm 0.05\%$	$\pm 0.2\%$
5000 Ω , 100 pF	$\pm 0.05\%*$	$\pm 0.15\%$
1 M Ω , 200 pF	$\pm 0.05\%$	$\pm 0.2\%$
1 M Ω , 500 pF	$\pm 0.06\%$	$\pm 0.4\%$
1 M Ω , 1000 pF	$\pm 0.08\%$	$\pm 0.8\%$
1 M Ω , 1500 pF	$\pm 0.1\%$	$\pm 1.2\%$

* $\pm 0.04\%$, 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: $\pm(0.03 \times \text{uncertainty})$; 20 kHz to 100 kHz: $\pm(0.06 \times \text{uncertainty})$

Gain Stability

Frequency Range	Max Capacitive Load	24 Hours	6 Months
dc to 20 kHz	1500 pF	0.03%	0.06%
20 kHz to 100 kHz	100 pF	0.08%	0.2%
20 kHz to 100 kHz	1500 pF	0.4%	0.8%

Maximum Slew Rates:*

Maximum Load	Maximum Input Slew Rates	Maximum Output Slew Rates
200 mA Resistive	8.0V/ μ s	800V/ μ s
100 pF Capacitive	8.0V/ μ s	800V/ μ s
200 pF Capacitive	5.0V/ μ s	500V/ μ s
500 pF Capacitive	3.0V/ μ s	300V/ μ s
1000 pF Capacitive	2.0V/ μ s	200V/ μ s
1500 pF Capacitive	1.0V/ μ s	100V/ μ s

* 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 ± 10 V dc or rms ac from chassis to reduce common mode errors

Input Impedance: 10 k Ω in parallel with less than 120 pF

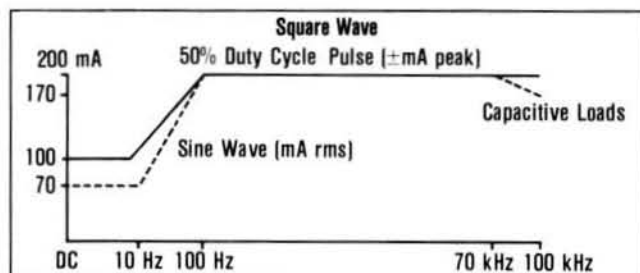
Input Connector: BNC, located on front panel. (Located on rear panel with Option -07)

Maximum Input Voltage: 50V dV or rms aV

Maximum Input Bias Current: 100 nA

General Specifications

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 1500 Ω 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 1500 Ω 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 overloads, 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

Input Power: 100V, 115V, 200V, 230V ac, $\pm 10\%$, 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: Instruction Manual, interface cable to 5200A, serialized and dated calibration certificate

Model

5205A Precision Power Amplifier

5205A-07 With Rear Input/Output

Accessories (Also see page 284)

Y5000 Interface Buffer for 5100 Series

Y5001 Interface Cable for 5100 Series, 5440B, or 5442A

M10-205-600 Rack Mount Kit for 5205A

M00-280-610 24" Rack Slides for rack adapter

Service & Support



(NSN 5895-01-088-8715) **5215A**

5215A Precision Power Amplifier

- Designed for use with 5200A Calibrator
- 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 aV coupled programmable inverting amplifier with a fixed gain of 100. AV 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 5215A-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 to exchange.

Calibration and Characterization

The 5215A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. 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

Absolute Uncertainty

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Frequency Hz	±(ppm setting + ppm range)	Frequency 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

* Traceable to U.S. NBS Standards. 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

* Traceable to U.S. NBS Standards. 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 aV

Output Voltage Resolution: 1 mV with 5200A; 10 mV with 5100 Series, aV 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

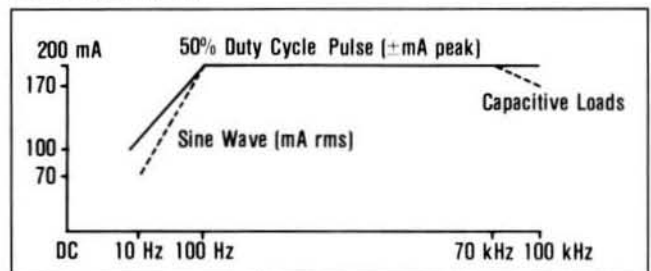
Stability

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 1500 Ω 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 1500 Ω 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 overloads, 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

Input Power: 100V, 115V, 200V, 230V ac, $\pm 10\%$, 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: Instruction Manual, interface cable to 5200A, power cords, serialized and dated calibration certificate

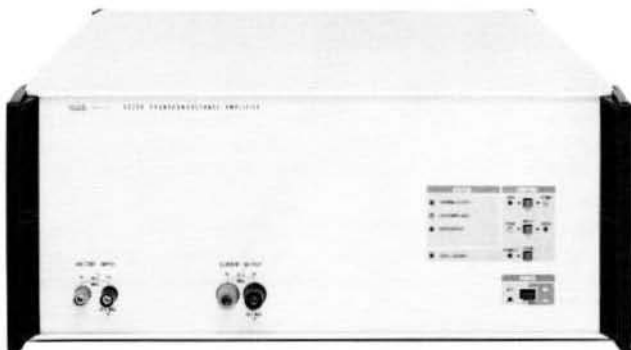
Model

5215A Precision Power Amplifier
5215A-07 Rear Only Output

Accessories (Also see page 284)

M10-205-600 Rack Mount Kit for 5205A
M00-280-610 24" Rack Slides for rack adapter

Service & Support



(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 the 5100B Series B

The Model 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters and VOM meters that measure up to 20 amperes. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20 amperes. The transconductance is 1 ampere per volt, either dc or rms ac from 30 Hz to 5 kHz.

The 5220A is designed to be controlled by the 5100B or 5101B Calibrator but may be driven by another voltage source such as the 5200A. When used with a 5100B or 5101B, the current range of those instruments is extended by a factor of 10 to 1. Also, options are available for the 5100B and 5101B that make the system compatible with IEEE Std 488-1978 or EIA Standard RS-232-C. A built-in mag cassette tape for the 5101B can be used to record the calibration steps of each procedure then later can be used to repeat the procedure with very little operator expertise.

Built-in Protection

The 5220A is built to survive in the "real" world of practical, day-to-day use. 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.

The Y5000 Interface/Buffer

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 work with a 5100B (or 5101B) Calibrator through an Interface/Buffer (Y5000) and cable that attaches to the rear panels.

With the Y5000 Interface/Buffer, 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 single Y5000 Interface/Buffer may be used to control and operate both a 5220A Transconductance Amplifier and a 5205A Power Amplifier from a 5101B (or 5100B).

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: $\geq \pm 4V$ dc, or 3V rms ac (4.25V peak)

DC Accuracy: $\pm(0.025\%$ of output +1 mA)

AC Accuracy: $\pm(0.05\%$ of output +1 mA) from 30 Hz to 1 kHz, and $\pm(0.05\%$ of output +1 mA) $\times f$ from 1 kHz to 5 kHz, where f = frequency in kHz

Short Term DC Stability: Output changes less than $\pm(0.005\% + 200 \mu A)$ in 10 minutes, with constant line, load, and temperature

Short Term AC Stability: Output changes less than $\pm(0.01\% + 500 \mu A)$ in 10 minutes, with constant line, load, and temperature

Harmonic Distortion and Noise: $\pm(0.05\%$ of output ± 1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, $\pm 0.05\%$ of output +1 mA) $\times f$ from 1 kHz to 5 kHz, where f = frequency in kHz

Temperature Coefficient: $\pm(0.0025\%$ 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: $\pm 20V$ dc or 20V ac rms

Temperature Range: 0°C to 50°C (operating) and -20°C to 65°C non-operating

Relative Humidity: $\leq 50\%$ to 50°C, $\leq 75\%$ to 40°C, $\leq 95\%$ 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: Manual, power cord, serialized and dated calibration certificate

Model

5220A Transconductance Amplifier

Accessories (Also see page 284)

Y5020 Current Shunt

Y5000* Interface/Buffer

Y5002* Cable (Y5000 to 5220A) or 5440 Series

M07-205-600 7" Rack Adapter

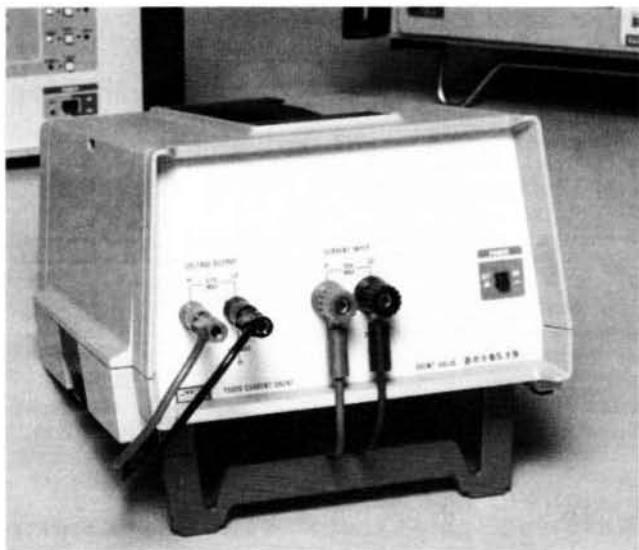
M00-270-610 20" Slides for Rack Adapter

M00-280-610 24" Slides for Rack Adapter

*Required when controlled from 5100B or 5101B

Service & Support

Y5020



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 calibrators. 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

* Referenced to the certified absolute value of shunt resistance stamped on the front panel

Stability: Less than 20 ppm resistance change in six months

Maximum Current: 20A direct current or rms alternating current

Burden Voltage: Less than 250 mV at 20 Amperes

Temperature Coefficient: Less than 20 ppm/°C; 18°C to 0°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: Instruction sheet

*For cooling fan. Specify 115V or 230V when ordering

Model

Y5020* Current Shunt

*Specify supply voltage (e.g., Y5020-115 or Y5020-230)

Service & Support

Local Primary Standards

Local primary direct voltage and resistance standards serve as the foundation for both direct and alternating voltage calibration. The accuracy of these standards is ensured by periodically submitting them to the National Bureau of Standards for comparison with their working standards. Temperature controlled saturated standard cells, four-terminal standard resistors (of the Thomas or NBS-type), and standard dividers provide calibration laboratories with the standards of voltage, resistance, and ratio they need. With them, accurate transfer of certified values may be made to calibrators, portable solid-state reference standards, and lower-echelon working standards and transfer standards. From these two local primary standards, voltages and resistances at other levels can be defined. Together, they define direct and alternating current.

Direct Voltage Reference Standards

Portable, solid-state dV reference standards, such as the Fluke 732A and 731B are designed to provide metrology laboratories, engineering areas and production test groups with a working standard of direct voltage that can be used in calibration, research and development. These standards provide the stability of standard cells without the problems associated with standard cells — such as intolerance to loading, vibration, and ambient temperature variations. There is an added advantage to working with a 10-volt reference instead of a 1-volt reference: Effects of noise and thermal emf are greatly reduced. The self-contained battery power supply and temperature-controlled oven of the 732A make this instrument suitable for the most exacting requirements of a precision transfer standard.

Alternating Voltage Reference Standards and Calibration

Calibration of aV instrumentation is especially complicated by the fact that there are no reproducible standards of alternating voltage. Since there is no aV counterpart to the standard cell, alternating voltages and currents must first be either rectified and converted to dV or compared to the heating effect of an equivalent direct voltage or current which may then be referred to an appropriate dV standard. A complication of the comparison process is knowing the frequency response of the converter. Fluke has, for many years, provided both aV and dV standards as well as the thermal transfer standards needed for comparing the aV standards to the dV standards.

Thermal transfer standards may be used to accurately measure an unknown alternating voltage or current by comparing the heating effect of the unknown with the heating effect of an equivalent direct voltage or current which is known. The Fluke 540B Thermal Transfer Standard provides the capability in an instrument designed for simple operation and wide dynamic range. For voltage measurements at frequencies above the 1 MHz range of the 540B, the A55 High Frequency Thermal Converters may be added to extend the range to 50 MHz. Alternating current measurement capability may also be added by means of the A40 and A40A shunts.

Fluke responded to the need for a precision fixed-frequency sinewave voltage source suited to calibration or reference applications with its 510A AC Reference Standard. In the calibration laboratory or out on the production floor, the Fluke 510A offers portability and an accurate 10V output available at any specified frequency from 50 Hz to 100 kHz. The 510A provides you with the ultimate in applications flexibility.

Calibration of aV devices and instrumentation up to 1200V rms and frequencies up to 1.2 MHz is available using the Fluke 5200A Precision AC Calibrator and a 5205A Precision Power Amplifier. Either an IEEE-488 interface or parallel interfacing is compatible. Fluke has designed this system to provide you with the option of either manual or semi-automated approaches to the calibration of aV voltmeters, DMMs, and other frequency-sensitive devices that require precision, variable frequency, and voltage stimuli.

DV Standards and Auxiliary Equipment

- 732A DV Reference Standard
- Transport Case and Battery Charger for 732A
- Direct Voltage Maintenance Program
- 752A Reference Divider
- 731B DC Reference Standard
- 750A Reference Divider
- 720A Kelvin-Varley Divider
- 721A Lead Compensator
- 845AB/AR Voltmeter/Null Detector

AV Standards and Auxiliary Equipment

- 510A AC Reference Standard
- 540B Thermal Transfer Standard
- A40/A40A Current Shunt
- A55 Thermal Converter

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 $\pm 1^\circ\text{C}$ 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	$\pm 0.5 \mu\text{V}$
100:1	0 to 1000V	0.5 ppm	$\pm 1.0 \mu\text{V}$

*Null accuracy refers to the required accuracy of the null detector reading during self-calibration

Temperature Coefficient: $\leq \pm 1$ ppm per $^\circ\text{C}$ over range of 18°C to 28°C. Typically 0.1 ppm per $^\circ\text{C}$ from 15°C to 30°C

Input Resistance:

10:1 Ratio: 380 k Ω $\pm 1\%$

100:1 Ratio: Divider is 4 M Ω ; Driven Guard is 4 M Ω ; total is 2 M Ω $\pm 1\%$

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: $\leq 75\%$ to 40°C, $\leq 45\%$ to 50°C, non-condensing

Altitude: $\leq 3050\text{m}$ (10,000 ft) operating; $\leq 12,200\text{m}$ (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 x 8.69 in x 23.75)

Weight: 8.4 kg (18.5 lb)

Included: Instruction manual

Model

752A Reference Divider

Accessories (Also see page 284)

5440A-7002 Low Thermal Copper EMF Plug-in Cables

Service & Support



(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 available through Fluke Direct Voltage Maintenance Program to NBS
- Line and rechargeable battery powered
- 12-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 12 hours on its internal battery — even longer on external batteries. Either line power or the 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 new 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 72 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*

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 12 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: ≤5 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: ≤6 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

*See the Direct Voltage Maintenance Program description on page 103 for the improved specifications and traceability which can be obtained for the 732A.

General Specifications (732A)

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

732A

Safety: IEC 348, 2nd edition, 1978 and ANSI C39.5, 1980
Power: 100V, 120V, 220V, or 240V ac $\pm 10\%$, 50 to 400 Hz or 24 to 30V ac 50 to 60 Hz. Also external 24 to 40V dc. Internal 24-V lead acid, gelled electrolyte battery operates for 12 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 x 8.69 in x 23.75 in)
Weight: 12.3 kg (27 lb)
Included: Instruction manual, line cord, adjustment tool

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)

Models

732A DC Reference Standard
732A-000* With Special Calibration, shipped hot**
732A-100* W/Calibration, Drift Certification, shipped hot**

*See next page for description
**Under power

Accessories (Also see page 284)

732A-7002 Transit Case
732A-7003 Battery Charger and Auxiliary Battery Case
732A-7004 Rack Shelf (Holds 2 732As or 732A and 752A)
732A-7005 Replacement Battery Pack

Service & Support

Direct Voltage Maintenance Program

- Volt traceability for your calibration laboratory with significant cost reductions over direct NBS calibration
- Uncertainty within a few tenths of a ppm
- Complies with MIL-STD-45662
- Avoid investing in redundant hardware: your equipment never needs to leave your 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 Bureau of Standards (NBS). 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.

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 NBS 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 Bureau of Standards. 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 re-calibration 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 calibration 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 732-200). 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	[(CU) ² + (DU) ²] ^{1/2}
732A-100	0.6 ppm	0.35 ppm	0.5 ppm	1.5 ppm	
732A-200	0.6 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

Note: At the present time, due to the difficulty in making timed shipment to international customers, calibration services requiring under power shipment are only available in the U.S.

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.
- The name and telephone number of an alternate responsible person.
- Any restrictions on hours of the day for receiving shipment.
- 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.

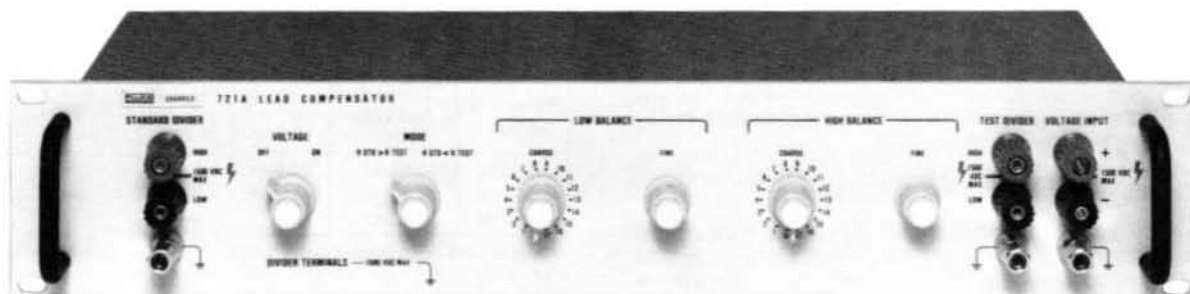
(continued next page)

Standards & Auxiliary Equipment

Direct Voltage Maintenance Program/721A

Options

- 732A-000* New 732A w/Special Cal, shipped under power
 - 732A-000R* Special Calibration, shipped under power
 - 732A-100* New 732A w/Cal, 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
- *Fluke will select air carrier. Shipping charges are not included



(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 m Ω
Maximum Ratio Between Divider Resistance: 4000:1
Maximum Allowable Lead Resistance: 150 m Ω
Maximum Divider Voltage: 1500V dc
Size: 8.8 cm H x 48.2 cm W x 15.2 cm D (3½ in x 19 in x 6 in)
Weight: 2.72 kg (6 lb)
Included: Manual

Model

721A Lead Compensator

February 1987 prices



(NSN 6625-01-012-4638) 731B

731B DC 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 precision 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 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: <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 x 4.5 x 12 in)

Weight: 2.26 kg (5 lb)

Included: Manual, power cord, batteries, serialized and dated calibration certificate

Model

731B DC Reference Standard

Accessories (Also see page 284)

M03-201-601 3½" Rack Adapter, Single

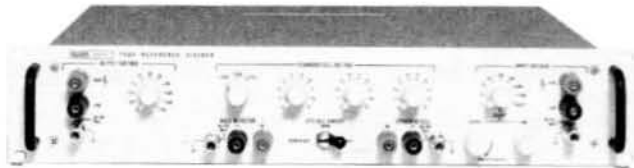
M03-202-603 3½" Rack Adapter, Dual

M03-206-604 3½" Rack Adapter, Triple

M03-205-605 3½" Rack Adapter, Quad

Service & Support

750A/720A



(NSN 6625-00-445-3332) 750A

750A Reference Divider

- 10 ppm basic division ratio accuracy
- Switched input and output ranges
- Built-in kV 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 μ V steps
Division Ratio Accuracy and Stability: (Referenced to Standard Cell tap) \pm (0.001% of output +0.5 μ V) for 1 year
Calibration: All ranges above 1.1V are adjustable \pm 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 μ V 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 (3½ in x 19 in x 13 in)
Weight: 7.25 kg (16 lb)

Model

750A Reference Divider

Service & Support

Warranty

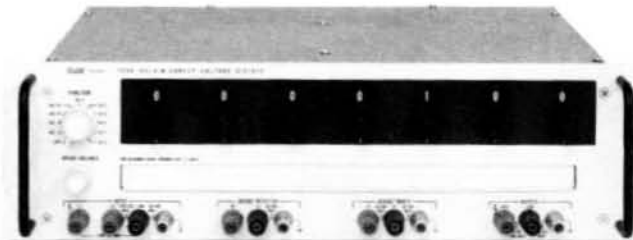
One-year extended warranty. Calibration warranted during calibration cycle. (See page 269 for further information on warranty and calibration.)

Extended Warranty

- SC1-750A Repair (with calibration)
- SC1-750A Repair (calibrated w/incoming or outgoing data)
- SC1-750A Repair (calibrated w/incoming & outgoing data)
- SC2-750A Calibration (1/year recommended)
- SC2-750A Calibration (1/yr w/incoming or outgoing data)
- SC2-750A Calibration (1/yr w/incoming & outgoing data)

Spare Parts

Recommended spare parts kits are available. Contact Replacement Parts Dept. at (800) 526-4731 in most of U.S.A., (206) 356-5774 from WA for more details.



(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) \pm 0.1 ppm of input at dial settings of 1.1 to 0.1, \pm 0.1 (10S)^{1/3} of input at dial settings (S) of 0.1 to 0
Absolute Linearity Stability: (Without self-calibration) \pm 1.0 ppm of input/yr at dial settings of 1.1 to 0.1, \pm 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 \pm 0.1 ppm of input

Temperature Coefficient of Linearity: \pm 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 \pm 1°C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days

Power Coefficient of Linearity: \pm 0.2 ppm of input/W max at dial settings of 1.1 to 0.1; \pm 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: \pm 0.5 μ V max

Maximum Input Voltage: 1000V on 1.0 input terminal, 1100V on 1.1 input terminal

Input Resistance: 100 k Ω \pm 0.005% at 1.0 input terminal at 25°C; 110 k Ω \pm 0.005% at 1.1 input terminal at 25°C

Temperature Coefficient of Input Resistance: \pm 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)

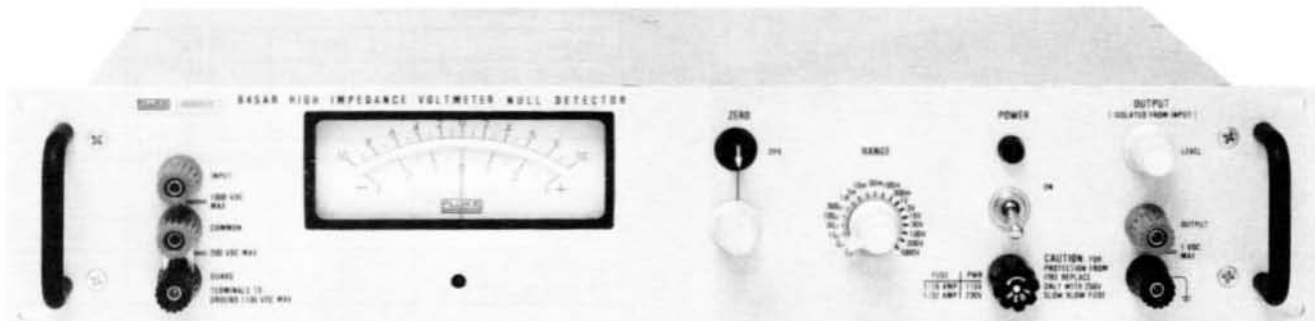
Weight: 8.16 kg (18 lb)

Included: Manual

Model

720A Kelvin-Varley Voltage Divider

Service & Support



(NSN 6625-00-257-7561) 845AR

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 3½ 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 $\pm 1\text{V}$ dc for end-scale deflection with $\pm 0.5\%$ 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 M Ω on 300 mV range and above. 10 M Ω on 3 mV through 100 mV range, 1 M Ω on 1 mV range and below

Accuracy: Model 845AB $\pm(2\%$ end-scale $+0.1 \mu\text{V})$. Model 845AR $\pm(3\%$ end-scale $+0.1 \mu\text{V})$

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 $\leq 50\%$ 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, $\leq 80\%$ relative humidity; better than 140 dB, open-circuited, $\leq 50\%$ relative humidity; better than 120 dB, open-circuited, $\leq 80\%$ 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: $\pm 1\text{V}$ 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 $\mu\text{V}/\text{hour}$; better than 0.3 $\mu\text{V}/\text{day}$

Overload Capability: Up to 1100V dc may be applied on any range. Typical recovery time is 4s

Power, Model 845AR: 115 or 230V ac $\pm 10\%$, 50 to 440 Hz, approx. 3W
Power, Model 845AB: 115 or 230V ac $\pm 10\%$, 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)

Model

845AB Voltmeter/Null Detector with batteries

845AR Voltmeter/Null Detector

Accessories (Also see page 284)

881A-102 7" Rack Adapter, Single

881A-103 7" Rack Adapter, Dual

Service & Support

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 $\pm 1\%$ 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 100 kHz. This assures a pure sinewave 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 bolted 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, and 100,000 Hz

Amplitude Uncertainty:* \pm ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz to 20 kHz	100	150	200
20 kHz to 50 kHz	150	250	350
50 Hz to 100 kHz	400	500	600

*After 10-minute warm-up in ambient temperature 21°C to 25°C

Amplitude Stability: \pm ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz to 20 kHz	20	50	100
20 kHz to 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: $\pm 0.1\%$, adjustable $\pm 1\%$

Frequency Stability: 500 ppm per mo

Load Regulation: ≤ 20 ppm to 10 kHz; ≤ 80 ppm at 100 kHz

Line Regulation: ≤ 10 ppm for $\pm 10\%$ line change

Input Power: 115 or 230V ac $\pm 10\%$, 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: Instruction Manual, power cord, serialized and dated calibration certificate

Model

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)

Accessories (Also see page 284)

M03-201-501 Rack Mount Kit, Single

M03-202-603 Rack Mount Kit, Dual

M03-206-604 Rack Mount Kit, Triple

M03-205-605 Rack Mount Kit, Quad

Service & Support



(NSN 6625-00-288-0184) 540B

540B Thermal Transfer Standard

- 100 ppm aV to dV transfer uncertainty
- Less than 100 ppm dc reversal error
- Frequency range 5 Hz to 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 ($\pm 0.01\%$) 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 interruption 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 Bureau of Standards. These ac/dc difference figures do not include U.S. National Bureau of Standards' random and systematic errors. Fluke test reports to the nearest 100 ppm are available at extra cost upon request.

Characterization

Ask for 540B-900 for a 72-point characterization of a new 540B Thermal Transfer Standard. 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 John Fluke Standards Laboratory in Everett, Washington. This 72-point characterization is intended to support customers who wish to characterize 5200A AC Calibrators as required by 5200A-800 Enhancement Software.

Special characterizations to meet specific calibration requirements are also available. Consult your local Fluke Sales Office or Representative for further information.

Specifications

Voltage Ranges: 0.5, 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500, and 1000V, with each range usable from $\frac{1}{2}$ to 1 times rating

aV to dV Transfer Uncertainty

Frequency Hz	Voltage Ranges			
	0.5 - 10V	20V - 50V	100V - 500V	1000V
5-20k	$\pm 0.01\%$	$\pm 0.01\%$	$\pm 0.01\%$	$\pm 0.02\%$
20k-50k	$\pm 0.01\%$	$\pm 0.01\%$	$\pm 0.01\%$	$\pm 0.04\%$
50k-100k	$\pm 0.05\%$	$\pm 0.05\%$	$\pm 0.20\%$	X
100k-500k	$\pm 0.10\%$	$\pm 0.10\%$	X	X
500-1M	$\pm 0.10\%$	X	X	X

Search Function: Meter display of input as percentage of range

Input Impedance: 180 Ω /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 $\pm 10\%$, 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: Instruction manual, A55 connecting cable, serialized and dated calibration certificate

Model

540B Thermal Transfer Standard

Accessories (Also see page 284)

540B-103 7" Rack Adapter

540B-110 Rechargeable Battery Pack (retrofit kit)

Service & Support

A40/A40A/A55



A40/A40A

A40 and A40A Current Shunts

- Ac current transfer measurements from 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 aI to dI current transfer measurements using the Model 540B Thermal Transfer Standard and a known dI source. Measurements may be made over a 2.5 milliamperes 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 aI to dI differences expressed in the specifications are deviations from dI standards maintained by the U.S. National Bureau of Standards, and may be obtained without the use 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 John Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of Standards. These aI to dI difference figures do not include U.S. National Bureau of standards 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

A40A Current Ratings: 10 and 20A

Uncertainty

Frequency	aI to dI 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%	

Model

A40* Current Shunts

A40A* Current Shunts

*Order by current rating, eg: A40-50 MA. Price is for each shunt

Accessories (Also see page 284)

A45-4003 Input Cable for A40A Shunts

A45-4004 Output Cable for A40A Shunts

Y8133 Test Lead Kit for A40 Shunts

C41 Storage Case

Service & Support

Warranty

One-year extended warranty. Calibration warranted during calibration cycle. (See page 269 for further information on warranty and calibration.)

Extended Warranty

SC1-A40 Repair (with calibration)

SC1-A40 Repair (calibrated w/incoming or outgoing data)

SC1-A40 Repair (calibrated w/incoming & outgoing data)

SC2-A40 Calibration (1/year recommended)

SC2-A40 Calibration (1/yr w/incoming or outgoing data)

SC2-A40 Calibration (1/yr w/incoming & outgoing data)



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 from subaudio frequencies to the VHF region. The design is comparable to that of standards maintained by the U.S. National Bureau of Standards.

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 Bureau of standards.

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, ac source to coaxial tee.

Specifications

Voltage Ratings: 0.5, 1, 2, 3, 5, 10, 20, 30, and 50V*

*Each converter is useable from $\frac{1}{2}$ to 1 times its rated voltage

Uncertainty:

Frequency	Calibration Uncertainty*	Typical aV to dV Difference
<1 MHz		< $\pm 0.01\%$
1 MHz	$\pm 0.05\%$	$\pm 0.01\%$
10 MHz	$\pm 0.10\%$	
20 MHz	$\pm 0.15\%$	$\pm 0.02\%$
30 MHz	$\pm 0.20\%$	$\pm 0.10\%$
50 MHz**	$\pm 0.50\%$	$\pm 0.30\%$

* 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: 200 Ω /V, approximate

Output Voltage: 7 mV nominal, at rated input

Output Resistance: 8 Ω

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 gm
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: Instruction manual and certification (see above)

Model

A55* High Frequency Thermal Converter

*Order by voltage rating, eg: A-55 -0.5V. Prices are for each converter

Accessories (Also see page 284)

A55-110 Accessory Kit

C55 Storage Case

Service & Support

Computer-Aided Calibration

Introduction

Introduction

More companies own Fluke automated calibration systems than all other brands combined, with more than 300 systems installed throughout the world. All of these companies choose Fluke for one simple reason: Fluke takes the risk out of calibration.

Only Fluke offers the comprehensive spectrum of automated meter and oscilloscope calibration solutions, all with full traceability to national standards. The system you buy today easily upgrades to achieve future goals, so your investment is always protected.

For 30 years Fluke has built state-of-the-art instruments supported by outstanding post-sales support. Our proven track record guarantees confidence tomorrow.

Why Computer-Aided Calibration?

Calibration labs today are more than ever being caught in the perennial problem of needing to do more, in less time, with less money, and fewer people. Calibration workloads are increasing, yet trained technicians are getting harder to find. Cal lab managers are constantly seeking new ways to relieve these problems.

Fortunately, cal labs do have the option of turning to computer-aided calibration. A computer or instrument controller aids calibration by controlling the calibration instruments via an IEEE-488 bus and by giving

operator instructions via menu driven prompts. A good computer-aided calibration system is traceable to national standards, can control the unit under test (UUT), and record calibration results automatically.

Computer-Aided Calibration Gives Needed Relief

Computer-aided calibration minimizes the need to have highly trained technicians perform repetitive calibration tasks. Instead, people with limited calibration background produce useful results with short learning curves. Your skilled technicians can be saved for more complicated tasks like repair and troubleshooting.

The quality of calibration is also improved through automation. Since the computer guides the calibration, repeatability of calibration events is ensured — a critical factor in a time of stricter calibration regulations.

Get Control of Your Time and Your Calibration

How do you know if you would benefit from computer-aided calibration? If you see your workload getting out of control, that is a good indication. Or, if you see a need for more people and are having trouble finding skilled people, that is another indication. You may also need computer-aided calibration if you are facing increasing regulation and a need for greater documentation.

If your lab performs verification checks prior to adjusting the UUT, you will especially benefit from computer-aided calibration because it provides greatly increased throughput. Computer-aided calibration also helps an operator adjust older UUTs faster, while fully automating the adjustment of the new generation of software calibrated UUTs.

Fluke Computer-Aided Calibration Selection Guide

Building Blocks for Computer-Aided Calibration		Applications Summary						
		Computer-Aided Bench-Top Clusters			Automated Calibration Workstations			
		Do-It-Yourself	7404B	7449A	7410A	A123-CD	A123-PE	Custom
Model	Description	Page 115	Page 117	Page 121	Page 124	Page 128	Page 128	Page 130
7411B	Calibration Software	▷	▷	▷	▷	▷	▷	▷
1722A	Instrument Controller	▷	▷	▷	▷	▷	▷	▷
1765A	Winchester Disk Drive	●	●	●	●	●	●	●
7422A	Combined 7411B and 1722A	●	—	—	—	—	—	—
5100B	Multifunction Calibrator	●	▷	▷	—	▷	▷	●
5200A	Precision 6-Digit aV Calibrator	●	—	—	—	—	▷	●
5205A	Precision Power Amplifier	●	●	●	—	●	●	●
5215A	Precision Power Amplifier	●	—	—	—	—	—	●
5220A	Transconductance Amplifier	●	●	●	—	●	●	●
5440B	Precision Direct Voltage Calibrator	●	—	—	—	▷	▷	●
5450A	Resistance Calibrator (1Ω-100M)	●	—	—	—	▷	▷	●
CG5001	Oscilloscope Calibrator (Tektronix®)	●	—	▷	▷	●	●	●
1953A	Frequency Counter/Timer	●	—	—	—	—	—	●
6011A	Signal Generator (10 Hz-11 MHz)	●	—	—	●	—	—	●
6060B	Signal Generator (10 kHz-1.05 GHz)	●	—	—	●	●	●	●
6061A	Signal Generator (10 kHz-1.05 GHz)	●	—	—	●	●	●	●
6070A	Signal Generator (200 kHz-520 MHz)	●	—	—	●	—	—	●
6071A	Signal Generator (200 kHz-1.04 GHz)	●	—	—	●	—	—	●
8505A	Digital Multimeter	●	—	—	—	—	—	●
8506A	Digital Multimeter	●	▷	▷	—	▷	▷	●
8520A	Digital Multimeter	●	—	—	▷	—	—	●
	Test Interface Panel	—	—	—	▷	▷	▷	●
	Rack	—	●	●	▷	▷	▷	▷
Calibration Capabilities:								
	Analog and Digital to 4½-Digit Meters		▷	▷	—	▷	▷	
	Analog and Digital to 5½-Digit Meters		▷	▷	—	▷	▷	
	Analog and Digital to 7½-Digit Meters		—	—	—	▷	▷	
	Oscilloscopes		—	▷	▷	●	●	
	Mobile Calibration		▷	▷	—	●	●	

▷ Standard ● Optional

Computer-Aided Calibration For Every Need

In the following pages you will find a variety of automated solutions to your calibration needs. From computer-aided calibration clusters to the world's most accurate automated calibration workstations, Fluke brings a fresh approach to calibration.

Computer-Aided Calibration Clusters — Using Fluke Calibration Software, Controllers & Instruments

Computer-Aided Calibration Clusters are automated combinations of calibration instruments controlled by the IEEE-488 bus. Thanks to Fluke 7411B Calibration software, you can define the instruments you want to automate. Consult the chart on page 114 to select the instruments you would like to automate. Then use Fluke 7411B Calibration software to transform the instruments from stand-alone manual mode, to full automation under the control of the Fluke 1722A Instrument Controller.

Your computer-aided calibration cluster will give you all the benefits of automated calibration — ease of use, automatic data recording, and reduced cost per calibration.

The Best of Both Worlds

Calibration instruments have two modes of operation: local (operated manually) and remote (automated control). Manual control gives you direct access to the instrument controls. Automated control lets the computer do the work. Fluke computer-aided calibration clusters give you the best of both worlds.

Fluke 7411B Calibration software guides you through automated calibration procedures. These procedures control your instruments in performing accurate calibrations of your test equipment. Instructions to the operator are presented on the 1722A screen. Any responses from the operator are made through the convenient, touch-sensitive screen.

Computer-aided calibration clusters also give you easy, direct access to your instruments for single tests. But automation of your benchtop cluster gives you added benefits stand-alone instruments cannot give.

Since the controller instructs the operator during each calibration, operators with less experience can perform calibration effectively. This is critical today when experienced technicians are getting hard to find.

Automated calibration is based on standard procedures you tailor to fit your calibration philosophy. These computer-aided procedures guarantee repeatability of your calibration tests — a feature absolutely necessary to satisfy stiffening government requirements. Plus, your system will record complete calibration results. You no longer need to spend time hand recording data.

Fluke Model 7404B For Calibrating 5½-Digit Meters

The Fluke 7404B is a computer-aided calibration cluster of instruments that automatically directs a Fluke 8506A DMM to measure the aV and dV outputs of the Fluke 5100B and, under program control, enhance their accuracy to 13 ppm for dV and 190 ppm for midband aV. These accuracies are sufficient to calibrate most models of 5½-digit DMMs. See page 117 for a complete description of the 7404B.

Fluke Model 7449A For Calibrating Meters and Oscilloscopes

Fluke Model 7449A adds a Tektronix CG5001 Oscilloscope Calibrator to the 7404B to provide all of the 7404B meter calibration features plus the oscilloscope calibration capability of the CG5001. The 7449A is available as a complete package from Fluke or its constituent elements can be ordered from Fluke and Tektronix. The 7449A is described on page 121.

Standard or Special Automated Calibration Workstations

Fluke also provides complete automated calibration workstations to fill state-of-the-art calibration requirements. An existing computer-aided

calibration cluster is upwardly expandable into an automated calibration workstation.

Our automated calibration workstations give you fully integrated, automated calibration with the benefits of convenient test interface panels. You get fully configured, computer-aided calibration software, the instruments of your choice from the Computer-Aided Calibration Selection Guide, and full rack integration. These workstations include instrument configurations demanded by metrologists around the world.

Fluke offers both standard and special automated calibration workstations for meters or oscilloscopes. Standard workstations are configured at Fluke to maximize the system capabilities of the integrated instruments. The Fluke 7410A is a standard automated oscilloscope calibration workstation. This is discussed in greater detail in the following pages.

Fluke will also configure special workstations to fit your own particular needs. From combined meter/oscilloscope workstations, to mobile calibration workstations, Fluke offers what you need to do your job. The instruments available with these workstations are covered in the Computer-Aided Calibration Selection Guide.

Configuring Your Own 7411B-Based Computer-Aided Calibration System

Fluke 7411B-based Computer-Aided Calibration Systems are easy to configure. Determine your calibration requirements. If a standard Fluke computer-aided calibration system does not fit your exact application and situation, select the instruments you need to integrate from the guide on page 112. You may already have some of these instruments in your lab or you can purchase them new.

Now look at the description of the Fluke 7411B Calibration software and 7422A Control and Software Package. Depending on what calibration instruments you own, one of these product packages will serve your needs for integration, software, and control. Your Fluke Sales Engineer can also provide assistance.

Total Calibration Support

Fluke, the world leader in calibration, offers a full complement of training and customer support services. From seminars on calibration philosophy to technical consultation and training after the sale, you can depend on Fluke.

A Fluke Sales Engineer can help you select and configure a computer-aided calibration system to suit your application. Our representatives have a solid understanding of calibration and the requirements of different applications and environments. You can depend on us to explain the calibration alternatives, and help you map out a long-range plan.

When you purchase an automated calibration workstation, we install the system at your facility. We make sure it is properly set-up and ready to calibrate. A Fluke technician will coach you through the major software functions, including writing a procedure and calibrating an instrument. You can usually be up and running in less than one day.

Fluke benchtop clusters, on the other hand, are designed to be easily installed yourself.

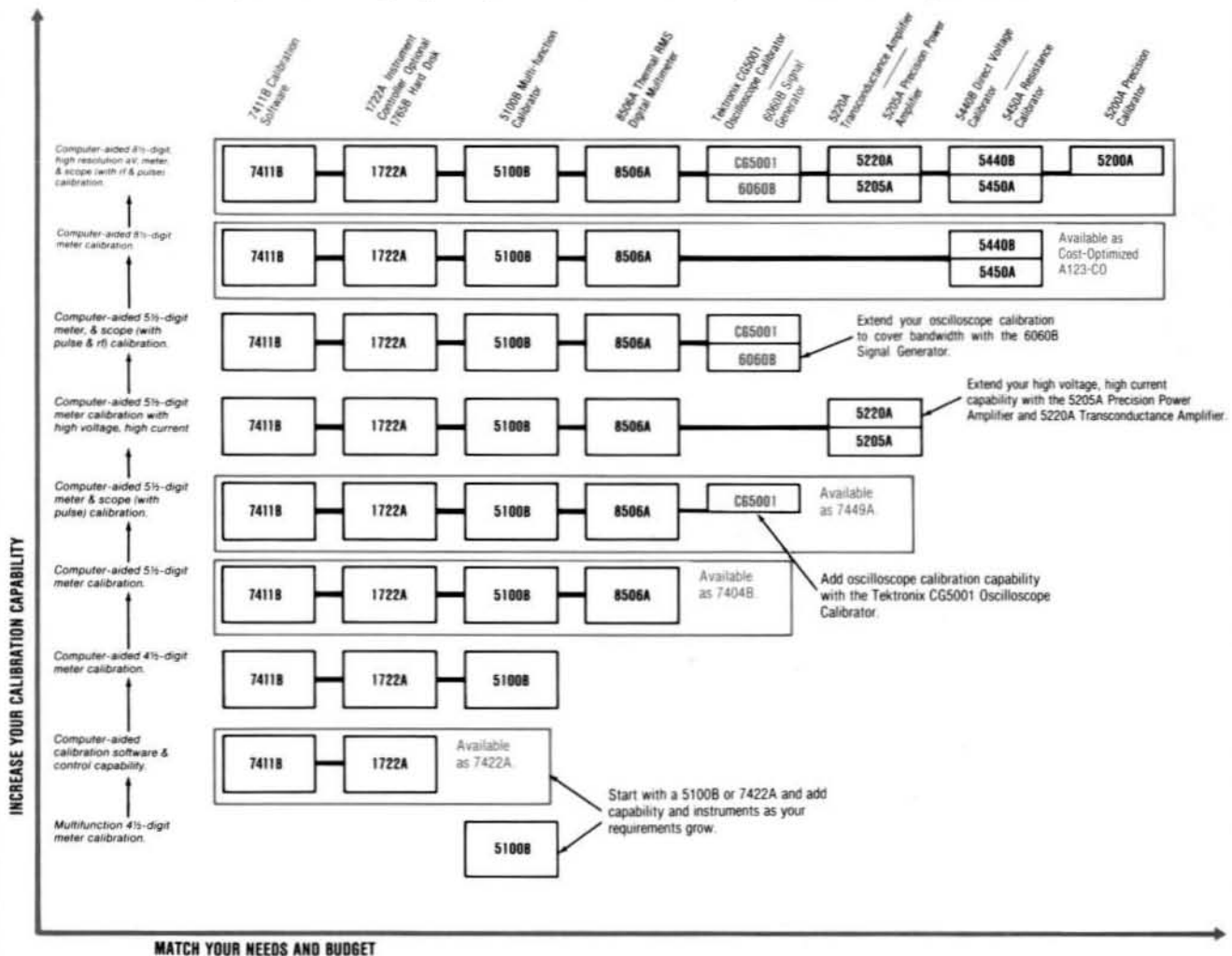
To help you take full advantage of your system's capabilities, Fluke offers extensive training. These courses, available at your site, Fluke Regional Support Centers, or the Fluke factory in Everett, Washington, help you begin calibrating immediately, using the advanced features of the system. Courses range from basic and advanced operation methods to training service technicians how to maintain and repair systems.

Fluke recognizes that a number of different people will be involved with calibration instruments. We've structured our training and manuals to accommodate each person's different role in the calibration process.

7400/A123 Series Calibration Systems Applications Training

Since Fluke has written the necessary software to operate the 7400/A123 Series, you must simply learn to write procedures. This five-day course teaches the overall 7400 program scheme, Performance Test and Calibration procedure writing, and Calibration History Management. (See page 273 for more details.)

Graph of Increasing Capability With Fluke 7411B Computer-Aided Benchtop Clusters





7411B Calibration Software 7422A Control and Software Package

- Generate calibration procedures, execute instrument calibrations, and manage calibration results
- Save time and money on your calibration process while protecting your past and future investment
- Perform "hands off" closed-loop, closed-case calibration of IEEE-488 meters
- New features include:
 - 10 or 20 MByte hard disk capability
 - RS-232-C interface to standard bar code readers
 - Calibration Management Software for IBM-PCs and compatibles
- Includes examples of meter and oscilloscope calibration procedures

A Comprehensive Approach To Automating Calibration

Fluke 7411B Calibration Software is a comprehensive approach to automating your calibration process. You generate calibration verification and adjustment procedures, run these procedures to reliably and quickly calibrate your instruments, obtain results listings of calibration, and automate your record keeping and traceability requirements. And the 7411B software gives you more than just meter calibration capability: you calibrate meters, oscilloscopes, power supplies, frequency counters, and various other instruments. 7411B Calibration Software is a must for any lab seriously considering automation.

New Features Give You Added Versatility

7411B software runs on the Fluke 1722A Instrument Controller, equipped with a floppy disk drive, or with one of two hard disk drives. These optional hard disk drives permit faster access to a greater volume of calibration procedures and data. Choose a 10 MByte or 20 MByte hard disk unit.

Via RS-232-C you can interface a wide variety of bar code readers. Units to be calibrated can be automatically identified and the proper cal procedures initiated, all without keyboard or touch-screen entry.

An optional software package, Cal Results→PC™, provides the ability to generate fully customized calibration or management reports on your IBM-PC or compatible. Calibration results on floppy disk are accepted by the PC and converted to dBase III format. Fixed-format reports can be generated without knowledge of dBase III. Fully customized reports can be created using the dBase III language.

Compatible With Your Existing Instruments and Procedures So You Can Build Your Own Systems

Based on the field-proven 7411A Calibration Software, the new expanded 7411B Calibration Software contains all the power and features of Fluke's computer-aided calibration systems, including the 7404B, 7449A, 7410A, and A123-Series calibration systems. Procedures you have written for your Fluke calibration system and 7411A software are completely compatible with the 7411B.

If a 7404B, 7449A, or other standard Fluke computer-aided calibration isn't suitable for a particular application or situation, the 7422A Control and Software Package can be used to configure a customized test or calibration system. The 7422A consists of a suitably-configured Fluke 1722A Instrument Controller, the 7411B software, an Operator's Aid, and shielded IEEE-488 bus cable. Simply add your existing instruments and you are ready to start.

Generate Calibration Procedures

7411B Calibration Software is easy to use. Your procedure writer does not need to know how to program computers to write 7411B procedures. With little training and start-up time, a procedure writer can quickly begin writing calibration procedures that meet the philosophy of your lab. 7411B software prompts the procedure writer through the process. A number of error checking features are included. Complete error messages are also provided.

The 7411B package includes examples of DMM and oscilloscope procedures. Use these procedures, modify them to fit your philosophy, or write your own custom procedures. Your procedure investment is secure—procedures you wrote in the past for your 7400-Series, A123-Series, or 7411A-based systems are compatible with the 7411B. And any future enhancements to the software will retain this compatibility.

Execute Instrument Calibrations

The non-technical operator of your 7411B-based automated calibration system will find the software easy to learn and work with. Menu prompt the operator and a touch sensitive screen makes operator-system interaction fast and easy. Graphics and messages help even a novice operator complete each test. When a procedure is finished, the operator can print the results and/or save them on hard or floppy disk.

Manage Calibration Results

Reporting and record keeping are the areas where automation can benefit you the most in time and consistency. The Calibration History Management feature of the 7411B makes managing your system and data simple. Create and generate reports. Save all test results or summarize results data. Generate automatic recall notices or create inventory reports. Manual record keeping is eliminated, along with the human errors that accompany manual methods.

Calibration History Management that runs on the Fluke 1722A Instrument Controller is standard with your 7411B software package. The 1722A interfaced with a printer can provide all the reports your lab needs to maintain traceability and stay on top of the workload.

Cal Results→PC™ is an optional software package for further manipulating your calibration data on an IBM-PC or compatible. This valuable option lets you bring the power of dBase III to your calibration function.

Computer-Aided Calibration

7411B Calibration Software

7422A Control and Software Package

Specifications

Mainframe Instruments Controlled by 7411B Calibration Software*

Fluke 1953A Universal Counter/Timer
Fluke 5100 Series B Multifunction Calibrators (5100B, 5101B, 5102B)
Fluke 5200A AC Calibrator
Fluke 5205A and 5215A Precision Power Amplifiers
Fluke 5220A Transconductance Amplifier
Fluke 5440 Series Direct Voltage Calibrators (5440A, 5440B, 5442A)
Fluke 5450A Resistance Calibrator
Fluke 6010A and 6011A Synthesized Signal Generators
Fluke 6060 Series Synthesized Signal Generators
Fluke 6070A and 6071A Synthesized Signal Generators
Fluke 8502A, 8505A, and 8506A Digital Multimeters
Fluke 8520A Digital Multimeter
Tektronix CG551 and CG5001 Oscilloscope Calibrators
Wavetek 278 Function Generator

* Mainframe instruments require an IEEE-488 interface, where applicable.

Types of Instruments Tested

Measurement and stimulus instruments ranging from direct voltage to 1 GHz, either manually or via an IEEE-488 interface. By using the IEEE-488 interface, instruments can be closed-loop, closed case tested with little or no operator interaction during the test procedure.

Major Capabilities

Write or modify a procedure
Verify and/or adjust an instrument
Calibration History Management on 1722A (standard)
Calibration History Management on IBM-PC (optional)

Calibration Modes

Performance Verification: In this mode the performance of the UUT is checked and the results recorded. No adjustments are permitted.

Calibration With Adjustment: In this mode the performance of the UUT is verified, adjusted, and the results are recorded.

Other Utilities

The following are other functions included within the 7411B Calibration Software.

Recording Results: Test procedure results can be recorded via a printer as described under List, Copy, and Delete Data.

List, Copy, or Delete Data: Possible data includes procedures and test results.

List: Procedures, results, and hard disk/diskette catalogs can be displayed on the 1722A or be listed to a RS-232-C Printer.

Copy: Procedures and results can be copied from hard disk to diskette, diskette to diskette, and to or from remote devices such as another computer.

Enter New Operator Name: A system operator uses this utility to enter his or her name for use in the header of the results display or print-out. The name on the print-out is the last name entered.

Identify UUTs by Bar Code: UUTs can be identified and the proper cal procedure initiated using a variety of bar codes and bar code readers.

Calibration History Management

This is a data management utility for manipulating results data to create user-defined reports. It allows the user to define, modify, or create a report, using the data fields in the test results files. Typical data may include a UUT's serial number, operator's name, calibration time (elapsed and chronological), and other such data. Capability is standard on 7411B.

An optional software package, "Cal Results→PC,"™ runs on IBM PC, XT, AT, or compatibles. Cal data is uploaded to PC via floppy disk. Fully customized reports may be generated. PCs must be equipped with 256K of memory, MS-DOS or PC-DOS at Rev 2.0 or greater, dBASE III, and 80 column print capability.

Upgrade to 7411B

If you presently own 7411A software, you can upgrade to 7411B at a reduced price. Order the 7411B/U Software Upgrade Package.

Every 7411B includes translation software such that all the procedures which you have written for use under standard 7411A will run with 7411B.

7411B Source Code

If you wish to customize your 7411B Calibration Software, you will need to order 7411B-100 Source Code. (Please note, source code is not required for writing or modifying procedures involving instruments controlled by the 7411B.) Source code includes fully commented and documented 7411B Calibration Software.

7411B-100 Source Code includes:

- Instrument Calibration Source Code Disks
- Procedure Generation Source Code Disks
- Calibration History Management Source Code Disks
- 7411B Source Code Manual
- 17XXA-203 Compiled BASIC Software Development System

Ordering Information

The following lists ordering information for 7411B Calibration Software and 7422A Control and Software Package. For further information see the 7411B Calibration Software Data Sheet, available from your Fluke Sales Engineer or by calling Fluke at one of the phone numbers at the back of this catalog.

Models

7411B Calibration Software including:

- Procedure Generation Software
- Instrument Calibration Software
- Calibration History Management Software
- Fluke-example calibration procedures
- 7411B Manual Set

7411B/U Upgrade from 7411A

7411B-100 Source Code for 7411B

7411B-500 Cal Results→PC™ Software

7411B-UGP/DM 8 Diskettes of DMM User Group Procedures

7411B-UGP/OS 10 Diskettes of Oscilloscope User Group Procedures

7411B-600 Additional 7411B Manual Set

7422A Control and Software Package including:

- 7411B Calibration Software
- 1722A Instrument Controller (including IEEE-488/RS-232-C interface, Option -008 and 1024K-byte RAM, Option -016)

Operator's Aid

Y8021 1m IEEE-488 cable

7411B Manual Set

1722A Manual Set

1765B/10 10 MByte Hard Disk Unit

1765B/20 20 MByte Hard Disk Unit

Training

7400 Calibration Systems Procedure Writing

Referred to as the Calibration Software Package, you'll attend this five day course to learn to write Performance Test and Calibration procedures for 7411 based systems. To do this you'll need to learn the overall 7400 Series program scheme. You will also learn to manage Calibration Histories and to become familiar with the 1722A Instrument Controller operating system and utilities. (See page 273 for more details.)



7404B

5

7404B Computer-Aided Benchtop Cluster

- Saves you time and money from the day of installation
- Protects your past and future investments
- 5½-digit meter calibration
- 7411B Calibration Software included
- Closed-loop calibration procedures included

The 7404B Computer-Aided Calibration Cluster is an automated, highly accurate meter calibration system. It allows you to quickly and accurately calibrate digital and analog meters, power supplies, and other electronic instruments. The 7404B combines field-proven Fluke hardware and state-of-the-art 7411B Calibration Software in a system designed for reliability, durability, and performance that will meet your most stringent demands. Hardware combines the Fluke 5100B Multifunction Calibrator and 8506A Digital Multimeter under the control of the 1722A Instrument Controller; the 1722A runs the 7411B Calibration Software.

The 7404B will save you time and money as soon as it is installed. (And installation is easy, requiring you only to connect the IEEE-488 cables and power cords in benchtop configurations.) A library of user group procedures is included, covering most common DMMs. User-friendly software prompts even your least trained technicians through procedures quickly and easily. You are not required to invest time in writing procedures or extensive training.

The 7404B protects your past investment by incorporating Fluke instruments you already own; your future investment is protected too by the 7411B Calibration Software. You can upgrade your 7404B as your needs grow without making additional software investments. 7411B Calibration Software is comprehensive, with built-in capability to integrate additional instruments into your 7404B Calibration Cluster without the requirement that you buy additional software packages.

Field-Proven Fluke Hardware and Software

The 5100B Multifunction Calibrator, the world's best-selling calibrator and heart of the 7404B, gives you six function capability in a single instrument. Functions include direct and alternating voltage, direct and alternating current, resistance, and rf. These sources (except rf) are available from a single output, simplifying the closed-loop calibration of DMMs.

The synergistic design of the 7404B gives you "accuracy enhancement." The 7404B uses the inherent accuracy of the 8506A Digital Multimeter to increase the accuracy of the 5100B, giving you more precise calibrations. Thanks to this accuracy enhancement, the 7404B gives you a best direct voltage stimulus uncertainty of 13 ppm and alternating voltage stimulus to 190 ppm. This enhancement process is accomplished automatically via software, rather than manually by the operator.

The 1722A Instrument Controller, which automates the 7404B, is a true instrument controller designed specifically for instrument control in the test and measurement environment.

Fluke has concentrated on designing an easy to use and convenient operator interface. While using the 7404B, you can interact with the system via the 1722A's Touch-Sense Display which displays instructions and options for obvious actions, or use the handheld operator keypad. A full ASCII keyboard is only used for writing or editing procedures and can be removed when it is not needed.

Upgrade Your Existing Fluke Instruments To A 7404B.

If you already own a Fluke 5100B, 5101B, or 8506A you can add the power of the 1722A Instrument Controller and 7411B Calibration Software to create your own 7404B. Complete packages are available that simplify the process of ordering upgrade hardware and software. Compare your existing equipment with Standard 7404B Components listed below and note the items you do not have. Then order only those items that you need to complete your upgrade from the Standard 7404B Component list or, if convenient, order upgrade packages listed under 7404B Options.

Standard 7404B Components

The standard 7404B consists of the following major items:

- Fluke 5100B Multifunction Calibrator with a 5100A-05 IEEE-488 interface option.
- Fluke 8506A Digital Multimeter with an 8500A-05 IEEE-488 interface option.
- Fluke 1722A Instrument Controller with a 17XXA-016 1024K-byte RAM option.
- Fluke 7404B-800 User Interface/Accessories Package that contains:
 - 7411B** Calibration Software with manuals.
 - 7400A-997** Operator's Aid, a small handheld keypad the operator uses in conjunction with the 1722A Touch-Sense display to control the 7404B.
 - 7400A-996** AC Divider, a small ac divider used to reduce the alternating voltage output of the 5100B to the millivolt level when calibrating wideband rf voltmeters at low frequencies.

Y8021 (3 each) Shielded one meter IEEE-488 bus cables.

Y8404 Analog Accuracy Enhancement Cable, used to connect the 5100B voltage outputs to the 8506A's rear input.

7411B Software Is Ready When You Expand Your 7404B

The 7411B Calibration Software provided with the 7404B is fully compatible with expansion of the 7404B's capabilities. The 7411B supports the addition of the 5205A or 5215A Precision Power Amplifiers and 5220A Transconductance Amplifier. It also supports the addition of other calibrators, such as the 5440B Direct Voltage Calibrator or 5450A Resistance Calibrator, to the calibration cluster. The 7404B can also be upgraded to a 7449A Oscilloscope/Meter Calibration Cluster by adding the 7410A-400 Oscilloscope Calibration option. Standard RS-232-C printers can be added to the system for generating hard copy of calibration constants and test results.

Specifications

All specifications 23°C ±5°C

Multifunction Direct Volts Specifications from 5100B (enhanced by 8506A):

Range	Absolute Uncertainty, 90 Days ±(ppm of output + floor)		Resolution	Load Current	Temperature Coefficient 0°C to 18°C/28°C to 40°C
	Enhanced	Normal			
0 - 20 mV	22 + 1.6 μV	38 + 5.2 μV	0.1 μV	See Note 1	±(5 ppm output + 1 ppm range + 1 μV)/°C
20 - 200 mV	22 + 1.6 μV	38 + 6.6 μV	1 μV	See Note 1	±(5 ppm output + 1 ppm range + 1 μV)/°C
0.2 - 2V	14 + 6.2 μV	38 + 21 μV	10 μV	See Note 1	±(5 ppm output + 1 ppm range + 1 μV)/°C
2 - 20V	10 + 60 μV	38 + 165 μV	100 μV	25 mA	±(5 ppm output + 1 ppm range + 1 μV)/°C
20 - 128V	17 + 600 μV	38 + 1.6 mV	1 mV	10 mA	±(5 ppm output + 1 ppm range + 1 μV)/°C
128 - 200V	17 + 6 mV	38 + 1.6 mV	1 mV	10 mA	±(5 ppm output + 2 ppm range)/°C
200 - 1100V	17 + 6 mV	38 + 16 mV	10 mV	6 mA	±(5 ppm output + 2 ppm range)/°C

¹Source resistance of 50 Ohm on the 20 mV, 200 mV, and 2V ranges.

Multifunction Alternating Volts Specifications from 5100B (enhanced by 8506A):

Range	Enhanced Absolute Uncertainty, 90 Days ±(ppm output + floor)			Resolution ²	Load Current ³	Temperature Coefficient 0°C to 18°C/28°C to 40°C
	50 Hz to 1 kHz ⁴	2 kHz to 20 kHz ⁴	30 kHz to 50 kHz ⁴			
1 - 12.5 mV	55 μV	55 μV	60 μV	0.1 μV	See Note 4	±(20 ppm output + 2 ppm range)/°C
12.5 - 20 mV	300 + 7 μV	300 + 7 μV	650 + 10 μV	0.1 μV	See Note 4	
20 - 125 mV	300 + 7 μV	300 + 7 μV	650 + 10 μV	0.1 μV	See Note 4	
125 - 200 mV	180 + 2 μV	180 + 2 μV	650 + 2 μV	0.1 μV	See Note 4	
0.2 - 2V	180 + 20 μV	180 + 20 μV	650 + 20 μV	1 μV	See Note 4	
2 - 20V	180 + 200 μV	180 + 200 μV	650 + 200 μV	10 μV	25 mA	
20 - 110V	180 + 2 mV	180 + 2 mV		100 μV	10 mA	
110 - 125V	180 + 2 mV			1.0 mV	10 mA	
125 - 200V	300 + 2 mV			1.0 mV	10 mA	
200 - 600V	300 + 10 mV			10 mV	6 mA	
600 - 1100V	500 + 50 mV			10 mV	6 mA	

²Stimulus resolution. Refer to "Measurement, Alternating Volts" specification in this data sheet for enhancement resolution.

³Maximum capacitive load of 875 pF to 20V and 275 pF from 20 to 1100V.

⁴Limited by 50 Ohm output resistance.

⁵There are 28 discrete frequencies over the entire range.

Boost Power Amplifier Output Specifications from 5205A driven by 5100B: (Option)

Range	Absolute Uncertainty, 90 Days ±(ppm of output + floor)		Resolution	Load Current ⁶	Temperature Coefficient 0°C to 18°C/28°C to 40°C
	50 Hz to 10 kHz ⁵	10 kHz to 50 kHz ⁵			
Standard: 100 to 1100V	800 + 0.1V	1200 + 0.15V	10 mV	200 mA ⁷	to 10 kHz: ±(30 ppm output + 5 mV)/°C
Enhanced: 100 to 600V	210 + 0.01V	610 + 0.01V	10 mV	200 mA ⁷	to 50 kHz: ±(50 ppm output + 5 mV)/°C

⁶Decreasing linearly from 200 mA at 100 Hz to 140 mA at 50 Hz.

⁷Maximum capacitive load of 1500 pF

Multifunction Cardinal Point Resistance Specifications from 5100B:

Resistor Value	Absolute Uncertainty, 90 Days, \pm ppm output	Mode	DMM-Supplied Test Current			Temperature Coefficient ppm/ $^{\circ}$ C 0 $^{\circ}$ C to 18 $^{\circ}$ C 28 $^{\circ}$ C to 40 $^{\circ}$ C	
			Power Coefficient ppm/mW	Max Power	Max Volts		Max Amps
1 Ohm	150	4-wire	0.1	1W	1V	1A	10
10 Ohm	100	4-wire	0.3	1W	3V	300 mA	10
100 Ohm	30	4-wire	0.3	1W	10V	100 mA	5
1 k Ω	30	4-wire	0.3	1W	30V	30 mA	5
10 k Ω	30	2-wire	0.3	1W	100V	10 mA	5
100 k Ω	30	2-wire	0.3	1W	300V	3 mA	5
1 M Ω	100	2-wire	0.2	100 mW	300V	300 μ V	5
10 M Ω	300	2-wire	0.02	10 mW	300V	30 μ A	10

Multifunction Current Output Specifications from 5100B:

Output Characteristics	Direct Current	Alternating Current* 50 Hz to 1 kHz
Ranges	200 μ A, 2 mA, 20 mA, 200 mA, 2A; bipolar	200 μ A, 2 mA, 20 mA, 200 mA, 2A
Absolute Uncertainty 90 Days	\pm (150 ppm output + 20 ppm range + 0.01 μ A)	\pm (500 ppm output + 50 ppm range + 0.02 μ A)
Resolution	5 ppm range	5 ppm range
Compliance Voltage	10V to 200 mA and 2.1V to 2A	7V rms to 200 mA and 1.4V rms to 2A
Temperature Coefficient (0 $^{\circ}$ C to 18 $^{\circ}$ C, 28 $^{\circ}$ C to 40 $^{\circ}$ C)	\pm (10 ppm output + 2 ppm range)/ $^{\circ}$ C	\pm (25 ppm output + 10 ppm range + 0.2 μ A/ $^{\circ}$ C)

*The multifunction output can supply current to 5 kHz.
There are 15 discrete frequencies over the entire range.

Boost Current Output Specifications from 5220A driven by 5100B: (Option)

Output Characteristics	Direct Current	Alternating Current 50 Hz to 5 kHz
Range	2A to 20A	2A to 20A
Absolute Uncertainty, 90 Days	\pm (250 ppm output + 1 mA)	50 Hz to 1 kHz: \pm (700 ppm output + 1 mA) 1 kHz to 5 kHz: \pm (700 ppm output + 1 mA) x frequency in kHz
Resolution	5 ppm range	5 ppm range
Compliance Voltage	4V	3V rms
Temperature Coefficient (0 $^{\circ}$ C to 18 $^{\circ}$ C, 28 $^{\circ}$ C to 40 $^{\circ}$ C)	\pm 30 ppm output + 0.1 mA/ $^{\circ}$ C	\pm (30 ppm output + 0.1 mA)/ $^{\circ}$ C

5

Measurement Capability of 8506A Multimeter

Direct Voltage Measurement Specifications

Input Characteristics				Absolute Uncertainty, 6 $\frac{1}{2}$ Digit Operation, 90 Days: \pm (ppm input + digits)		
Range	Maximum Displayed Voltage	Resolution	Input Ohms	Uncertainty vs. Mode		Temperature Coefficient \pm (ppm input + digits)/ $^{\circ}$ C ⁹
				Average	Normal	
100 mV	200.0000 mV	100 mV	\geq 10,000 M Ω	20 + 8	25 + 40	3 + 5
1V	2.000000V	1 μ V	\geq 10,000 M Ω	12 + 6	15 + 8	3 + 1
10V	20.00000V	10 μ V	\geq 10,000 M Ω	See Note 10	10 + 8	2 + 0.5 ¹¹
100V	128.0000V	100 μ V	10 M Ω	15 + 6	18 + 8	3 + 1
1000V	1200.000V	1 mV	10 M Ω	15 + 6	18 + 8	3 + 0.5

⁹Temperature coefficient applies for 0 $^{\circ}$ C to 18 $^{\circ}$ C and 28 $^{\circ}$ C to 40 $^{\circ}$ C operation.

¹⁰7 $\frac{1}{2}$ digit operation with 20,000,000 count at full scale and 1 μ V resolution, uncertainty 8 ppm input plus 60 digits.

¹¹ \pm (2 ppm + 5 digits) in average mode.

Normal Mode Rejection: 100 dB at 60 Hz or 95 dB at 50 Hz

Common Mode Rejection: 160 dB at 60 Hz with 1 k Ω unbalance in either lead

 Alternating Voltage Measurement Specifications 5 $\frac{1}{2}$ -Digit Operation

Range	Maximum Displayed Voltage	Resolution	Input Impedance
100 mV	125.000 mV	1 μ V	1 M Ω + 1% shunted by <180 pF on all ranges
300 mV	400.000 mV	1 μ V	
1V	1.25000V	10 μ V	
3V	4.00000V	10 μ V	
10V	12.5000V	100 μ V	
30V	40.0000V	100 μ V	
100V	125.000V	1 mV	
500V	600.000V	1 mV	

Computer-Aided Calibration

7404B

High Accuracy Mode, Absolute Uncertainty, 5½-Digit Operation, 90 Days:

Range	Input Frequency vs. Percent Input Amplitude Uncertainty						
	10 to 40 Hz	40 Hz to 20 kHz	20 to 50 kHz	50 to 100 kHz	100 to 200 kHz	200 to kHz	500 kHz to 1 MHz
100 mV	0.08	0.026 ¹²	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	12.0
100V	0.08	0.016	0.06	0.2	1.0	3.5	—
500V	0.08	0.016	0.06	0.2	—	—	—

¹²Add 5 digits (5 μ V) to the % of reading.

Temperature Coefficient (0°C to 18°C, 28°C to 40°C): 0.1 x 90 day uncertainty

Common Mode Rejection: >120 dB, dc to 60 Hz with 100 Ω in either lead

Note: Enhanced and Normal Modes of aV measurement are available. See the 8506A data sheet.

Resistance Measurement Specifications Input Characteristics: (Option)

Ohms Range	Full Scale	Number of Digits	Resolution in Ohms	Test Current	Absolute Uncertainty, 90 Days \pm (ppm input + digits)	Temperature Coefficient \pm (ppm input + digits)/°C ¹³
10 Ω	20.0000 Ω	5½	100 $\mu\Omega$	10 mA	50 + 20	8 + 1.5
100 Ω	200.0000 Ω	6½	100 $\mu\Omega$	10 mA	30 + 14	7 + 2
1 k Ω	2.000000 k Ω	6½	1 m Ω	1 mA	30 + 8	7 + 2
10 k Ω	25.00000 k Ω	6½	10 m Ω	78 μ A	30 + 8	7 + 2
100 k Ω	250.0000 k Ω	6½	100 m Ω	7.2 μ A	30 + 8	7 + 5
1 M Ω	4.10000 M Ω	5½	10 Ω	4.5 μ A	30 + 1	10 + 1
10 M Ω	35.0000 M Ω	5½	100 Ω	450 nA	200 + 1	50 + 1
100 M Ω	265.000 M Ω	5½	1 k Ω	56 nA	500 + 1	200 + 1

¹³Apply temperature coefficient for 0° C to 18° C and 28° C to 40° C.

Measurement Configuration: 2-wire or 4-wire on all ranges

Ordering Information

The following information applies to the 7404B. Ordering information for a 7449A Oscilloscope Calibration cluster is found on page 122.

Model

7404B Computer-Aided Meter Calibration Cluster

Options

- 7404A-970 5100B w/-03 and -05 Options
- 7400A-506 8506A w/-05 Option
- 7400A-993 1722A w/-016 and -008 Options
- 7404B-800 User Interface/Accessories Package
- 5100A-03 Wideband AC Voltage for 5100B & 5101B
- 5100A-05 IEEE-488 Interface for 5100B or 5101B
- 8500A-05 IEEE-488 Interface for 8506A
- 8505A-02A* Ohms Converter
- 8500A-03* Current Converter
- 5205A Precision Power Amplifier for aV and dV
(requires Y5000 and Y5001 in 5100B)
- 5215A Precision Power Amplifier for aV
(requires Y5000 and Y5001 in 5100B)
- 5220A Transconductance Amplifier
(requires Y5000 and Y5002 in 5100B)
- 1722A-007 512K-byte RAM Expansion for 1722A
- 1722A-008 IEEE-488/RS232C Interface for 1722A

*Cannot install both -02A and -03 in 8506A at the same time

Accessories

- Y5000 Boost Interface for for 5100B
(one Y5000 supports both voltage and current boost)
- Y5001 Boost Cable for 5205A or 5215A
- Y5002 Boost Cable for 5220A
- Y8021 1m Shielded Cable, for IEEE-488 bus
- Y8022 2m Shielded Cable, for IEEE-488 bus
- Y8023 4m Shielded Cable, for IEEE-488 bus

Service & Support



7449A

7449A Computer-Aided Oscilloscope/Meter Calibration Cluster

- Saves you time and money from the day of installation
- Protects your past and future investments
- Oscilloscope and meter calibration
- All 7404B capabilities included
- 7411B Calibration Software included
- Oscilloscope and meter calibration procedures included

The Fluke 7449A Computer-Aided Oscilloscope/Meter Calibration Cluster adds oscilloscope calibration capability to the already impressive line up of capabilities of the Fluke 7404B Calibration Cluster. With the 7449A you get calibration and verification capability of oscilloscope vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy, and calibrator output accuracy along with up to six functions for meter calibration and reliable measurement capability. In the 7449A, instrumentation joins flexible software to give you combined oscilloscope/meter calibration on which you can depend.

The Fluke 7449A gives you the Fluke 5100B Multifunction Calibrator, the Fluke 8506A Digital Multimeter for measurement and accuracy enhancement, and the Tektronix CG5001 Oscilloscope Calibrator, all controlled via IEEE-488 bus by the Fluke 1722A Instrument Controller.

The 7449A gives you up to six function meter calibration with a basic direct voltage uncertainty of 13 ppm and alternating voltage uncertainty to 190 ppm. Plus, for oscilloscope calibration you get voltage output amplitude from 40 μ V to 200V, time markers from 400 pS to 5S, a risetime less than 200 pS, square wave amplitude uncertainty of 0.25%, and measurement capability.

All this capability is controlled by the Fluke 1722A Instrument Controller featuring the Touch-Sense Display. Extremely fast command execution, advanced instrument control capabilities, and expansive

memory give the 1722A important advantages over personal computers as the "brain" of your computer-aided benchtop cluster.

The 7449A has been designed to be very easy to use. With the 7449A you can get good calibration results from operators with little calibration experience. Instructions are presented on the screen of the 1722A, operators make their choices via the Touch-Sense Display or via the convenient Operator's Aid, and results are automatically recorded.

Upgrade Your 7404B or CG5001 To a 7449A

If you already own a Tektronix CG5001 Oscilloscope Calibrator, a Fluke 7404B Computer-Aided Meter Calibration Cluster, or other instruments used in the 7404B, you can upgrade to a 7449A by adding the instruments you need and putting them under control of the Fluke 1722A Instrument Controller and 7411B Calibration Software. Compare your existing equipment with the standard 7449A components listed below, note what you still need, then order only those items you need to complete the upgrade.

The standard 7449A consists of the following items:

- 7404B Computer-Aided Meter Calibration Cluster consisting of:
 - Fluke 5100B with a 5100A-05 IEEE-488 interface option.
 - Fluke 8506A with an 8500A-05 IEEE-488 interface option.
 - Fluke 1722A with a 17XXA-016 1024K-byte RAM option.
 - Fluke 7404B-800 User Interface/Accessories option containing:
 - 7411B Calibration Software
 - 7400A-997 Operator's Aid, a small handheld keypad that the operator uses in conjunction with the 1722A's Touch-Sense Display to control the 7449A.
 - 7400A-996 AC Divider, a small ac divider used to reduce the alternating voltage output of the 5100B to the millivolt level when calibrating rf meters or trigger levels at low frequencies.
 - Y8021 Three shielded, one meter long IEEE-488 bus cables.
 - Y8404 Analog Accuracy Enhancement cable used to connect the 5100B voltage outputs to the 8506A's rear inputs.
- Fluke 7410A-400 consisting of a Fluke-supplied, serviced, warranted, and supported:

Tektronix CG5001 Oscilloscope Calibrator with:

- Output cable assembly (Tektronix part number 012-0884-00)
- Pulse head (Tektronix part number 015-0311-01)
- Comparator head (Tektronix part number 015-0310-01)
- TM5006 mainframe with CG5001 installed
- Three blank plug-in panels (Tektronix part number 016-0195-03)

- Fluke Y8021 shielded one meter long IEEE-488 bus cable

7411B Software Is Ready When You Expand Your 7449A

The 7411B Calibration Software supplied with the 7449A is fully compatible with expansion of the 7449A's capabilities. 7411B software supports the addition of a synthesized signal generator such as the Fluke 6060B Signal Generator. It also supports the addition of other calibrators for improved meter calibration performance (see the 7404B description for more information). Standard RS-232-C printers can be added to the system for generating hard copy of calibration constants and test results. A full list of instruments supported by 7411B Calibration Software is on page 116.

Specifications

Voltage (Amplitude Mode)

The standard voltage is used to calibrate vertical display accuracy.

Range: 40 μ V to 200V (1-2-5 steps with multiplier)

Multipliers: 1, 2, 3, 4, 5, 6, 8, 10 divisions

Polarity: Positive from ground

Uncertainty: $\pm(0.25\% \pm 1 \mu\text{V})$

Frequency: DC or 10 Hz to 100 kHz (decade steps). 40 mV to 80 mV from 10 Hz to 100 kHz; 100 mV to 10V from 10 Hz to 100 kHz, or dc; 12V to 200V from 10 Hz to 10 kHz, or dc

Variable Range: $\pm 9.9\%$

Current (Amplitude Mode)

The standard current is used to calibrate current probes.

Range: 1 mA to 100 mA (1-2-5 sequence)

Multipliers: 1, 2, 3, 4, 5, 6, 8, 10

Uncertainty: $\pm(0.25\% + 2 \mu\text{A})$

Frequency: Dc or 10 Hz to 1 MHz (decade steps)

Variable Range: $\pm 9.9\%$

Edge (Amplitude Mode)

The low distortion pulses obtained in this mode are used to test oscilloscope input amplifier and attenuator compensation.

Low Range: 20 mV to 1V (1-2-5 steps with multipliers)

Polarity: Positive or negative transitions to ground

Rise Time or Fall Time: < 1.3 ns

Aberrations: $\pm 2\%$

Long Term Flatness: $\pm 0.5\%$ after first 10 ns

Frequency: 10 Hz to 1 MHz (decade steps)

Variable Amplitude Range: $> \pm 9.9\%$ from nominal

Termination: 50 Ω

High Range: 1.2V to 100V (1-2-5 steps with multipliers)

Polarity: Negative voltage, rising to ground

Rise Time: < 100 ns

Aberrations: $\pm 2\%$

Long Term Flatness: $\pm 0.5\%$ after first 500 ns

Frequency: 10 Hz to 100 kHz (decade steps)

Variable Amplitude Range: $> \pm 9.9\%$ from nominal

Termination: ≥ 1 M Ω

Markers (Timing Mode)

The markers obtained in this mode are used to calibrate oscilloscope time bases.

Range: 5 ns to 10 ns (1-2-5 steps)

Uncertainty: $\pm 0.01\%$

Amplitude: 1 volt minimum into 50 Ω

Variable Range: $\pm 9.9\%$

Slewed Edge (Timing Mode)

Slewed edges are used to calibrate the very fastest ranges found on oscilloscope timebases.

Range: 100 ns to 0.4 ns (1-2-5 steps plus 0.4 ns)

Uncertainty: $\pm 0.01\%$

Edge Position Uncertainty: ± 40 ps

Amplitude: > 1 V into 50 Ω

Variable Range: $\pm 9.9\%$

Trigger Output Rate

The oscilloscope under test may be triggered externally from this source. The output amplitude is 1 volt (minimum) into 50 Ω .

Marker Mode

Normal: Slaved to marker rate from 5s to 100 ns, remains at 100 ns for faster markers

Divided by 10: Reduces normal trigger rate by a factor of ten

Divided by 100: Reduces normal trigger rate by a factor of one hundred

Slewed Edge Mode: One trigger per slewed edge. (Rate divided by 10 and divided by 100 not available)

All Other Modes

Normal: Slaved to output frequency

Divided by 10: One-tenth output frequency

Divided by 100: One-hundredth output frequency

Pulse Head

The Pulse Head is used to generate fast-rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.

Amplitude: 1.1 volt peak $\pm 5\%$ into 50 Ω

Adjustable Range: $\pm 10\%$

Rise Time: ≤ 200 ps

Polarity: Positive or negative from ground

Aberrations: $\pm 3\%$ of pulse amplitude; not to exceed 4% peak-to-peak for adjacent peaks for zero to 50 ns

Frequency: 100 Hz to 100 kHz (decade steps)

Comparator Head

The Comparator Head is used to calibrate built-in oscilloscope calibrators against the signals available from the CG5001. Both the oscilloscope calibrator and CG5001 standard amplitude signals are applied to the Comparator Head and simultaneously displayed on the oscilloscope CRT. The CG5001 signals are then varied to obtain congruent displays. Errors are displayed on the CG5001 readout.

Input

AC Voltage: $\pm 40 \mu\text{V}$ to $\pm 100\text{V}$, 10 Hz to 1 MHz — squarewave

DC Voltage: -100 mV to +100V

Resistance

Open: Underterminated (the resistance of the oscilloscope input)

50 Ω : 50 Ω $\pm 1\%$ in 50 Ω position. Maximum voltage is $\pm 5\text{V}$ peak in the 50 Ω position

Chop Parameters

Frequency: 30 Hz nominal. (Auto)

Auto Timeout: Internally selectable 0.5, 1 or 2 minutes

For complete specifications see Tektronix CG 5001 manual.

Model

7449A Computer-Aided Oscilloscope/Meter
Calibration Cluster

Options

7410A-400 Tektronix CG5001 Oscilloscope Calibrator

17XXA-007 512K-byte RAM expansion for 1722A

17XXA-008 IEEE-488/RS232C interface for 1722A

See options for 7404B on page 117.

Accessories (Also see page 284)

Y8021 Shielded, 1m IEEE-488 bus cable	85
Y8022 Shielded, 2m IEEE-488 bus cable	95
Y8023 Shielded, 4m IEEE-488 bus cable	105

Service & Support



7410A

7410A Automated Oscilloscope Calibration Workstation

- Saves you time and money now while protecting your past and future investments
- Efficient and productive oscilloscope calibration
- 7411B Calibration Software included
- Oscilloscope calibration procedures included

The Fluke 7410A is a fully integrated, automated calibration workstation which rapidly and accurately calibrates oscilloscopes of any manufacturer. It also verifies and calibrates plug-ins, probes, amplifiers, calibration fixtures, and related devices. The 7410A can be customized by the user to accommodate additional workloads.

The Fluke 7410A combines the powerful 1722A Instrument Controller with the Tektronix CG5001 Programmable Calibration Generator and the Fluke 8520A DMM. Other Fluke instrumentation provides additional measurement and stimulus capability to address the bulk of scope workload.

With the 7410A you increase throughput and reliability. This improvement in quality and productivity results from the 7411B Calibration Software included with each workstation. The 7411B is both extensive and operator-oriented. Your productivity will increase as your workload does, reducing your cost per calibration. This alone can often justify the purchase of a 7410A.

You get software you can depend on; the 7411B has been thoroughly

tested and field proven by Fluke. The 7411B package includes calibration procedures for oscilloscopes which you can use as they are, modify them to fit your needs, or easily write new procedures of your own. All 7411B procedures are onward compatible with future offerings from Fluke.

Specifications

Voltage (Amplitude Mode): Square waves or direct voltage used to calibrate vertical axis

Range: 40 μ V to 200V (1-2-5 steps with multiplier)

Multipliers: 1, 2, 3, 4, 5, 6, 8, 10 divisions

Polarity: Positive from case ground

Uncertainty: $\pm(0.25\% + 1 \mu$ V)

Frequency: 40 to 80 mV: 10 Hz to 100 kHz; 0.1 to 10V: direct voltage or 10 Hz to 100 kHz; 12 to 200V: direct voltage or 10 Hz to 10 kHz

Adjustment: Amplitude can be varied $\pm 9.9\%$ from nominal

Current (Amplitude Mode) Used to calibrate current probes

Range: 1 mA to 100 mA (1-2-5 sequence)

Multipliers: 1, 2, 3, 4, 5, 6, 8, 10

Uncertainty: $\pm(0.25\% + 2 \mu$ A)

Frequency: Dc or 10 Hz to 1 MHz (decade steps)

Droop: $\leq 1\%$

Adjustment: Amplitude can be varied $\pm 9.9\%$ from nominal

Edge (Amplitude Mode): Used to calibrate vertical risetime

Low Range: 20 mV to 1V p-p (1-2-5 steps with multipliers)

Multipliers: 1, 2, 3, 4, 5, 6, 8 and 10
Polarity: Positive or negative transitions to case ground
Rise Time or Fall Time: ≤ 1.3 ns
Aberrations: $\pm 2\%$
Long Term Flatness: $\pm 0.5\%$ after first 10 ns
Frequency: 10 Hz to 1 MHz (decade steps)
Variable Amplitude Range: $> \pm 9.9\%$ from nominal
Termination: 50 Ω
High Range: 1.2V to 100V (1-2-5 steps with multipliers)
Polarity: Positive transitions only (negative voltage rising to ground)
Rise Time: < 100 ns
Aberrations: $\pm 2\%$ of square wave amplitude
Long Term Flatness: $\pm 0.5\%$ after first 500 ns
Frequency: 10 Hz to 100 kHz (decade steps)
Variable Amplitude Range: $> \pm 9.9\%$ from nominal
Termination: ≥ 1 M Ω

Markers (Timing Mode): The markers obtained in this mode are used to calibrate time base accuracy.

Range: 10 ns to 5s (1-2-5 steps)
x10 Magnifier: Increase marker rate by factor of ten (0.1 μ s to 5s range)
Uncertainty: $\pm 0.01\%$
Amplitude: 1V minimum into 50 Ω
Adjustment: Time can be adjusted to $\pm 9.9\%$ from nominal

Slewed Edge (Timing Mode): Used to calibrate time base accuracy.
Range: 0.4 ns to 100 ns (1-2-5 steps plus 0.4 ns)
x10 Magnifier: Increases slewed edge by factor of ten (5 ns to 100 ns range)
Uncertainty: $\pm 0.01\%$
Position: ± 40 ps uncertainty in position of edge
Amplitude: > 1 V minimum into 50 Ω
Adjustment: Time can be adjusted to $\pm 9.9\%$ from nominal

Trigger Output: Used to calibrate external trigger mode.
Normal: Slaved to marker rate from 5s to 100 ns, remains at 100 ns for faster rates

Slewed Edge Mode: One trigger per slewed edge
All Other Modes: Slaved to output frequency
Division: The trigger rate can be reduced by factors of 10:1 and 100:1 (not available in slewed edge mode)
Amplitude: 1V minimum into 50 Ω

Pulse Head: Used to calibrate very fast vertical risetimes.
Amplitude: 1.1V peak $\pm 5\%$ into 50 Ω
Polarity: Positive or negative transitions from case ground
Rise Time: ≤ 200 ps
Aberrations: $\pm 3\%$ of pulse amplitude; not to exceed 4% p-p for adjacent peaks for zero to 50 ns
Frequency: 100 Hz to 100 kHz (decade steps)
Adjustment: Amplitude can be adjusted $\pm 9.9\%$ from nominal

Comparator Head: Used to calibrate built-in calibrator output.
Input: Alternating Voltage: ± 40 μ V to +100V, 10 Hz to 1 MHz, squarewave; Direct Voltage: -100 mV to +100V
Resistance: Open: unterminated (the resistance of the oscilloscope input) 50 Ω ; 50 Ω $\pm 1\%$ in 50 Ω position. Maximum voltage is ± 5 V peak in the 50 Ω position
Chop: Frequency: 30 Hz nominal (auto); Auto Timeout: Internally selectable at 0.5, 1, or 2 minutes. For complete specifications see the Tektronix CG5001 manual.

Measurement Specifications

DC Voltage Measurements

Uncertainty: \pm (% of Input + Digits)

Range	24 Hours 23°C $\pm 1^\circ$ C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
100 mV	0.003 + 6	0.0065 + 7	0.011 + 11
1V	0.003 + 1	0.006 + 2	0.011 + 2
10V	0.002 + 1	0.005 + 1	0.009 + 1
100V	0.003 + 1	0.007 + 2	0.012 + 2
1000V	0.0035 + 1	0.0065 + 1	0.011 + 11

Maximum Input: ± 100 V peak, HI to LO; ± 20 V peak GUARD to chassis terminal and GUARD to LO terminal, for any range

High DC Voltage Measurements

Using an 80K-6 High Voltage Probe supplied with each 7410A, measurements of 1000V to 6000V dc may be made with an accuracy of $\pm 1\%$. The probe has an impedance of 75 M Ω ± 25 M Ω . Up to 40 kV may be measured using the optional 80K-40 probe.

AC Voltage Measurements (True RMS)

Uncertainty: \pm (% of Input + % of Full Scale)*

Frequency	24 Hours 23°C $\pm 1^\circ$ C			90 Days 23°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+ % FS AC	+ % FS DC	% of Input	+ % FS AC	+ % FS DC	% of Input	+ % FS AC	+ % FS DC
40 Hz to 20 kHz	0.08	0.02	0.06	0.1	0.03	0.08	0.15	0.05	0.16
20 kHz to 100 kHz	1.0	0.3	0.4	1.0	0.3	0.4	2.0	0.6	0.8
100 kHz to 300 kHz	2.4	0.6	0.6	2.4	0.6	0.6	4.0	1.0	1.0
300 kHz to 1 MHz	8.0	2.5	2.5	8.0	2.5	2.5	15.0	5.0	5.0

* From 0.1% of range to full scale. For 650V range multiply percent of full scale by 1.6.

Resistance Measurements

Uncertainty: \pm (% of Input + Digits)

Range	24 Hours 23° $\pm 1^\circ$ C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
10 Ω	0.0045 + 6	0.0080 + 7	0.0140 + 12
100 Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3
1000 Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3
10 k Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3
100 k Ω	0.0040 + 2	0.0090 + 2	0.0140 + 3
1 M Ω	0.0090 + 2	0.0160 + 2	0.0200 + 3
10 M Ω	0.0300 + 1	0.0440 + 1	0.0450 + 3
100 M Ω	0.0400 + 5	0.0500 + 5	0.0600 + 5

* Using Conductance mode. When the instrument is operated in the 10 ns to 100 ns range the resolution is 0.001 ns. Therefore, if the reading is converted to ohms the resolution is 0.1 M Ω for a 100 M Ω reading and 0.001 M Ω for a 10 M Ω reading.

General Specifications

Temperature: +10°C to +40°C, operating; -10°C to +60°C, non-operating
Relative Humidity: $\leq 70\%$ from +18°C to +40°C
Power Line: 108V to 127V ac or 216V to 254V ac, 50 Hz to 60 Hz

Computer-Aided Calibration

7410A

Power: 525 VA fully loaded, including 1722A, 6011A, and 6070A (or 6071A). 425 VA without 6011A. 400 VA without 6070A (or 6071A). 300 VA without 6011A, 6070A, or 6071A. For unit under test, 400 VA maximum.

Size

Standard Cabinet: 110 cm H x 61 cm W x 87.6 cm D (43.3 in x 24 in x 34.5 in)

1722A Controller: 14.6 cm H x 43.2 cm W x 62.2 cm D (5.25 in x 17 in x 20 in)

Workstation: 103 cm H x 81.3 cm W x 121 cm D (40.7 in x 32 in x 47.5 in). Table leaf is 61 cm wide (24 in)

Weight

Standard Cabinet: Approximately 163 kg (360 lb) fully loaded, including 6011A and 6070A (or 6071A) but excluding 1722A and Workstation. Approximately 151.6 kg (335 lb) without 6011A. 135.3 kg (299 lb) without 6070A (or 6071A). 125 kg (274 lb) without 6011A, 6070A or 6071A.

1722A Controller: 17.4 kg (38 lb)

Workstation: Approximately 73 kg (161 lb)

Model

7410A Automated Calibration Workstation

Options

7410A-211 w/6011A Signal Source

7410A-260 w/6060B Signal Generator

7410A-270 w/6070A Signal Source

7410A-271 w/6071A Signal Source

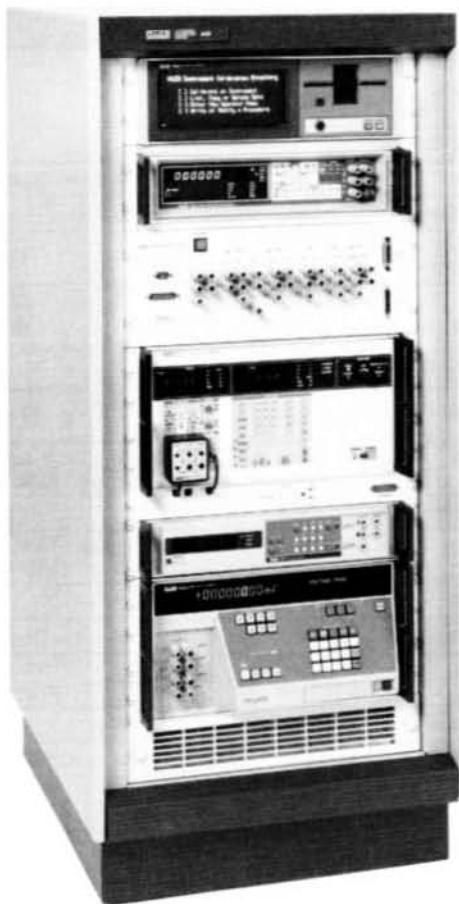
80K-40 High Voltage Probe

7400A-520 Workstation Table

Accessories (Also see page 284)

Y1706 Pack of 10 Blank Disks

Service & Support



A123-CO

Special Automated Calibration Workstations

- Automated state-of-the-art accuracy
- Configurable to fit your calibration needs
- Combined meter/oscilloscope capability in one workstation
- Mobile automated calibration workstations

Flexibility is the key word for Fluke's new state-of-the-art special 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.

Fluke offers two standard configurations of the A123 system, each with a wide variety of options for meters and oscilloscopes. These workstations combine the accuracy of computer-aided calibration, the convenience of a test interface panel and the flexibility of semi-customized configurations to meet virtually any application required by metrologists all over the world. These workstations can be mounted in mobile racks to allow the calibrator to be easily transported to the work site.

If these standard systems do not perfectly fit your requirements, Fluke will configure arrangements of the instruments listed in the table on page 116. Contact your local Fluke Sales Office for help in configuring a workstation.

The Fluke A123 — The World's Most Accurate 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 be added to extend the frequency range and also boost the alternating voltage output and current output.

One of the major benefits of owning a Fluke computer-aided calibration system is that you can enhance your system as your workload changes or budget money becomes available. The graph on page 114 illustrates the growth path from a simple 5100B Multifunction Meter Calibrator to an A123 system providing full state-of-the-art source accuracy for meters and oscilloscopes.

Procedure generation and system control are accomplished by Fluke's 7411B Calibration Software. This software allows a procedure writer, who knows how to write calibration procedures in technical English, to produce the computer files necessary to operate the A123 without knowing any formal computer language. The 7411B will prompt the procedure writer to choose Function Selection Codes (FSC) and to enter the data required to calibrate a particular instrument such as a DMM.

At calibration time, the 7411B uses the procedure data previously entered by the procedure writer to execute a calibration sequence. The operator interfaces with this sequence by responding to requests appearing on the 1722A touch sensitive display. Replies are entered either through the touch sensitive display or by pressing the appropriate button on the handheld operator's aid.

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.

The calibration philosophy is constantly changing. In many cases, it is much more cost effective to take the calibration equipment to the instruments to be calibrated, instead of the reverse, which was the practice a few years ago. The size, ruggedness, and temperature specifications of modern equipment make this possible now. All Fluke A123 Automated Calibration Workstations can be mounted on optional mobile bases with semi-pneumatic wheels which provide a smooth ride over the factory floor.

"Cost Optimized" A123 for DMM Calibration (A123-CO)

"Cost Optimized Calibration" is a philosophy developed by Fluke many years ago to allow the cal lab manager to find a balance between increasing calibration confidence and reducing cost. The goal is the same: getting the most out of your calibration budget. In cost optimized calibration, the lab manager selects calibration equipment that has sufficient precision and capability to provide the level of calibration confidence required and the available budget. Whatever starting level is chosen, expansion to a higher level is always possible when extra funding becomes available. The software and calibration procedures remain compatible and there are no dead ends.

In the "cost optimized" A123-CO, only the alternating voltage is performance optimized, all other functions provide sufficient precision and capability for the most modern high accuracy DMMs. The alternating voltage function of multimeters can be accurately calibrated to 190 ppm within the maximum volt/hertz product (1000V at 1 kHz decreasing to 20V at 50 kHz). This can be enhanced by the addition of the 5205A Precision Power Amplifier. Similarly, the 2 amp direct and alternating current output can be boosted to 20 amp by the optional 5220A Transconductance Amplifier.

A standard feature of A123-CO system is the 8506A Digital Multimeter which provides measurement capability for direct voltage, alternating voltage, and resistance. This is used to self-test the system.

Optional equipment may be added to the A123-CO Automated Workstation to provide highly accurate stimulus for oscilloscope calibration. The Tektronix CG5001 Oscilloscope Calibrator provides calibration and verification of oscilloscope gain, horizontal timing and gain, vertical pulse characteristics, and probe accuracy.

Similarly, a Fluke 6060B Synthesized Signal Generator can be added for oscilloscope calibration to provide a very pure sinewave output from 100 kHz to 1050 MHz. Low frequencies from 10 Hz to 10 MHz can be provided by the 5100A-03 Option. The CG5001 and 6060B are not connected to the test interface panel.

The A123-CO consists of:

- 1722A Instrument Controller with
- 1024K RAM Option -016
- IEEE-488 Interface Option -008
- 8506A Thermal RMS Digital Multimeter with
- Ohms Option -02A
- IEEE-488 Interface Option -05
- 5100B Multifunction Calibrator with
- IEEE-488 Interface Option -05
- 5440B Direct Volts Calibrator
- 5450A Resistance Calibrator
- A123 MTIP Modular Test Interface Panel with cables
- 48" Rack Assembly, Power Distribution and Fan
- 7411B Software package

Optional with A123-CO:

- 5205A Precision Power Amplifier
- 5220A Transconductance Amplifier
- CG5001 Oscilloscope Calibrator
- 6060B Synthesized Signal Generator
- Wideband Output Option -03 for 5100B
- 1765B Winchester Disk Drive
- Additional 48" Rack Assembly, Power Distribution and Fan
- Mobile base for racks with semi-pneumatic wheels

A123-CO Specifications

A123-CO Specifications

Meter Calibration (Sourcing)			
	Total Range	Best Accuracy For Output Of	
Direct Voltage	0 to 1100V	$\pm(0.0003\% + 5 \mu V)$	0 to 11V
Resistance	0 to 100 M Ω 18 Cardinal Points	$\pm 0.0006\%$	19 k Ω
Alternating Voltage	1 mV to 1100V 50 Hz to 50 kHz See 5100B Specs.	$\pm(0.018\% + 20 \text{ counts})$	125 mV to 110V 50 Hz to 20 kHz
Direct Current	0 to 2A	$\pm(0.015 + 2 \text{ counts} + 0.01 \mu A)$	0 to 2A
Alternating Current	0 to 2A 50 Hz to 5 kHz	$\pm(0.05\% + 5 \text{ counts} + 0.02 \mu A)$	0 to 2A 50 Hz to 1 kHz
Optional Extended Specs With 5205A			
Alternating Voltage	100V to 1100V 50 Hz to 50 kHz	$\pm(0.021\% + 0.01V)$	100V to 600V 50 Hz to 10 kHz
With 5220A			
Direct Current	2A to 20A	$\pm(0.025\% + \text{mA})$	2A to 20A
Alternating Current	2A to 20A 50 Hz to 5 kHz	$\pm(0.07\% + \text{mA})$	2A to 20A 50 Hz to 1 kHz
Digital Multimeter (Measuring)			
	Total Range	Best Accuracy For Output Of	
Direct Voltage	0 to 1200V	$\pm(8 \text{ ppm} + 6 \text{ counts})$	2V to 20V
Alternating Voltage	0 to 600V 10 Hz to 1 MHz	$\pm 0.016\%$ of R _{dg}	125V mV to 600V 40 Hz to 20 kHz
Resistance*	0 to 265 M Ω	$\pm(0.003\% + 0.8 \text{ counts})$	100 Ω to 4.1 M Ω
Options			
Direct Current*	0 to 1.28A	$\pm(0.03\% + 10 \text{ counts})$	0 to 16 mA

*Both functions cannot be present at the same time

Optional Oscilloscope Calibration:

CG5001 Option

Voltage: (Amplitude Mode) Used to calibrate vertical accuracy 40 μV to 200V (1-2-5 steps), $\pm(0.25\% + 1 \mu V)$

Current: (Amplitude Mode) Used to calibrate current probes 1 mA to 100 mA (1-2-5 steps), $\pm(0.25\% + 2 \mu A)$

Edge: (Amplitude Mode) Used to test input amplifiers and attenuators

Low Range: 20 mV to 1V (1-2-5 steps) <1.3 nS risetime with up to $\pm 2\%$ aberrations

High Range: 1.2V to 100V (1-2-5 steps) <100 nS risetime with up to $\pm 2\%$ aberrations

Markers (Timing Mode) Used to calibrate timebases 5s to 10 ns (1-2-5 steps), $\pm(0.01\%)$

Stewed Edge (Timing Mode) Used to calibrate very fast timebases 100 ns to 0.4 nS (1-2-5 steps), $\pm(0.01\% + 40 \text{ ps})$

Pulse Head: Used to test very wide bandwidth vertical amplifiers <200 ps risetime with up to $\pm 3\%$ aberrations

6060B Option

Frequency: 10 kHz to 1050 MHz; 10 Hz resolution

Amplitude: -137 to +13 dBm; 0.1 dB resolution

For details refer to 6060B Synthesized Signal Generator specifications on page 137.

"Performance Enhanced" A123 for DMM Calibration (A123-PE)

The "performance enhanced" A123-PE is the logical extension to the "cost optimized" A123-CO. It has the same high accuracy direct voltage and full capability alternating voltage to provide all the requirements of a top-of-the-line computer-aided calibration workstation. The addition of the 5200A Precision Alternating Voltage Calibrator improves the basic alternating voltage accuracy, extends the frequency range to 1 MHz and increases the volts-hertz product by a factor of 10. It is characterized at precise voltages and frequencies to provide the very best performance for high precision DMMs.

The equipment for the A123-PE is fitted in a dual 48" rack which has sufficient space for all the standard options. These options are the same as those detailed for the A123-CO including the oscilloscope calibration capabilities.

The A123-PE consists of:

All equipment detailed for A123-CO plus:

5200A Precision Alternating Voltage Calibrator
Dual 48" Rack Assembly, Power Distribution and Fans

Options:

Same as those detailed under A123-CO

A123-PE Specifications

Meter Calibration (Sourcing)

Direct Voltage, Resistance, Direct Current and Alternating Current are identical to A123-CO

	Total Range	Best Accuracy For Output Of	
Alternating Voltage	1 mV to 1100V 50 Hz to 50 kHz plus 100 nV to 100V 10 Hz to 1 MHz 10 ⁷ Volts Hertz Factor	$\pm(0.018\%$ $+20 \text{ counts})$	125 mV to 110V 50 Hz to 20 kHz
		$\pm 130 \text{ ppm}$ 50 Hz to 20 kHz	500 mV to 100V
Optional 5205A	100V to 1100V 10 Hz to 100 kHz	$\pm 180 \text{ ppm}$	1000V 50 Hz to 10 kHz

Digital Multimeter (Measuring)

Same as those detailed under A123-CO

Oscilloscope Calibration

Same as those detailed under A123-CO

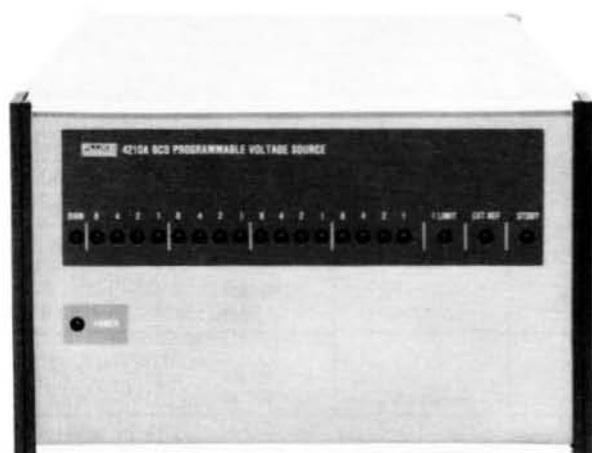
Prices

For prices on the configuration to meet your specific requirements, please contact your local Sales Representative. See pages 297 and 300.

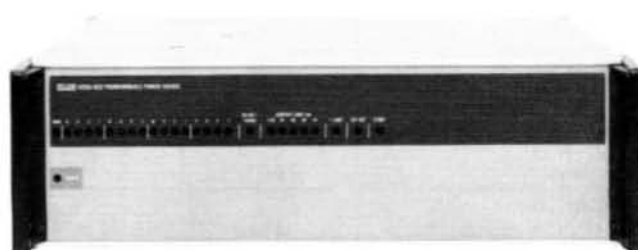
Complete Support

Fluke is the world leader in calibration instrumentation. This world leadership is reflected in the system support you receive when you purchase a Computer-Aided-Calibration Workstation from Fluke.

- A123 users can become members of the Fluke Computer-Aided Calibration Users Group. This provides a means of communication among users who exchange calibration procedures or helpful hints on approaches to computer-aided calibration.
- A123 users have access to the extensive library of procedures that have been written for a wide variety of DMM's and oscilloscopes.
- On-site installation by a qualified Fluke technician is included in the price of all A123 systems.
- A full 90-day on-site warranty is standard with all A123 systems.
- On-site or factory training is optionally available through Fluke Technical Service Centers.
- Fluke offers the best service support in the calibration industry. Service contracts are available through Fluke Technical Service Centers for on-site repair.



4210A, 1/2 Rack Width



4250A, Full Rack Width

4200 Series Power Supplies

- 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
- $\pm 0.01\%$ 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 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 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.

IEEE-488 Compatibility Option (-05)

The 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 IEEE-488 interface offers a "Direct Ladder Access" mode of programming. This mode is a 4-byte transfer sequence with limited 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.

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).

5

Programmable Power Supplies

4200 Series

Specifications

Characteristics	1/2 Rack	Full Rack Width				1/2 Rack
	4210A	4250A	4270A	4265A	4275A	4216A
Display	BCD	BCD	BCD	Binary	Binary	Binary
Current Range	± 100 mA	± 1 A	± 0.5 A	± 1 A	± 0.5 A	± 100 mA
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 μ s	70 μ s	80 μ s	70 μ s	85 μ s	18 μ s
Within 0.01% of step	30 μ s	100 μ s	110 μ s	100 μ s	110 μ s	30 μ s
Low Voltage Range						
Voltage Range	± 9.999	± 9.999 V	± 9.999 V	± 16.383 V	± 32.7675 V	± 16.383
Resolution	1 mV	1 mV	1 mV	1 mV	0.5 mV	1 mV
W/Option -07	100 μ V	100 μ V	100 μ V	—	—	—
90-Day Accuracy ² $\pm 0.01\%$ of output	± 100 μ V	± 100 μ V	± 100 μ V	± 100 μ V	± 160 μ V	± 100 μ V
90-Day Stability ³ $\pm 0.003\%$ of output	± 60 μ V	± 70 μ V	± 70 μ V	± 70 μ V	± 105 μ V	± 60 μ V
Ripple and Noise ⁴	300 μ V rms	500 μ V rms	500 μ V rms	500 μ V rms	500 μ V rms	300 μ V 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	—	± 65.00 V	± 99.99 V	± 65.53 V	± 110 V	—
Resolution	—	10 mV	10 mV	4 mV	2 mV	—
W/Option -07	—	1 mV	1 mV	—	—	—
90-Day Accuracy ² $\pm 0.01\%$ of output	—	± 700 μ V	± 700 μ V	± 300 μ V	± 530 μ V	—
90-Day Stability ³ $\pm 0.003\%$ of output	—	± 490 μ V	± 490 μ V	± 210 μ V	± 370 μ V	—
Ripple and Noise ⁴	—	1 mV rms	1.2 mV rms	1 mV rms	1.2 mV rms	—
Programming Noise	—	260 mV p-p	260 mV p-p	260 mV p-p	260 mV p-p	—

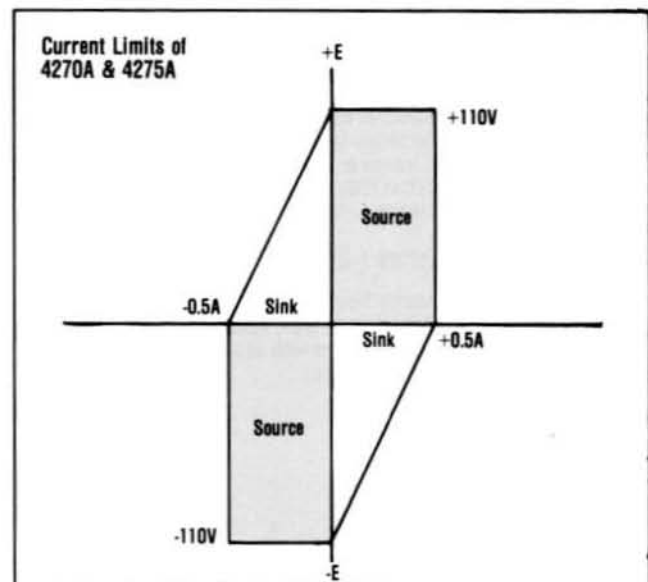
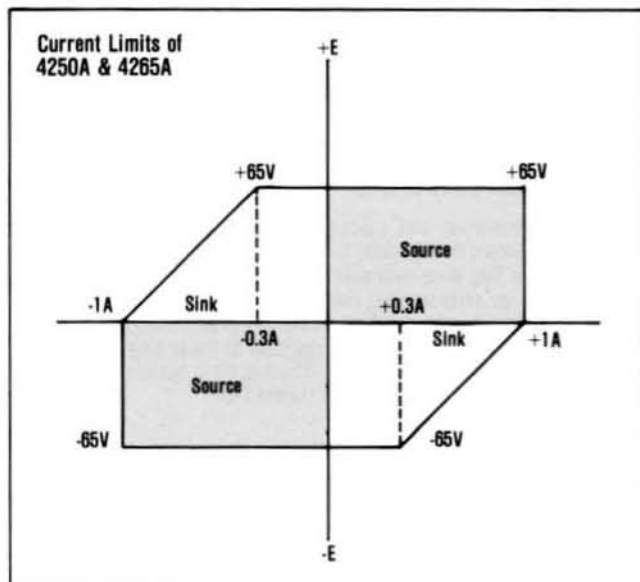
* Also 1% steps to 11%. Limit at 120% of range without Option -06

1. Percent of output, no load to full load, $\pm 10\%$ 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: 20G, 11 millisecond half-sinewave
Vibration: 4.5G, 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 200 W

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: Instruction manual, service manual, power cord, mating digital input cable connector, screw terminal outputs. Order Y8021, Y8022, or Y8023 cable separately for Option -05

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*

4210A

4200A-01 Isolated Control Logic

4200A-07 100 μ V Resolution

4210A-03 External Reference

4210A-05 Interface for IEEE-488 bus

4210A-09/BCD Multi-strobe Logic

4216A

4200A-01 Isolated Control Logic

4216A-03 External Reference

4216A-05 Interface for IEEE-488 bus

4216A-09/Binary Multi-strobe Logic

4250A

4250A-01 Isolated Control Logic

4250A-03 External Reference

4250A-05 Interface for IEEE-488 bus

4250A-06 Programmable Current Limit

4250A-07 100 μ V Resolution (4250A only)

4250A-09/BCD Multi-strobe Logic

4265A

4265A-01 Isolated Control Logic

4265A-03 External Reference

4265A-05 Interface for IEEE-488 bus

4265A-06 Programmable Current Limit

4265A-09/Binary Multi-strobe Logic

4270A

4270A-01 Isolated Control Logic

4270A-03 External Reference

4270A-05 Interface for IEEE-488 bus

4270A-06 Programmable Current Limit

4270A-07 100 μ V Resolution (4270A only)

4270A-09/BCD Multi-strobe Logic

4275A

4275A-01 Isolated Control Logic

4275A-03 External Reference

4275A-05 Interface for IEEE-488 bus

4275A-06 Programmable Current Limit

4275A-09/Binary Multi-strobe Logic

* All options are field-installable. To order, add a "K" to the option number, example 4200A-03K. Contact the Parts Department for field installation of the -07 and -09 options. Order Cable Y8021, Y8022, or Y8023 separately.

Accessories (Also see page 284)

Rack Adapters for 4210A and 4216A

M05-200-603 5 1/4", Dual

M05-203-601 5 1/4", Offset

M05-203-602 5 1/4", Centered

Rack Adapter for 4250A, 4265A, 4270A, 4275A

M05-205-600 5 1/4"

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 with Cable

4210A-4014 PCB Extender Board

4270A-4303 PCB Extender Cable

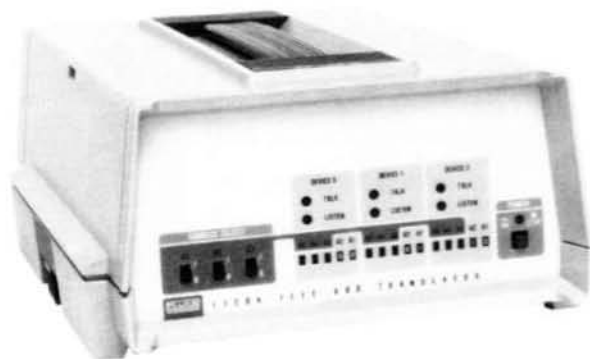
Y8021 1m Cable, for IEEE-488 bus

Y8022 2m Cable, for IEEE-488 bus

Y8023 4m Cable, for IEEE-488 bus

Service & Support

1120A



(NSN 5811-01-202-7491) **1120A**

1120A IEEE-488 Translator

Fluke's Portable Test Instrumentation (PTI) system puts low cost instruments on the IEEE 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.

Building A System

Instruments that presently operate through the 1120A Translator to work in an IEEE-488 systems 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 catalog for a complete listing of IEEE-488 compatible instruments.

A 17-4 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.

Model

1120A IEEE-488 Translator
A17-4 Bit Parallel Interface

Accessories (Also see page 284)

Y8021 1m (39.4 in) Shielded Cable
Y8022 2m (78.8 in) Shielded Cable
Y8023 4m (13 ft) Shielded Cable

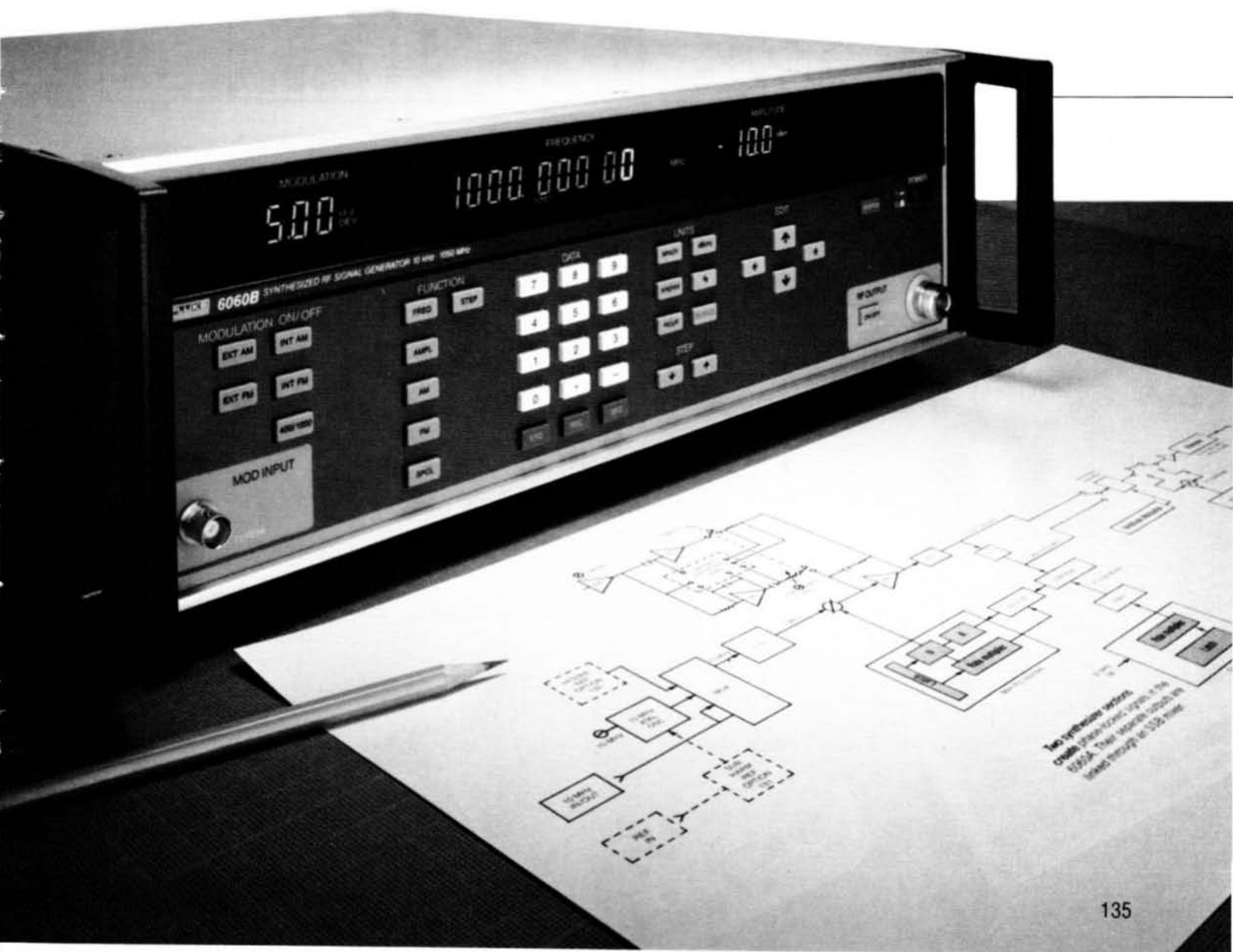
Service & Support

Signal Generators



Designers, manufacturers and service people working in RF and L-Band applications rely on Fluke programmable synthesized signal generators for high performance at low cost. The 6060 Series Signal Generators provide exceptional stability and accuracy at frequencies up to 2100 MHz. Interactive front panel controls offer an easy-to-use operator interface, and IEEE-488 interface and programmability permit remote control for automated testing.

Simple, solid construction of our signal generators results in low noise with low radiated EMI and low microphonics. And that same construction gives you high reliability and minimum down-time. Dollar for dollar, Fluke generators outperform all others in applications requiring high spectral purity and low residual FM or AM.



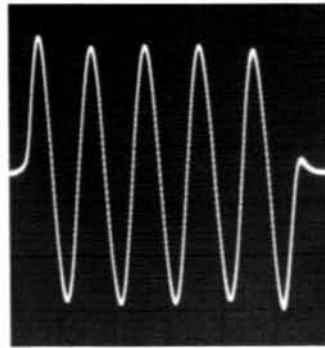
Two synthesizers within create ultra-low noise, ultra-high accuracy. Their separate outputs are mixed through a 320 MHz

Selection Guide

Signal Generators	6011A	6060B	6061A	6062A	6070A	6071A	6160B
Frequency Range	10 Hz-11 MHz	10 kHz-1050 MHz	10 kHz-1050 MHz	100 kHz-2100 MHz	200 kHz-520 MHz	200 kHz-1040 MHz	1 MHz-160 MHz
Resolution	0.1 or 10 Hz	10 Hz	10 Hz	10/20 Hz	1 Hz	1 or 2 Hz	0.1 or 1 Hz
Switching Time	2 ms to 34 ms	<100 ms	<100 ms	<100 ms	<85 ms	<85 ms	<800 μ sec
Output Level	-55 to +27 dBm	-127 to +13 dBm	-127 to +13 dBm	-127 to +13 dBm	-127 to +19 dBm	-127 to +19 dBm	+3 to +13 dBm
Resolution	0.01 dB	0.1 dB	0.1 dB	0.1 dB	0.1 dB	0.1 dB	Continuously Variable
Modulation	AM, FM opt	AM, FM	AM, FM	AM, FM, ϕ M, Pulse	AM, FM, ϕ M, PM opt	AM, FM, ϕ M	—
Int Mod Freq	—	400 & 1000 Hz	400 & 1000 Hz	400 & 1000 Hz	20 Hz to 200 kHz	20 Hz to 200 kHz	—
Simultaneous Mod	—	Yes	Yes	Yes	Yes	Yes	—
Spectral Purity							
Non-Harmonic	<-60 dBc	<-60 dBc	<-60 dBc	<-60 dBc, <-54 dBc	<-90 dBc	<-84 dBc	<-83 dBc
Harmonics	<-50 dBc	<-30 dBc	<-30 dBc	<-30 dBc @2000 MHz	<-30 dBc	<-30 dBc	<-30 dBc
Sub-Harmonic	—	—	—	<-50 dBc	—	<-35 dBc	—
Line Spurious	—	—	—	—	<-56 dBc	<-50 dBc	—
Phase Noise	-106 dBc/Hz at 10 MHz	-116 dBc/Hz (typ)	-123 dBc/Hz (typ)	-123 dBc/Hz (typ)	<-132 dBc/Hz	<-132 dBc/Hz	<-121 dBc/Hz at 160 MHz
				20 kHz offset at 500 MHz			
Rev Power Protect	—	50W	50W	25W	50W opt	50W opt	—
Rel Ampl & Freq	Yes	Yes	Yes	Yes	Yes	Yes	—
Digital Sweep	—	—	—	—	Yes	Yes	—
Audio Output	—	—	—	—	Yes	Yes	—
IEEE-488 Program	Yes opt	Yes opt	Yes	Yes	Yes	Yes	Yes opt*

*Via Fluke 1120A IEEE-488 Translator

6060 Series



Modulating the Pulse. The heart of the new Fluke 6062A's pulse modulator is a set of monolithic GaAs switches.

pulse-width limitations associated with some forms of modulators.

The GaAs FET switch is much faster than the commonly used PIN diode switch, and accounts for the high speed of the 6062A's pulse modulator. Its inherent broad bandwidth makes it possible to locate the FET pulse modulator near the signal generator's output. This configuration is free of the duty-cycle and minimum



The Fluke 6060 Series offers broad frequency and amplitude ranges and the modulation versatility required for rf design, development and testing applications.

The general purpose 6060B is a fully programmable unit designed for a wide variety of equipment testing. The 6061A offers superior performance for rf applications demanding increased spectral purity. This low-noise unit shares many features with the 6060B, but has residual FM guaranteed less than 6 Hz rms in the frequency range of 245 to 512 MHz.

Used for L-band applications in avionics, communication, and navigation, the Fluke 6062A completes the 6060 Series.

The 6062A features a high-quality gallium arsenide pulse modulator and extended frequency — as high as 2100 MHz — to simulate radar and pulsed communications signals.



6062A

6

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
- 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 troubleshooting test routines are contained within the unit to aid in calibration and maintenance. Unique to the 6062A is a self-calibration capability.



6060B



6061A



6062A

Options Summary

The 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 -830), 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

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	<±5x10 ⁻⁶ total, 0-50°C	<±1x10 ⁻⁷ total, 0-50°C	<±2x10 ⁻¹⁰ /°C, 0-50°C
Aging Rate	<±5x10 ⁻⁷ /mo	<±1x10 ⁻⁷ /mo	<±5x10 ⁻¹⁰ /day <±1.5x10 ⁻⁸ /mo
Warm-up (typical)	1 hr to within 1 ppm of final frequency	20 min to within ±3x10 ⁻⁸ of final frequency	30 min to within ±1x10 ⁻⁸ of final frequency

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

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	6062A
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 (6062A only)	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:

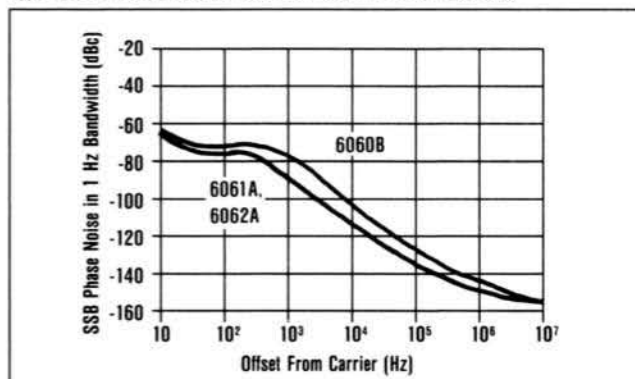
Frequency Range	6060B	6061A		6062A	
	(Spec)	(Spec)	(typ.)	(Spec)	(typ.)
Below 245 MHz	44	18	12	18	12
245 to 512 MHz	22	9	6	9	6
512 to 1050 MHz	44	18	12	18	12
1050 to 2100 MHz	N/A	N/A	N/A	36	24

Residual FM (Hz rms) CCITT:

Frequency Range	6060B	6061A		6062A	
	(Spec)	(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)

Typical SSB Phase Noise @ 500 MHz (with internal reference)



Output

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: -127 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

Signal Generators

6060 Series

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 MHz to 2100 MHz
+13 to -127 dBm	±1.0 dB	±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 MHz to 1050 MHz	1050 MHz 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: 50 ohms, 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 50 ohm source, 10 kHz to 1050 MHz. Will withstand up to 50V dc. 6062A: 25W RF from a 50 ohm source, 100 kHz to 2100 MHz; up to 25V 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 (+10 dBm)

Amplitude Modulation

AM Depth: 0 to 99% in 1% steps

AM Accuracy: ±(2% + 4% of setting) (6060B and 6061A)

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 90% 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: 400 Hz and 1 kHz (see Modulation Source for specifications)

External BW: (3 dB)

	6060B and 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

Output Frequency	Maximum Peak Deviation	
	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 245 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

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: $\pm 7\%$ 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 50 ohm 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, $\pm 3\%$ for 20-30°C; add $\pm 0.1\%/^{\circ}\text{C}$ 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: 600 ohms nominal (560 ohms nominal when EXT AM and EXT FM enabled simultaneously)

External Modulation Annunciators: EXT HI/EXT LO indicator when 1V peak, $\pm 2\%$ 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

Options 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)

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

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): $\leq 10,000$ ft

Power: 100, 120, 220, 240V ac $\pm 10\%$, 47-63 Hz, (for 400 Hz consult the factory) < 180 VA, (< 15 VA standby with opt -130)

Weight: < 16 kg (35 lb)

Size: 13.3 cm H x 43.2 cm W x 50.8 cm D (5.25 in x 17 in x 20 in)

EMI: Meets MIL-STD 461B RE02, CE03, FCC Part 15(j), Class A

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

Models

6060B

6061A

6062A

Options

6060A-130 High Stability Reference

6060B-132 Mid Stability Reference

6060B-488 IEEE-488 Interface (6060B only)

6060B-488K IEEE-488 Interface (6060B only)

6060B-651 Low-rate AC-FM (6060B, 6062A only)

6061A-651 Low-rate AC-FM (6061A only)

6060B-830 Rear Output & Modulation Input (6060B, 6061A)

6062A-830 Rear Output & Modulation Input (6062A only)

Accessories (Also see page 284)

Y6001 Rack Mount Kit, includes 24" slides

Y9100 Attenuator, 50 Ohm, 6 dB, BNC

Y9101 Attenuator, 50 Ohm, 14 dB, BNC

Y9102 Attenuator, 50 Ohm, 20 dB, BNC

Y9103 50 Ohm Feedthru Termination, BNC

Y9111 3 ft (0.91m) 50 Ω Cable, BNC

Y9112 6 ft (1.83m) 50 Ω Cable, BNC

Y9301 Min-Loss Pad, 50 Ω to 75 Ω

Y9307 Adapter, N to BNC, 75 Ω

Y9308 Adapter, N to BNC, 50 Ω

Y9315 Coaxial Cable, N male

Y9316 Cap, Non-shorting, BNC

Y9317 50 Ω Termination, N

Service & Support

Signal Generators

6060A/AN



(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 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.

Specifications

Specifications apply 1 hour after turn-on within operating temperature range.

Frequency (8½-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 $< \pm 0.5$ ppm/month, $< \pm 5$ ppm for 25°C, ± 25 °C. Frequency stability $< \pm 0.5$ ppm/hour 1 hour after warm up. Internal reference signal (10 MHz TTL) available at rear connector

External: Accepts 10 MHz TTL signal

Amplitude (3½-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: $\pm 6\%$ 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 600 ohms

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: $\pm 5\%$ 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 600 ohms

Modulation Source

Internal: 0.4 kHz or 1 kHz, $\pm 5\%$

External: $\pm 5\%$ max; 1V peak provides indicated modulation index. Nominal input impedance is 600 ohms

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 560 ohms

Deviation Meter

Frequency Input: 30 MHz to 500 MHz

Input Signal Level: 15 mV to 5V rms

Input Impedance: 50 ohms nominal

Measurement Ranges: Two ranges of 500 kHz and 50.0 kHz full scale

Polarity: Selectable \pm peak

Modulation Rate: 100 Hz to 8 kHz

Accuracy: $\pm 6\%$ of full scale range from 100 Hz to 8 kHz

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 μ V of the generator's output signal into a 1-inch diameter, two-turn loop, 1 inch from any surface as measured into a 50 ohm 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 50 ohm 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, PPO, DC1, DT1, C0, and E1

Size: 43 cm W x 13.3 cm H x 55.3 cm D (17 in x 5.25 x 21.8)

Power: 115V, 230V ac $\pm 10\%$, 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

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: $\pm(2\% + 4\%$ 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: <0.3 f_m for internal rates and 30% AM

FM Accuracy: $\pm 7\%$ 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, $\pm 2\%$, over a 0.02 kHz to 100 kHz band

Deviation Meter Accuracy: $\pm 5\%$ 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

Model

6060A/AN Synthesized Signal Generator

Options

6060B-130 High Stability Reference

6060B-132 Mid Stability Reference

Accessories (Also see page 284)

Y6001 Rack Mount Kit, includes 24" slides

Y9100 Attenuator, 50 Ohm, 6 dB, BNC

Y9101 Attenuator, 50 Ohm, 14 dB, BNC

Y9102 Attenuator, 50 Ohm, 20 dB, BNC

Y9103 50 Ohm Feedthru Termination, BNC

Y9111 3 ft (0.91m) 50 Ω Cable, BNC

Y9112 6 ft (1.83m) 50 Ω Cable, BNC

Y9301 Min-Loss Pad, 50 Ω to 75 Ω

Y9307 Adapter, N to BNC, 75 Ω

Y9308 Adapter, N to BNC, 50 Ω

Y9315 Coaxial Cable, N Male

Y9316 Cap, Non-shorting, BNC

Y9317 50 Ω Termination, N

6060B/AK



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, Golan-Sequential Code (GSC) NEC, NTT and British-Post-Office-Code-Standardization-Advisory-Group (POCSAG).

Specifications

Frequency

Frequency Range: 10 kHz to 1050 MHz. Output frequency is displayed on an 8½-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

Amplitude

Amplitude Range: -127 to +13 dBm (+13 dBm peak on AM), with overrange to -147 and +19 dBm, displayed on a 3½-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 μ V 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 ≥ 400 kHz

Spectral Purity

Spurious: <-60 dBc for offsets greater than 10 kHz, (-55 dBc <100 kHz)

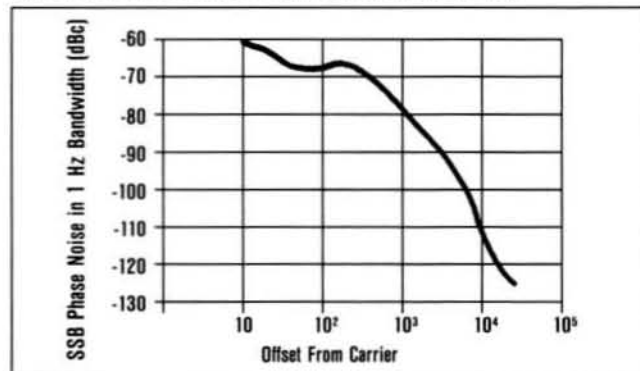
Harmonics: <-30 dBc (-26 dBc <100 kHz)

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: $\pm (2\% + 4\%$ 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: $\pm 7\%$ 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

Modulation Source

Internal: 400 Hz and 1 kHz, $\pm 3\%$ for 20°C to 30°C (add $\pm 0.1\%/^{\circ}$ 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; INTAM and FM; EXTAM and FM; 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

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: $< \pm 2 \times 10^{-10}/^{\circ}\text{C}$. 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 $< 0.5 \mu\text{V}$ 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 $\pm 10\%$, 47 to 63 Hz, $< 180 \text{ VA}$; $< 15 \text{ VA}$ standby with Option -130

Size: 50.8 cm L x 43.1 cm W x 13.3 cm H (20 in L x 17 in W x 5 1/4 in H)

Weight: $< 15.9 \text{ kg}$ (35 lb)

Model

6060B/AK Signal Generator

Options

6060B-130 High Stability Reference

6060B-132 Mid Stability Reference

6060B-488 IEEE-488 Interface

6060B-830 Rear Output and Modulation Input

Accessories (Also see page 230)

Y6001 Rack Mount Kit, includes 24" slides

Y9100 Attenuator, 50 Ohm, 6 dB, BNC

Y9101 Attenuator, 50 Ohm, 14 dB, BNC

Y9102 Attenuator, 50 Ohm, 20 dB, BNC

Y9103 50 Ohm Feedthru Termination, BNC

Y9111 3 ft (0.91m) 50 Ω Cable, BNC

Y9112 6 ft (1.83m) 50 Ω Cable, BNC

Y9301 Min-Loss Pad, 50 Ω to 75 Ω

Y9307 Adapter, N to BNC, 75 Ω

Y9308 Adapter, N to BNC, 50 Ω

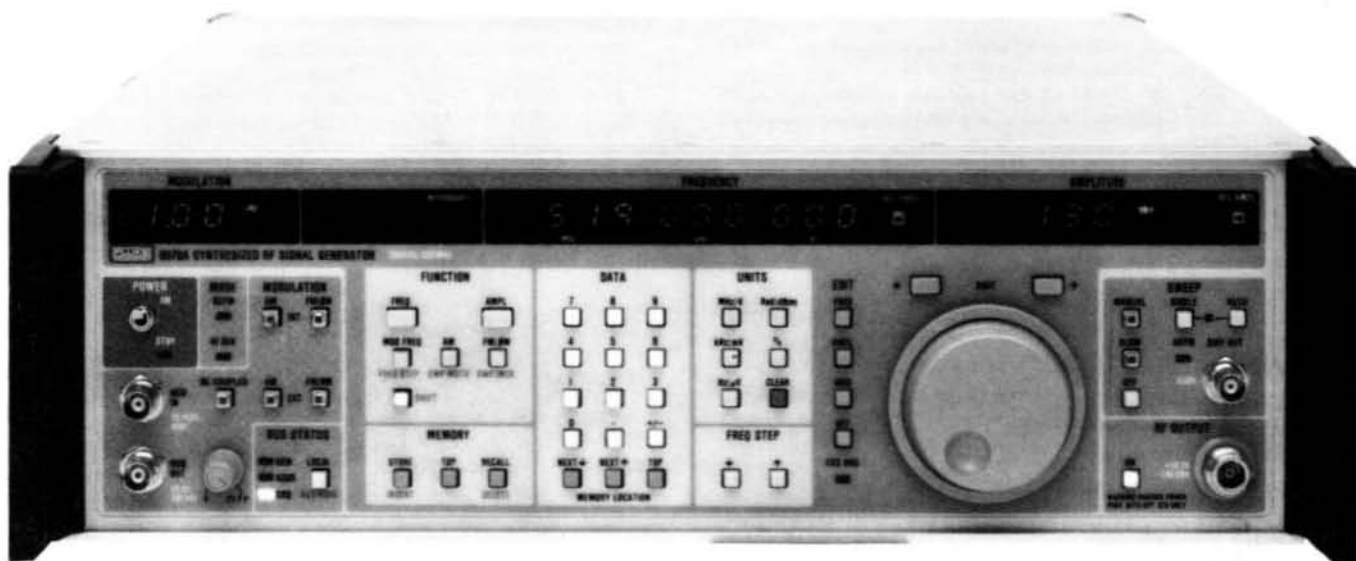
Y9315 Coaxial Cable, N male

Y9316 Cap, Non-shorting, BNC

Y9317 50 Ω Termination, N

Signal Generators

6070A/6071A



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, ϕ M 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 setability 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 IEEE Std 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.

AM, FM, ϕ M 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+ ϕ M 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%.

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, narrow-band 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 and 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

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 $\leq \pm 0.5$ ppm/month. Temperature effects: $\leq \pm 5$ 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 squarewave. Input impedance is 50 ohms. External reference is automatically switched in when connected

Reference Output: 10 MHz TTL level

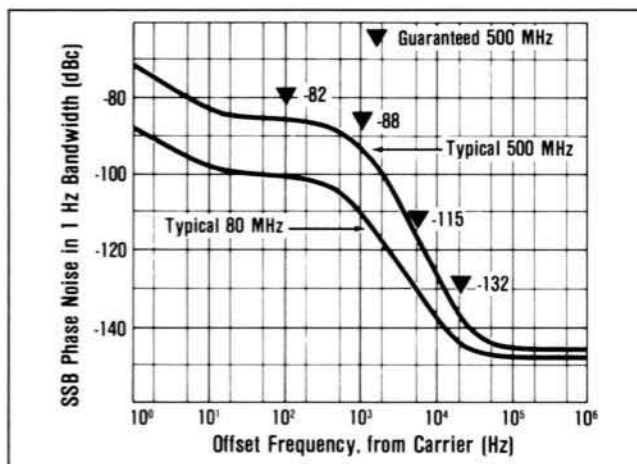
Spectral Purity

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: $\leq 0.02\%$ 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, $\geq +13$ dBm	-30	-30	-30	-25	N/A
$\leq +13$ dBm	-35	-35	-35	-35	N/A
Harmonic (6071A)					
$f_0, 2f_0, 3f_0$ offset, $\geq +13$ dBm	-30	-30	-25	-20	N/A
$\leq +13$ dBm	-35	-35	-35	-35	-25

Output

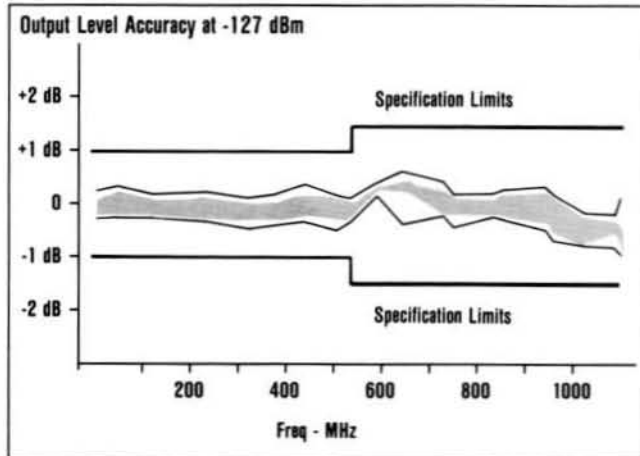
Voltage Level Range: -140 dBm to +19 dBm for frequencies up to 520 MHz. Above 520 MHz (6071A), -140 dBm to +13 dBm

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	± 1.0	± 1.5

20°C $\pm 5^\circ$ 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)

Carrier Range	AM Depth	Internal or External AC Coupled	External DC Coupled
0.2 to 5 MHz	≤70%	20 Hz to 8 kHz	DC to 8 kHz
5 to 520 MHz	≤90%	20 Hz to 50 Hz	DC to 50 kHz
520 to 1040 MHz	≤70%	20 Hz to 50 kHz	DC to 50 kHz

Incidental FM (for 30% AM): 0.3 x modulation frequency for <520 MHz; 0.6 x modulation frequency for >520 MHz

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 $f_m \times (520 - f_o)$	499
62.5 to 125 MHz	199 or $f_m \times f_o$	f_o or 99.9
125 to 250 MHz	499 or $f_m \times f_o$	f_o or 199
250 to 520 MHz	999 or $f_m \times f_o$	f_o or 499
520 to 1040 MHz	999 or $f_m \times f_o$	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 ≥100 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:		DCFM Mode On 0.5%+
	Off 0.5%+	On	
0.2 to 62.5 MHz	0.75% per 100 kHz dev	1.5%	1.2% per 100 kHz dev ($600 \div f_o$) % per 100 kHz dev
62.5 to 125 MHz	3.0% per 100 kHz 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

Incidental 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	Total Harmonic Distortion Per Radian of Deviation With High Deviation Mode	
		Off	On
0.2 to 62.5 MHz	99.9	$0.5 + (0.75 \times 10^{-5} \times f_m)$ %	1.5%
62.5 to 125 MHz	19.9	$0.5 + (3.0 \times 10^{-5} \times f_m)$ %	
125 to 250 MHz	49.9	$0.5 + (1.5 \times 10^{-5} \times f_m)$ %	
250 to 520 MHz	99.9	$0.5 + (0.75 \times 10^{-5} \times f_m)$ %	
520 to 1040 MHz	99.9	$0.5 + (0.375 \times 10^{-5} \times f_m)$ %	

f_m = Modulation frequency in hertz

φM Resolution: 0.01 radian for <10 radians, 0.1 radian for ≥10 radians
φM 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)

φM 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, φM, AM + FM, AM + φM

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 ϕ M accuracy**Impedance:** 600 Ω , 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 re-called**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 $\leq \pm 5 \times 10^{-10}$ per day after a 21-day warmup. Temperature effects: $\leq \pm 2 \times 10^{-10}/^\circ\text{C}$ **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 50 Ω receiver**Temperature:** 0 $^\circ\text{C}$ to 50 $^\circ\text{C}$, operating; -40 $^\circ\text{C}$ to +75 $^\circ\text{C}$, non-operating**Relative Humidity:** $\leq 95\%$ to 25 $^\circ\text{C}$; $\leq 75\%$ to 50 $^\circ\text{C}$ **Altitude:** $\leq 10,000$ feet**Power:** 100, 120, 200, 240V ac $\pm 10\%$ 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:** Operator's manual, service manual, power cord, serialized and dated calibration certificate**Models****6070A** Synthesized Sig Gen (0.2-520 MHz)**6071A** Synthesized Sig Gen (0.2-1040 MHz)**Options****607XA-130** Ovenized Reference Oscillator**607XA-570** Non-Volatile Memory**607XA-830** Rear RF Output**607XA-831** Auxiliary RF Output**607XA-870** Reverse Power Protection**6070A-950** Pulse Modulation**Accessories (Also see page 284)****Y6001** Rack Mount Kit, includes 24" slides**Y9100** Attenuator, 50 Ohm, 6 dB, BNC**Y9101** Attenuator, 50 Ohm, 14 dB, BNC**Y9102** Attenuator, 50 Ohm, 20 dB, BNC**Y9103** 50 Ohm Feedthru Termination, BNC**Y9111** 3 ft (0.91m) 50 Ω Cable, BNC**Y9112** 6 ft (1.83m) 50 Ω Cable, BNC**Y9308** Adapter, N to BNC, 50 Ω **Y9315** Coaxial Cable, N male**Y9316** Cap, Non-shorting, BNC**Y9317** 50 Ω Termination, N**Service & Support**

Signal Generator

6011A



RS-232



(NSN 6625-01-049-7760) 6011A

6011A Signal Generators

- 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 = 0.5 dB
- Frequency switching 2 ms

The 6011A has an output impedance of 50 ohms (75 ohms optional) 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 using a 7-digit LED readout. The rms output voltage into a 50 ohm load ranges from 400 μ V to 5V or 10V rms into an open circuit or high impedance load. Referred to 1 milliwatt in a 50 ohm load, 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.

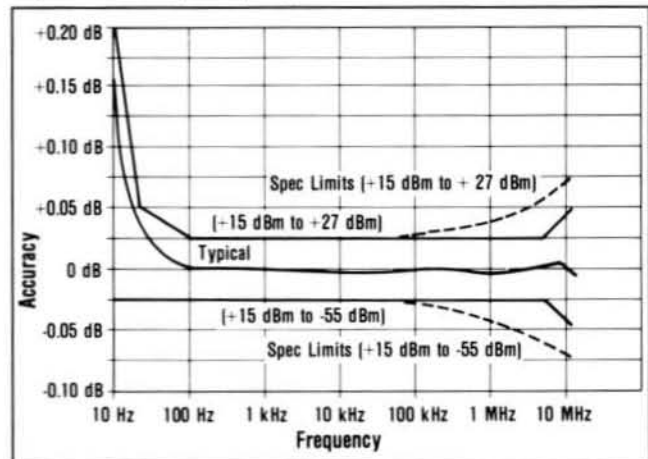
To avoid accidentally selecting an excessive output voltage, a limit may be stored in the 6011A. In addition, you may store up to nine different frequencies and/or output levels that may be recalled at random, quickly and without error — an important consideration for repetitive testing.

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.

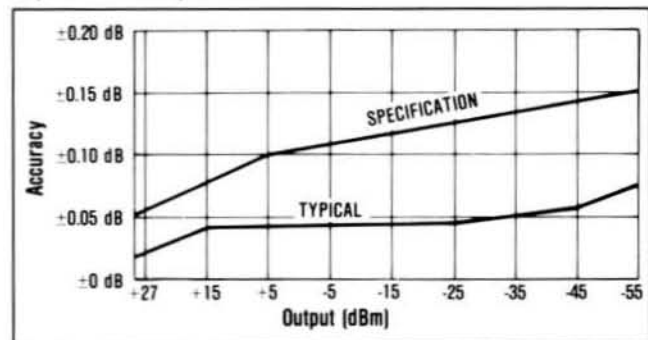
Any selected frequency may be increased or decreased in steps of practically any size, using the EDIT controls. This provides a manual sweep capability for checking frequency response, peaks, nulls, etc. A frequency or output level may be stored as a reference with other frequencies or levels added or 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 IEEE Std 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 Accuracy vs Frequency



Output Level Accuracy vs Level



Specifications

PARAMETER											
Frequency											
Low Range	10 Hz to 109.9999 kHz										
High Range	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										
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 or 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 and 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 to 11 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 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 <table border="1"> <thead> <tr> <th>Offset from Carrier</th> <th>SSB Phase Noise</th> </tr> </thead> <tbody> <tr> <td>20 Hz</td> <td>-102 dBc</td> </tr> <tr> <td>200 Hz</td> <td>-108 dBc</td> </tr> <tr> <td>20 kHz</td> <td>-106 dBc</td> </tr> <tr> <td>1 MHz</td> <td>-130 dBc</td> </tr> </tbody> </table>	Offset from Carrier	SSB Phase Noise	20 Hz	-102 dBc	200 Hz	-108 dBc	20 kHz	-106 dBc	1 MHz	-130 dBc
Offset from Carrier	SSB Phase Noise										
20 Hz	-102 dBc										
200 Hz	-108 dBc										
20 kHz	-106 dBc										
1 MHz	-130 dBc										

PARAMETER	
Amplitude	
Impedance	50 Ω (75 Ω w/Option -10)
Range: dBm Volts	+26.98 dBm to -55.01 dBm into 50 Ω 5.000V rms to 0.3972 mV rms into 50 Ω
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 and 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 = 600 Ω 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 50 Ω) 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
75 Ω	Option -10

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 $+50^\circ\text{C}$

Aging Rate: < 1 part in 10^6 per 24 hours at constant temperature, or 1 part in 10^6 per year

Temperature Dependence: $< \pm 5$ parts in 10^7 from 0°C to $+50^\circ\text{C}$

Phase-Lockable Input Option [-02]

Input Frequency: 1, 2, 2.5, 5 or 10 MHz

Input Level: > 100 mV, < 5 V 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 ± 5 V max	1V for 40 Hz ± 5 V 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: $\leq 80\%$ to 50°C

Power: 115V or 230V ac $\pm 10\%$, 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 x 8.5 in x 19 in)

Weight: 11.4 kg (25 lb)

Safety: CSA 556B certified

Included: Instruction Manual, power cord, serialized and dated calibration certificate

Model

6011A Synthesized Signal Generator

Options

6011A-01 High Performance TCXO

6011A-02¹ Phase Lock Input

6011A-03¹ Frequency Modulation

6011A-04^{*} Rear Panel Output

6011A-05² IEEE-488 Interface

6011A-06^{2*} EIA Standard RS-232-C Interface

6011A-07 50-400 Hz Line Power

6011A-08 100V, 50-60 Hz Line Power

6011A-09^{*} 20-31 MHz Tracking Output

6011A-10 75Ω Output Impedance

^{*} Field installable options — order -03K, -05K, or -09K

¹ Cannot have -02 and -03 options together

² Cannot have -05 and -06 options together

Accessories (Also see page 230)

Y9111 3 ft (0.93m) 50Ω BNC Cable

Y9112 6 ft (1.85m) 50Ω BNC Cable

M05-203-601 $5\frac{1}{4}$ " Rack Adapter, Offset

M05-203-602 $5\frac{1}{4}$ " Rack Adapter, Centered

M05-200-603 $5\frac{1}{4}$ " Rack Adapter, Dual

M00-203-631 $5\frac{1}{4}$ " Rack Adapter w/18" slides

Service & Support



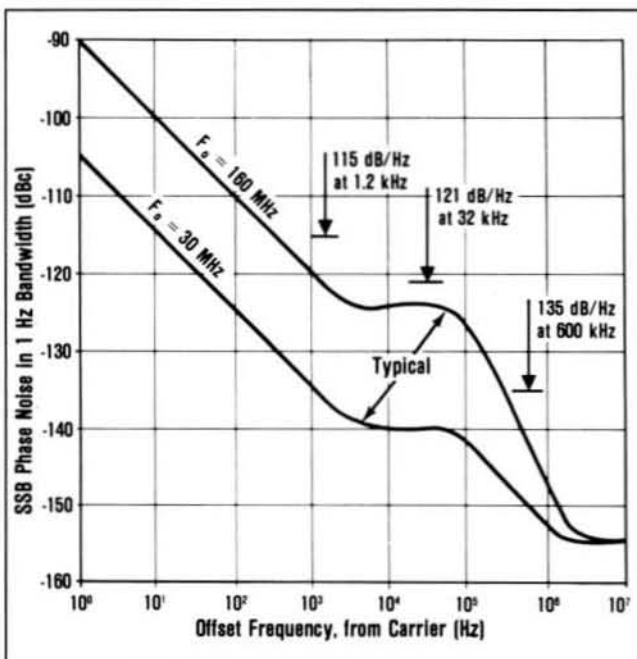
6160B

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 μ s
- Built-in BCD programming
- Optional 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 IEEE Std 488-1978 is achieved using the Fluke 1120A Translator and 6XXXA-529 Interface.

Specifications

Parameter											
Frequency											
High Band Range	10 MHz to 160 MHz										
Minimum Step	1 Hz										
Low Band Range	1 MHz to 12 MHz										
Minimum Step	0.1 Hz										
Local Control	Front panel rotary switches										
Remote Control	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	<table border="1"> <thead> <tr> <th>MHz</th> <th>dBc</th> </tr> </thead> <tbody> <tr> <td>1 to 20</td> <td>-100</td> </tr> <tr> <td>20 to 40</td> <td>-95</td> </tr> <tr> <td>40 to 80</td> <td>-89</td> </tr> <tr> <td>80 to 160</td> <td>-83</td> </tr> </tbody> </table>	MHz	dBc	1 to 20	-100	20 to 40	-95	40 to 80	-89	80 to 160	-83
MHz	dBc										
1 to 20	-100										
20 to 40	-95										
40 to 80	-89										
80 to 160	-83										
Harmonic, Spurious	<25 dBc, typically <-30 dBc										
Amplitude Noise**	<-94 dBc (typical)										
Absolute Phase Noise** (including effects of int'l standard)	<-62 dBc (typical)										
Residual Phase Noise** (including effects of int'l standard)	<-74 dBc (typical)										
Phase Noise Spectral Density	<table border="1"> <thead> <tr> <th>Offset from Carrier</th> <th>SSB Phase Noise</th> </tr> </thead> <tbody> <tr> <td>1.2 kHz</td> <td><-115 dBc</td> </tr> <tr> <td>32 kHz</td> <td><-121 dBc</td> </tr> <tr> <td>600 kHz</td> <td><-135 dBc</td> </tr> </tbody> </table>	Offset from Carrier	SSB Phase Noise	1.2 kHz	<-115 dBc	32 kHz	<-121 dBc	600 kHz	<-135 dBc		
Offset from Carrier	SSB Phase Noise										
1.2 kHz	<-115 dBc										
32 kHz	<-121 dBc										
600 kHz	<-135 dBc										
1 Hz Bandwidth											
Outputs											
Main Output	Adjustable from +3 dBm to +13 dBm into 50 Ω (0.3V to 1V rms) with front-panel control or external dc voltage. Level maintained ± 1 dB into 50 Ω										
Other Outputs	5 MHz at nominally 1V rms into 50 Ω										
Output Options	Rear Panel, Opt -04										
Miscellaneous											
Reference Frequency	External, 5 MHz at 0 dBm to +16 dBm into 50 Ω										
Level Control	External, 0.1 to 0.8V dc nominal into >2 k Ω produces an output level change of from +3 dBm to +13 dBm										
Switching Speed	<800 μ s 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	<table border="1"> <thead> <tr> <th>Option</th> <th>Aging Rate</th> <th>Temp. Stability</th> </tr> </thead> <tbody> <tr> <td>Option -02, -05, or Other Source</td> <td>-02 $\pm 2 \times 10^{-9}$/day -05 $\pm 5 \times 10^{-6}$/yr</td> <td>1×10^{-8}, 0°C to 50°C 1×10^{-6}, 0°C to 50°C</td> </tr> </tbody> </table>	Option	Aging Rate	Temp. Stability	Option -02, -05, or Other Source	-02 $\pm 2 \times 10^{-9}$ /day -05 $\pm 5 \times 10^{-6}$ /yr	1×10^{-8} , 0°C to 50°C 1×10^{-6} , 0°C to 50°C				
Option	Aging Rate	Temp. Stability									
Option -02, -05, or Other Source	-02 $\pm 2 \times 10^{-9}$ /day -05 $\pm 5 \times 10^{-6}$ /yr	1×10^{-8} , 0°C to 50°C 1×10^{-6} , 0°C to 50°C									

Frequency Synthesizer

6160B

* 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 x 7 in x 20 in)

Weight: 20.5 kg (45 lb)

Included: Manual, power cord, mating connector for programming input lines, serialized and dated calibration certificate

Model

6160B* Frequency Synthesizer

Options

6160B-02* Frequency Std. 2×10^{-9} /day

6160B-04 Rear Panel RF Output

6160B-05* Frequency Std. 5×10^{-6} /year

6XXXA-522K 1120A Interface, field installable

6XXXA-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 or Service Centers only.

** Requires 1120A IEEE-488 Translator. Includes 6XXXA-522K and Y7205 Cable.

Accessories (Also see page 284)

1120A IEEE-488 Translator

Y7205 6 ft Ribbon Cable for 6XXXA-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)

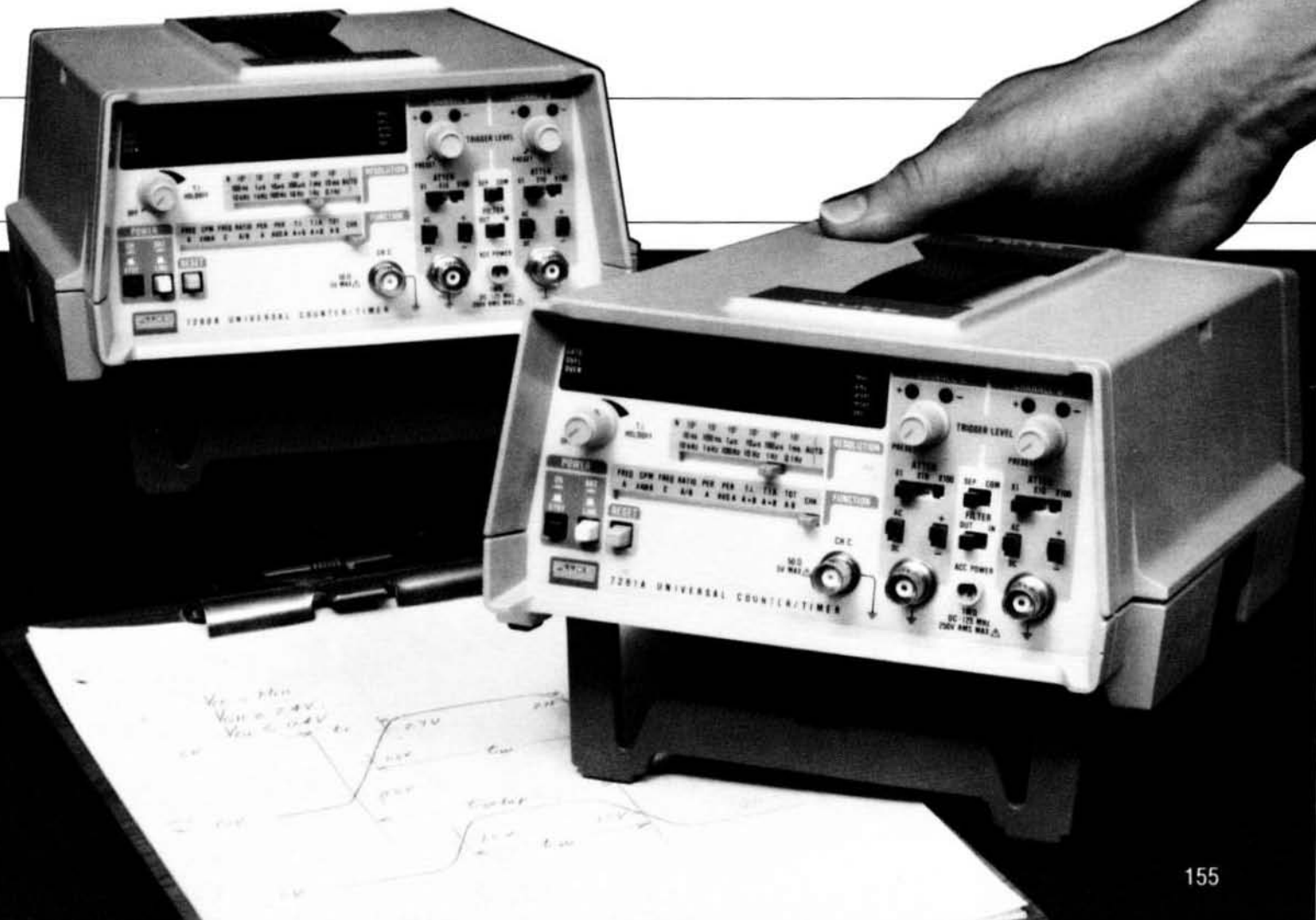
Service & Support

Counters



All Fluke electronic counters can measure the frequency of electronic signals from 50 Hz to 30 MHz, with certain models capable of measurements up to 1300 MHz. Most Fluke counters can also measure the period or time interval of one or more cycles, for even quicker measurements of low frequency signals.

For time interval measurements such as the duration of pulses, the time between successive pulses, or the timing difference between pulses from two different signal sources, choose from Fluke's line of Universal Counter/Timers. For applications requiring portability, Fluke also offers a battery option for several of its counters. NOTE: If your frequency measurement range does not exceed 700 kHz, and you do not need to measure time intervals, also consider the Fluke 8060A 4½-digit multimeter.



Selection Guide

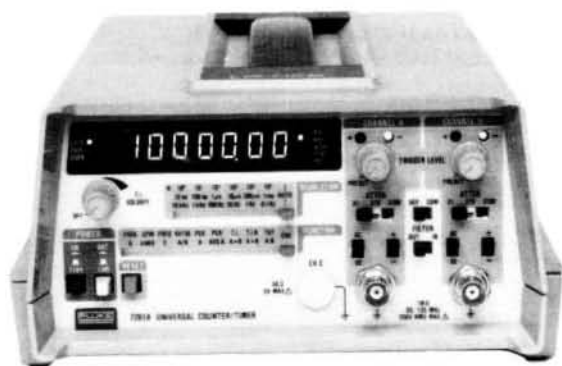
Counters	1900A	1910A	1911A	1912A	7220A	7250A	7260A	7261A	1953A
Basic Measurement Frequency	80 MHz	125 MHz	250 MHz	520 MHz	1300 MHz	80 MHz	125 MHz	125 MHz	125 MHz
Channel C	—	—	—	—	—	—	1300 MHz	1300 MHz	1250 MHz
Frequency Ratio	—	Yes**	Yes**	Yes**	—	Yes	Yes	Yes	Yes
Period and Time Resolution	100 ns	100 ns	100 ns	100 ns	—	100 ns	100 ns	10 ns	100 ns
Period Average Resolution	100 ps	100 ps	100 ps	100 ps	—	1 ps	1 ps	0.1 ps	1 ps
Time-Interval-Average Resolution	—	—	—	—	—	—	31.6 ps	31.6 ps	—
Totalize	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Yes
Trigger Coupling	AC	AC	AC	AC	AC	AC	AC, DC	AC, DC	AC, DC
50 MHz Sensitivity (rms)	25 mV	15 mV	15 mV	15 mV	10 mV	10 mV	10 mV	10 mV	30 mV
Noise Filter	Yes	—	—	—	Yes	Yes	Yes	Yes	—
Attenuation	10x	10x	10x	10x	10x, Var	10x, Var	10x, 100x	10x, 100x	10x
Marker Output	—	—	—	—	—	—	Yes	Yes	Yes
Time-Interval Holdoff	—	—	—	—	—	—	Yes	Yes	—
TCXO Timebase Option	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Std
Oven Timebase Option(s)	—	—	—	—	Two	Two	Two	Two	Two
External Timebase Input	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Internal Timebase Output	—	—	—	—	Yes	—	Yes	Yes	Std
Battery Option	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
IEEE-488 Programmable	—	—	—	—	Opt*	Opt*	Opt*	Opt*	Opt

*Via Fluke 1120A IEEE-488 Translator

**Using external timebase input



(NSN 6625-01-128-4823) **7260A**



(NSN 6625-01-106-0453) **7261A**

7260A & 7261A Universal Counter/Timers

- 8-digit display
- 100 MHz clock/10 nS resolution (Model 7261A)
- Phase modulation timebase option available on Model 7261A
- X1, X10, X100 attenuation
- 100 kHz low-pass filter
- Selectable + or — slope triggering and ac or dc coupling

The 7260A and 7261A are Fluke Counter/Timers packaged in the versatile Portable Test Instrument (PTI) case. Both counters 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 minimize 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 holdoff 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.

Simple, Hands-Off Operation

These counters are designed to let you keep your hands and mind on the job instead of on the counter controls. Select the measurement function you want, set the resolution switch to AUTO range and they will automatically choose the correct range for best resolution, position the decimal point properly, and light an annunciator LED to inform you of the unit of measurement.

Portable Counter, 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 maximum 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.

IEEE-488 and PTI

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 via the 1120A, including counters and digital voltmeters. The unique stack-and-latch design makes them easy to carry about; requires less bench space, too.

Low Susceptibility, Minimal RF Radiation

A lightweight, internal, 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 susceptibility in high rf environments as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

Specifications

Frequency Measurements (Channel A)

Range: 0 Hz to 125 MHz
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ± 1 count \pm timebase error*
Display: kHz or MHz with decimal
 *See Timebase Characteristics chart

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 \pm timebase error*
Display: kHz or MHz with decimal
 *See Timebase Characteristics chart

Universal Counter/Timers

7260A/7261A

Ratio Measurements (A/B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for Channel B
Resolution: \pm frequency of B \div N* x frequency of A
Accuracy: Resolution \pm frequency of B x trigger error of B \div 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, sine wave
Pulse Width: \geq 500 ns from 0 Hz to 100 kHz, \geq 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: \pm 1 count \pm timebase error \pm trigger error
Display: ms, or sec with decimal for 7260A, μ s, ms, or sec with decimal for 7261A

Period-Averaged Measurements (CH A)

Range: 1 ps to 9,999,999.9 μ s for 7260A; 0.1 ps to 999,999.99 μ s for 7261A
Frequency Range: 0 Hz to 2 MHz, sine wave
Pulse Width: \geq 500 ns from 0 Hz to 100 kHz, \geq 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 \div N* \pm timebase error \pm trigger error \div N* for 7260A, or 10 ns \div N* \pm timebase error \pm trigger error \div N* for 7261A
Display: μ s or ms with decimal

*N = 10⁰ to 10⁵ 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, sine wave
Pulse Width: \geq 50 ns, for 7260A, \geq 10 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: \pm 1 count \pm timebase error \pm trigger error
Display: ms or sec 7260A; μ s, ms, sec 7261A
Time Interval Holdoff: 20 μ s to 20 ms, continuously variable

Time-Interval-Averaged Measurements (CH A/CH B)

Range: 1 ns to 9,999,999.9 μ s for 7260A, or 0.1 ns to 999,999.99 μ s for 7261A
Frequency Range: 0 Hz to 5 MHz, sine wave
Pulse Width: \geq 50 ns for 7260A, \geq 10 ns for 7261A
Resolution: 100 ns \div \sqrt N* for 7260A, 10 ns \div \sqrt N* for 7261A
Accuracy: 100 ns \div \sqrt N* \pm 10 ns \pm timebase error \pm trigger error \div \sqrt N* for 7260A; 10 ns \div \sqrt N* \pm timebase error \pm trigger error \div \sqrt N* for 7261A
Dead Time: 4 μ s
Display: μ s or ms with decimal

*N = 10⁰ to 10⁵ 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 μ s-20 ms, cont 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: \pm 1 count \pm 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 M Ω , 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: 50 Ω , 2.5: 1 VSWR, maximum
Maximum Input: 5V rms, fused

External Timebase Input

Frequency: 10 MHz, ac coupled
Sensitivity: 300 mV rms
Impedance: 1 k Ω , 30 pF, nominal
Maximum Input: 3V rms

Triggering

Trigger Level Output: \pm 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

Timebase Characteristics

Characteristics	Option			
	Standard	-112 TCXO	-131 Oven	-132 Oven
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const Temp)	$\pm 5 \times 10^{-7}$ /mo	$\pm 3 \times 10^{-7}$ /mo $\pm 1 \times 10^{-6}$ /yr	$\pm 1 \times 10^{-7}$ /mo*	$\pm 5 \times 10^{-8}$ /mo* $\pm 3 \times 10^{-9}$ /day*
Temperature Accuracy (0°C to 40°C)	$< 5 \times 10^{-6}$ **	$\pm 2 \times 10^{-6}$	$\pm 1 \times 10^{-7}$	$\pm 3 \times 10^{-8}$
Line Variation ($\pm 10\%$ change)	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$	$\pm 4 \times 10^{-9}$
Battery Operation	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-8}$
Warm-up				
10 Minutes	—	—	$\pm 5 \times 10^{-7}$	$\pm 5 \times 10^{-7}$
20 Minutes	—	—	$\pm 3 \times 10^{-8}$	$\pm 3 \times 10^{-8}$

* After five days of continuous operation

** Peak-to-peak variation over temperature range

(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 amplifier too early or too late, calculated as follows:

$$\text{Microseconds of trigger error} = \frac{2 \times \text{pk noise voltage (V)}}{\text{signal slope at trigger point (V/\mu s)}}$$

or Trigger error = $\pm 0.3\%$ 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.

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F

Operating Time: 2.8 hours (2 hours, 7261A) typical continuous, decreasing to 2 hours (1.5 hours, 7261A) worst case

Charge Time: 16 hours at room temperature

Charge Protection: Thermistor-actuated shutdown of charging circuit if battery temperature exceeds 65°C

Discharge Protection: Automatic low-voltage shutdown to prevent over discharge

Note: Not compatible with Option -331

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 the 7260A or 7261A 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

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)

Description: Provides third channel input to measure frequencies from 50 MHz to 520 MHz

Sensitivity: 10 mV rms

Input Impedance: 50Ω

VSWR: 2.5:1, maximum

Maximum Input: 5V rms, fuse-protected

1300 MHz Channel C Option (-331)

Description: Provides third channel input to measure frequencies from 100 MHz to 1300 MHz and has a triggered mode to capture and display 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 from 1000 MHz to 1300 MHz

Input Impedance: 50Ω

VSWR: 2.5:1 maximum

Maximum Input: 5V rms, fuse-protected

General Specifications

Display: 8-digit LED with leading zero suppression, decimal, and annunciators

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

Marker Output: TTL compatible output. Positive going edge indicates Channel A trigger, negative going edge indicates Channel B trigger. Typical delay from the time signal triggers input amplifier to the time marker changes level at rear panel output is 30 ns for the 7261A, 75 ns for the 7260A

Temperature: 0°C to 40°C, operating; -40°C to +70°C, non-operating

EMI: Internal metal RFI shield (tested to MIL-STD-461, Notice 3).

Safety: Designed to meet requirements of UL 1244 and IEC 348

Power: 100V, 120V, 220V or 240V ±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)

Included: Instruction manual, power cord, serialized and dated calibration certificate. Order Y9111 or Y9112 coaxial cable(s) separately

Models

7260A Universal Counter/Timer

7261A Universal Counter/Timer

Options

72XXA-010* Rechargeable Battery Pack

72XXA-112* TCXO, 2 ppm

72XXA-131* Low Power Oven

72XXA-132* Superior Low Power Oven

7261A-190** Timebase Phase Modulation (7261A only)

72XXA-310* 50-520 MHz, Channel C

72XXA-331*** 100-1300 MHz, Channel C

72XXA-521* PTI Interface w/PTI Cable

72XXA-522K Personality Card, for 1120A

72XXA-529¹ 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 72XXA-521, 72XXA-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 page 284)

1120A IEEE-488 Translator

A53 Whip Antenna

Y7201 Attenuator/Filter

Y9111 3 ft (0.93m) Coaxial Cable, 50Ω

Y9112 6 ft (1.85m) Coaxial Cable, 50Ω

Y9103 50Ω Feed-thru Termination

Y2014 5/4" Rack Adapter, Single

Y2015 5/4" Rack Adapter, Double

Y2020 Panel Mounting Kit

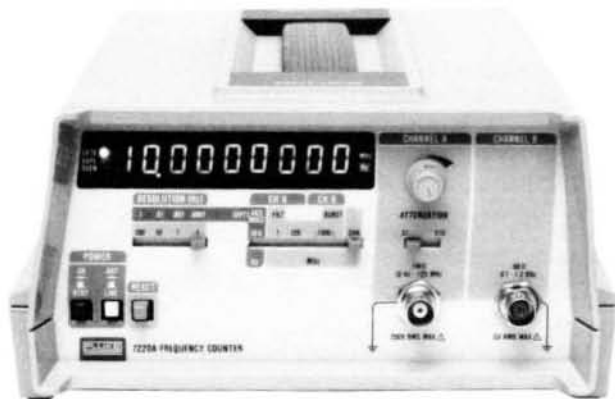
Y7203 2 ft PTI Ribbon Cable

Y7204 5 ft PTI Ribbon Cable

Y2023 PTI Accessory Case

Service & Support

7220A



7220A

7220A Communications Counter

- 9-digit display
- Channel A range: 10 Hz to 125 MHz
- Channel B range: 100 MHz to 1300 MHz
- Ac-coupled, 1 megohm input on Channel A, 50 ohm input Channel B
- Continuously variable X1 and X10 wideband attenuator
- Switchable 100 kHz low-pass filter
- Internal metal shielding

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. Electromagnetic interference is greatly reduced with internal metal shielding to meet most of the requirements of U.S. Military Standard MIL-STD-461.

Housed in Fluke's Portable Test Instrument (PTI) case, the 7220A stacks and latches to any other PTI product to become part of a complete, one handle measurement system. The case easily comes apart for servicing.

Resolution Multiplier

Option -351 increases measurement resolution by a factor of 1000 for frequencies from 10 Hz to 10 kHz without requiring any more measurement time. Resolution goes from 0.001 Hz for 10 Hz signals to 0.1 Hz for 10 kHz signals.

Ovenized Accuracy with Battery Portability

With Option -010, the 7220A may be operated away from ac line power. The internal rechargeable battery pack will provide power for 5½ hours for typical operation. For demanding field applications, the superior accuracy of optional ovenized oscillators assures the highest performance from your counter. These oscillators consume very little power in contrast to conventional ovenized oscillators, so may be used when the 7220A is operating from batteries. And, when you leave the lab on a field assignment, you can switch battery power to the oven to keep the oscillator warm and standing by for measurements with maximum stability and accuracy. There are two low-power oven options to choose from—one (-131) with an aging rate of $\pm 1 \times 10^{-7}$ /month and one (-132) with a superior aging rate of $\pm 5 \times 10^{-8}$ /month. Also there is a low-cost conventional temperature-compensated crystal oscillator (TCXO) for superior accuracy (Option -111).

IEEE-488 Compatibility

Using the Fluke 1120A Translator, a 7220A may be operated in a system configuration with other instruments compatible with IEEE Std 488-1978.

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 \pm 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 M Ω , <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: 50 Ω

VSWR: 2.5:1, maximum

Maximum Input: 5V rms

External Timebase

Frequency: 10 MHz

Sensitivity: 300 mV rms

Impedance: 1 k Ω shunted by 30 pF, ac-coupled

Maximum Input: 3V rms

Output: TTL-level 10 MHz squarewave, 200 Ω , nominal

Timebase Characteristics

Characteristics	Option			
	Standard	-111 TCXO	-131 Oven	-132 Oven
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const Temp)	$\pm 5 \times 10^{-7}/\text{mo}$	$\pm 3 \times 10^{-7}/\text{mo}$ $\pm 1 \times 10^{-6}/\text{yr}$	$\pm 1 \times 10^{-7}/\text{mo}^*$	$\pm 5 \times 10^{-9}/\text{mo}^*$ $\pm 3 \times 10^{-9}/\text{day}^*$
Temperature Accuracy (0°C to 40°C)	$< 5 \times 10^{-6}^{***}$	$\pm 1 \times 10^{-6}$	$\pm 1 \times 10^{-7}$	$\pm 3 \times 10^{-8}$
Line Variation ($\pm 10\%$ change)	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 4 \times 10^{-9}$
Battery Operation	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-8}$
Warm-up ^{***}				
10 Minutes	—	—	$\pm 5 \times 10^{-7}$	$\pm 5 \times 10^{-7}$
20 Minutes	—	—	$\pm 3 \times 10^{-8}$	$\pm 3 \times 10^{-8}$

* After five days of continuous operation

** Includes temperature variations during operation

*** Compared to frequency 24 hours after turn on

Option Specifications
Battery Pack Option (-010)

Type: Nickel-Cadmium, size F

Operating Time: 5½ hours, typical operation

Charge Time: 16 hours at room temperature

Charge Protection: Thermistor-actuated shutdown of charging circuit if battery temperature is too high

Discharge Protection: Automatic shutdown prevents over-discharge

PTI Interface (-521)

Type: Serial BCD output of all 9 digits, decimal, and measurement units

Personality Card Option (-522K)

For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)

Description: Interfaces the 7220A to IEEE-488 bus via the Fluke 1120A IEEE-488 Translator. (1120A purchased separately.) Provides full measurement output capability

Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

Resolution Multiplier Option (-351)

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 \pm timebase accuracy*

*See timebase characteristics for timebase accuracy

General Specifications

Display: Nine-digit LED

Self-Check: Counts and displays 10 MHz clock

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, 240V ac $\pm 10\%$ switch-selectable, 47 Hz to 63 Hz, 24VA maximum

Size: Style C PTI case, 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in x 8.0 in x 4.3 in)

Weight: 3.2 kg (7 lb)

Included: Instruction manual, power cord, serialized and dated calibration certificate. Order cables and accessories separately.

Model

7220A 1300 MHz Frequency Counter

Options

72XXA-010* Rechargeable Battery Pack

7220A-111* 1 ppm TCXO

72XXA-131* Low-power Oven

72XXA-132* Superior Low-power Oven

7220A-351* 1000X Resolution Multiplier

72XXA-521* PTI Interface w/PTI Cable

72XXA-522K Personality Card for 1120A

72XXA-529A¹ Interface for IEEE-488 Bus

* Factory or Service Center installation only.

** Factory installation only.

¹ The -529 Option can be ordered and installed at time of manufacture only.

This option can only be used in conjunction with the Fluke 1120A IEEE-488 Translator, purchased separately. Includes 72XXA-521, 72XXA-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 page 284)

1120A IEEE-488 Translator

A53 Whip Antenna

Y9111 3 ft (0.93m) Coaxial Cable, 50Ω

Y9112 6 ft (1.85m) Coaxial Cable, 50Ω

Y9103 50Ω Feed-thru Terminator

Y2014 5¼" Rack Adapter, Single

Y2015 5¼" Rack Adapter, Double

Y2020 Panel Mounting Kit

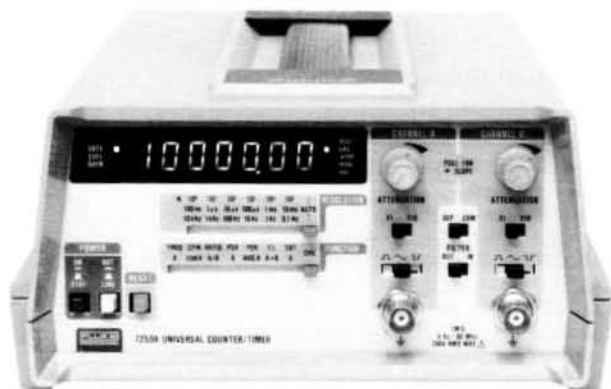
Y7203 2 ft PTI Ribbon Cable

Y7204 5 ft PTI Ribbon Cable

Y2023 PTI Accessory Case

Service & Support

7250A



(NSN 6625-01-176-1269) 7250A

7250A Universal Counter/Timer

- Frequency to 80 MHz
- Time intervals from 100 ns to 99,999.99 sec
- Period average range 1 ps to 999,999.9 ms
- Autorange
- Internal stainless steel shield

The 7250A Counter is the lowest priced model in the Portable Test Instrument (PTI) series. Its construction and features are much like those of the 7260A and 7261A.

The instrument will measure frequency 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.

Simple Operation

The 7250A lets you keep your hands and mind on the job instead of on the counter controls. Select the measurement function you want, set the resolution switch to AUTOrange and the 7250A will automatically choose the correct range for best resolution with up to 7-digit display. It will then position the decimal point properly and light an annunciator LED to inform you of the unit of measurement.

Controls You May Need

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 frequency 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 \pm slope controls, fixed-offset trigger level switches, and a separate/common switch at your fingertips.

Take It to the Job

The rugged case, compact design, and optional rechargeable battery pack means you can take the 7250A with you to solve those tough field service problems, with no sacrifice in performance. You can operate the counter continuously for up to 3.5 hours before recharging. And battery protection is foolproof. A relay provides positive protection against over-discharge and a thermistor sensor protects against charging when the batteries are too hot.

Laboratory Accuracy in the Field

For applications demanding the best possible accuracy, optional ovenized oscillators are available. They consume very low power in contrast to conventional oscillators, so they can even be used when the 7250A is operating from batteries. When you go out on a field assignment, switch battery power to the oven before leaving and you will arrive with laboratory accuracy with a warm-up.

Low Electromagnetic Interference

A lightweight, internal, stainless steel shield surrounds the instrument and mates with the metal front and rear panels to provide an enclosure meeting most requirements of MIL-STD-461. This means low susceptibility in high-rf environments as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

IEEE-488 Compatibility, PTI Package

The 7250A incorporates the Fluke-developed portable test instrument (PTI) packaging concept which lets you easily configure low cost, convenient mini-test systems using the Fluke 1120A IEEE-488 Translator. The 7250A is rack-mountable with the 1120A when used with other equipment compatible with IEEE Std 488-1978.

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 \pm timebase error*
Display: kHz or MHz with decimal
 *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 \pm timebase error \pm trigger error
Display: ms, or sec with decimal

Period-Average Measurements (CH A)

Range: 1 ps to 999,999.9 μ s
Frequency Range: 5 Hz to 1 MHz, sinewave
Resolution: 100 ns to 1 ps in decade steps
Accuracy: ± 100 ns \div N* \pm timebase error \pm trigger error \div N*
Display: μ s or ms with decimal

*N = 10⁰ to 10⁵ 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/CH 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 \pm timebase error \pm 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: \pm frequency of B \div (N* x frequency of A)
Accuracy: \pm Resolution \pm (frequency of B x trigger error of B \div N*)
Display: Digits with decimal, no annunciator

Counts Per Minute (cpm x 100.* 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: X 1 X 100, continuously variable

Filter: Low pass, 100 kHz 3 db point, nominal

Trigger Level: +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, 5V rms 1 MHz to 80 MHz

External Timebase Input

Frequency: 10 MHz, ac coupled

Sensitivity: 300 mV rms

Impedance: 1 kΩ, 30 pF, nominal

Maximum Input: 3V rms

Timebase Characteristics

Same as for 7260A & 7261A

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F

Operating Time: 3.5 hours continuous, decreasing to 3 hours, typical worst case with Option -131 or -132 ovenized oscillators installed

Charge Time: 16 hours at room temperature

Charge Protection: Thermistor-actuated shutdown of charging circuit if battery temperature exceeds 65°C

Discharge Protection: Automatic low-voltage shutdown to prevent over discharge

PTI Interface (-521)

Type: Serial BCD output of all 7 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 the 7250A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. (Note: 1120A must be purchased separately.) Provides full measurement output capability, and limited triggering and reset of a measurement

Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

General Specifications

Display: 7-digit LED with leading zero suppression, decimal, and annunciators

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 lbs)

Included: Instruction manual, power cord, serialized and dated calibration certificate.

Model

7250A Universal Counter/Timer

Options

72XXA-010* Battery Pack, NiCd Rechargeable

72XXA-112* TCXO, 2 ppm

72XXA-131* Low Power Oven

72XXA-132* Superior Low Power Oven

72XXA-521* PTI Interface w/PTI Cable

72XXA-522K Personality Card

72XXA-529[†] IEEE-488 Interface

* Factory or Service Center installation only.

** Factory installation only.

[†] The -529 Option can be ordered and installed at time of manufacture only. Includes parts needed to interface the 7250A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. Includes 72XXA-521, 72XXA-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 page 284)

1120A IEEE-488 Translator

A53 Whip Antenna

Y7201 Attenuator/Filter

Y9111 3 ft (0.93m) Coaxial Cable, 50Ω

Y9112 6 ft (1.85m) Coaxial Cable, 50Ω

Y9103 50Ω Feed-thru Terminator

Y2014 5/4" Rack Adapter, Single

Y2015 5/2" Rack Adapter, Double

Y2020 Panel Mounting Kit

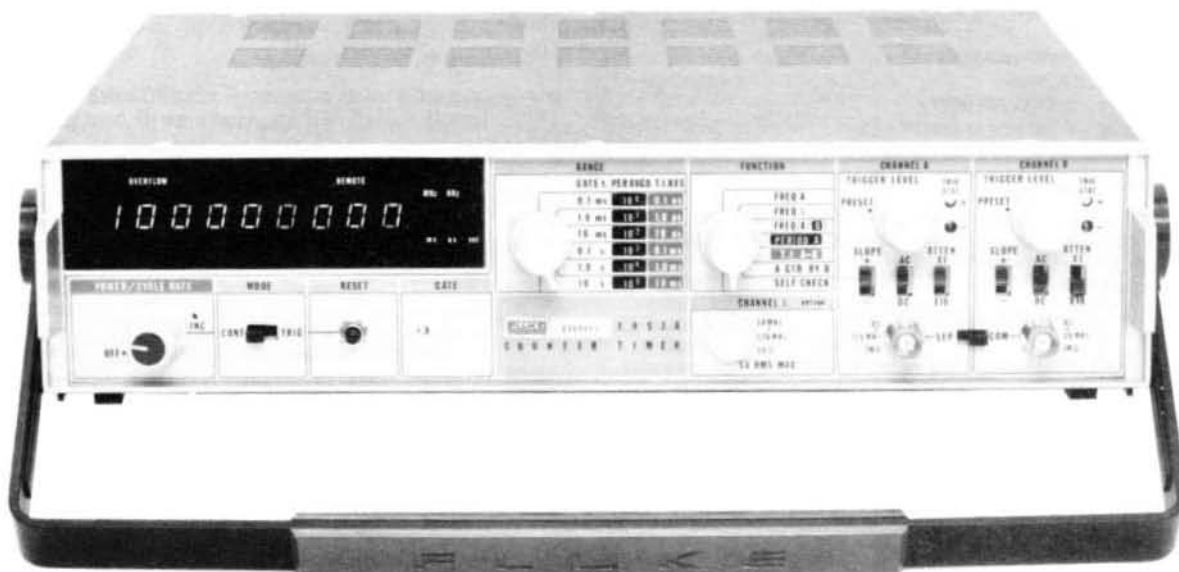
Y7203 2 ft PTI Ribbon Cable

Y7204 5 ft PTI Ribbon Cable

Y2023 PTI Accessory Case

Service & Support

1953A



(NSN 6625-01-046-4912) 1953A

1953A Universal Counter/Timer

- Frequency, frequency ratio, period, period averaging, time interval, gated totalize measurements
- 9 digit display
- Trigger level controllable on both channels
- Selectable + or — slope triggering, ac or dc coupling, X1 or X10 attenuation
- Switch selection of separate or common input between channels

The 1953A is Fluke's sophisticated system counter which has an outstanding price/performance ratio and a wide array of options which allow you to select just the capability you need to solve your specific measurement problems.

Features

The standard instrument features all the basic functions required for a variety of measurements: frequency, frequency ratio, period, period averaging, time interval, and gated totalize. Wide-ranging provides six choices of gate times, period averages, and time interval resolutions. The 1953A counts to 125 MHz, higher with Option -07, -13, or -14.

The trigger-level controls for channels A and B allow the user to select a preset trigger level (0V dc) or to vary the level at which the input signal will trigger the counter. Two LED trigger status indicators operate in conjunction with each level control to show whether the counter is correctly triggered or when the input is more positive or negative with respect to the selected trigger level (see diagram). Two output jacks allow a DMM to be used to set the levels accurately.

Three signal conditioning switches are provided for each channel permitting the operator to select positive or negative slope triggering, ac or dc coupling, and X1 or X10 attenuation.

Dual input channels are direct coupled with 30 mV sensitivity. A switch for selection of separate or common input between channels is provided to allow input of either a single source common to both channels or two separate sources each on a separate channel. This is particularly useful in

time interval measurements. A TTL marker pulse output permits accurate determination of the start and stop signal trigger points. By connecting this marker pulse to an oscilloscope Z-axis input, the portion of the waveform displayed on the oscilloscope during the time interval measured will be intensity modulated.

A display check lights all digit segments when the reset button is pressed with the counter in self-check mode. A large, easy-to-read 9-digit LED display includes full leading zero suppression, automatic annunciation, and overflow.

Options

Three 50Ω input prescalers are available to extend frequency measurement capability from 0 to 125 MHz (standard) to 520, 1000 or 1250 MHz. A superior TCXO and two oven stabilized timebases provide higher accuracy measurements. Available to systems oriented users is a choice of three remote programming options, two of the fast parallel controlled type and one using the bi-directional IEEE-488 interface. A separate parallel data output option is available for digit, decimal point, overflow, and units annunciation information for data acquisition use. All options are TTL compatible.

IEEE-488 Interface Option

This interface permits interconnection with bus-compatible Fluke instruments and those of other manufacturers having the standard interface. The Fluke IEEE Interface Option (-15) is intended for systems applications where bus management and data manipulation are performed via a system controller (terminal, calculator, computer, etc.). The counter can also be manually operated without the use of a controller, displaying measurement information locally and outputting data (talk only mode) directly to a printer, display terminal or other peripheral device.

The 1953A Option -15 is compatible with the IEEE-488 Interface standard using the preferred ASCII (U.S.A. Standard Code for information interchange) character-serial, seven bit code set. Interface driver and receiver circuits are all TTL compatible which permits remote operation of the counter's function, range, and signal conditioning, with front panel lockout.

Output information is comprised of 9 display digits, decimal point, and exponent for frequency or time units. Overflow indication is provided beyond a display of 10⁹.

Two internal D/A converters are included for remote programming of the A and B channel trigger levels. Each provides 1% resolution.

Specifications

Frequency Measurements

Range: 0 to 125 MHz (dc coupled) 5 Hz to 125 MHz (ac coupled). Prescalers to 1250 MHz (Options -07, -13, -14). All prescalers have clean dropout to eliminate false readings

Gate Time: 0.1 ms to 10s in 6 decade steps (prescaled input increases gate time by a factor of 4 or 8)

Resolution: 0.1 Hz at 10s gate time to 10 kHz at 0.1 ms gate time

Accuracy: \pm Timebase accuracy ± 1 count

Readout: kHz or MHz displayed with decimal point

Period Measurements

Range: 0 to 25 MHz (dc coupled), 5 Hz to 25 MHz (ac coupled)

Periods Averaged: 1 period to 10^5 periods in decade steps

Clock Frequency: 10 MHz

Resolution: 0.1 μ s at 1 period to 1 ps at 10^5 periods

Accuracy: Timebase accuracy ± 1 count + trigger error of signal on input A*

Readout: ms or μ s automatically displayed with decimal point

* See Timebase Characteristics chart

Time Interval Measurements

Range: 0.1 μ s to 10^7 s

Input: Channels A and B; common or separate

Resolution: 10 ms to 0.1 μ s in 6 decade steps

Accuracy: ± 1 count + timebase accuracy + trigger error*

Readout: ms or s automatically displayed with decimal point

* See Timebase Characteristics Chart

Totalize Measurements

Totalizing: A gated by B

Range: 0 to 125 MHz (dc coupled), 5 Hz to 125 MHz (ac coupled)

Readout: Counts without annunciation or decimal point

Ratio Measurements

Display: f1/f2, where f1 and f2 are applied at input channels A and B respectively

Range:

f1: 0 to 125 MHz (dc coupled), 5 Hz to 125 MHz (ac coupled)

f2: 0 to 25 MHz (dc coupled), 5 Hz to 25 MHz (ac coupled)

Accuracy: ± 1 count of signal on input A + trigger error of signal on input B*

Readout: Decimal point without unit annunciation

* See Timebase Characteristics chart

Sensitivity

Channel A: 30 mV rms sinewave from dc 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 from dc to 25 MHz; 100 mV with minimum pulse width of 50 ns

Channel C: See Option -07, -13, -14

Input Impedance

Channel A or B: 1 M Ω , ≤ 30 pF

Channel C: 50 Ω nominal

Attenuator & Limiting

Channel A and B only: Sensitivity is decreased by a factor of approximately 10 in the X10 position

Dynamic Range w/o Limiting: -3.5 to +3.5V (Channel A and B) 1V rms (Channel C)

Impedance In Limiting Condition: 120 k Ω in parallel with 75 pF (Channel A and B). VSWR less than 3:1 (Channel C)

Slope & Trigger Level

Channel A and B only: Front panel slide switch selects positive or negative slope triggering. Front panel control has ± 1 V range when attenuator is in X1 position, and ± 10 V in the X10 position

Maximum Input Voltage: Channel A & B — 250V max dc + ac peak, 150V rms to 1 kHz; 5V rms to 125 MHz; Channel C — 5V rms, fuse protected

Trigger Level Output: Channel A & B trigger levels available at rear panel BNC connectors

Timebases

	Standard	-04 Option	-10 Option	-20 Option
Frequency	10.00 MHz	10.00 MHz	10.00 MHz	10.00 MHz
Aging Rate (Constant Temperature)	$\pm 3 \times 10^{-7}$ /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
Temperature 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 ($\pm 10\%$)	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$	$\pm 3 \times 10^{-9}$	$\pm 1 \times 10^{-9}$

* Trigger error of channels A or B is less than $\pm 0.3\%$ of one period \div periods averaged for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude

** Trigger error in time interval mode is less than ± 0.0025 /signal slope (V/ μ s) in μ s

† Peak to peak variation

External Timebase Input

Frequency Required: 10 MHz

Sensitivity: 250 mV

Impedance: 1 k Ω , 20 pF

Dynamic Range w/o Limiting: 8V peak to peak

Input Impedance During Limiting: 470 Ω in parallel with 30 pF

Option Specifications

Timebase Multiplier (-05)

Allows use of external 1, 5, or 10 MHz reference clock (standard unit accepts 10 MHz). This option also permits burst measurements to be made when a "level" signal is available if burst is longer than 100 μ s

Superior TCXO (-04)

See timebase specifications above

Oven Stabilized Timebase (-10)

Oven is activated whenever instrument is connected to the AC line. See timebase specifications above

Superior Oven-Stabilized Timebase (-20)

Oven is activated whenever instrument is connected to the AC line. See timebase specifications

IEEE-488 Interface (-15)

Full remote programming of function, range, and all signal conditioning controls including trigger levels. Directly compatible with IEEE-488-1978 Interface Standard. Data output includes 9 digits of display information, decimal point, and exponent for time or frequency units. Front panel lockout is provided. Ask for application bulletin 23

Repertoire: SH1, AH1, T5, L4, SR1, RL2

Digital Output Unit (-02)

Provides BCD TTL outputs from each digit, plus overflow, units annunciation, decimal point, and print command.

Basic Parallel Remote Programming (-11)

Allows single-line programming (TTL or contact closure) of range, mode, slope, and reset functions. Allows analog programming of trigger levels, and provides power sense, overflow status, and system ready outputs. Front panel lockout is provided

Full Parallel Remote Programming (-12)

Includes all the features of Option -11, plus programming of ac or dc coupling, attenuation, separate/common, and digital trigger level. Trigger level of channels A and B is programmable over a +1V to -1V range (2 BCD digits plus sign), giving a resolution of 1%, and an accuracy of 5% plus 2 mV (1 year). Temperature stability is better than 200 μ V/ $^{\circ}$ C. Two analog input/output lines are provided for either checking the D/A performance, or programming via analog levels. Option -12 increases input capacitance to 37 pF maximum

Rear Inputs (-16)

Two rear inputs in parallel with A and B front inputs (capacity 85 pF) plus a rear input for channel C (decreased sensitivities)

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 50 Ω 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 (50 Ω) for levels less than 1V rms

General Specifications

Display: 9-digit LED display with large 7-segment characters. Full leading zero suppression

Cycle Rate: In "CONT" mode, the time interval between successive measurements can be varied by means of a cycle rate control between approximately 0.2 and 2.0s. "Reset" button clears display and activates a new measurement

Reset: In "TRIG" mode, readings may be updated by pushing the "Reset" button or by grounding the external reset pin on the remote control connector. With external reset the display is not cleared

Self-Check: A timebase-derived 10 MHz signal is internally counted

Gate Time: High True, TTL level output

Time Interval Marker: Low True, TTL level output

Temperature: 0 $^{\circ}$ C to +50 $^{\circ}$ C, operating; -40 $^{\circ}$ C to +75 $^{\circ}$ C, non-operating

Power: 115 or 230V ac \pm 10% (100V operation 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: Instruction manual, power cord, serialized and dated calibration certificate. Order Y9111 or Y9112 coaxial cable(s) and Y9103 50-Ohm Terminator separately

Models

1953A Universal Counter/Timer

1953A-12 With Option -12 Installed

1953A-15* With Option -15 Installed

**Not compatible with Option -02 or -11*

Options

1953A-02 Digital Output Unit

19XXA-04 Superior TCXO

1953A-05 Timebase Multiplier

1953A-07* 520 MHz

1953A-10** Oven-Stabilized Timebase

1953A-11** Basic Remote Programming

1953A-13* 1000 MHz

1953A-14* 1250 MHz

1953A-16** Rear Inputs

1953A-20** Superior Oven-Stabilized Timebase

** Factory or Service Center installation only*

*** Factory installation only*

Accessories (Also see page 284)

A53 Whip Antenna

Y7201 Attenuator/Filter

M00-200-622 3 $\frac{1}{2}$ " Rack Adapter

M00-200-626 3 $\frac{1}{2}$ " Rack Adapter w/slides, for DEC cabinets

Y7206 3 $\frac{1}{2}$ " Adapter w/slides, for non-DEC cabinets

Y8021 1m Cable, IEEE-488 bus

Y8022 2m Cable, IEEE-488 bus

Y8023 4m Cable, IEEE-488 bus

Y9103 50 Ω Feed-thru Terminator

Y9111 3 ft (0.93m) Coaxial Cable, 50 Ω

Y9112 6 ft (1.85m) Coaxial Cable, 50 Ω

Service & Support



(NSN 6625-01-049-1844) 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

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:

- 10⁰ single period (100 ns resolution)
- 10¹ periods averaged (10 ns resolution)
- 10² periods averaged (1 ns resolution)
- 10³ periods averaged (100 ps resolution)

Autorange position automatically seeks to fill all 6 digits but will not select a period average of greater than 10² averages

Totalizing: Accumulates up to 999999 counts, then activates overflow indicator

Sensitivity: 25 mV, typically 15 mV rms sinewave, 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 M Ω , \leq 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:	($\pm 10\%$) $<\pm 1 \times 10^{-7}$

Display: 6-digit LED, leading zero suppression. Time between successive measurements is 200 ms plus measurement time.

Annunciation: MHz, kHz, ms, μ s, 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 ϕ M. 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 $\pm 10\%$ (100V ac available) 50, 60 or 400 Hz. 6.5W line model, 8.5W battery model

Fuses: 1/8A line version, 1/2 amp 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 (4¼ lb) with batteries

Included: Instruction manual, power cord. Order Y9111, Y9112 coaxial cable(s) and Y9103 50-Ohm Terminator separately

Models

1900A Multifunction Counter

1900A-01 With Rechargeable Battery

Accessories (Also see page 284)

A53 Whip Antenna

C86 Carrying Case, Molded Plastic

Y7201 Attenuator/Filter

Y8205 Soft Carrying Case w/shoulder strap

Y9111 3 ft (0.93m) Coaxial Cable, 50 Ω

Y9112 6 ft (1.85m) Coaxial Cable, 50 Ω

Y9103 50 Ω Feed-thru Terminator

M00-100-714 Dust Cover

M00-200-611 3½" Rack Adapter, Offset

M00-200-612 3½" Rack Adapter, Center

M00-200-613 3½" Rack Adapter, Dual

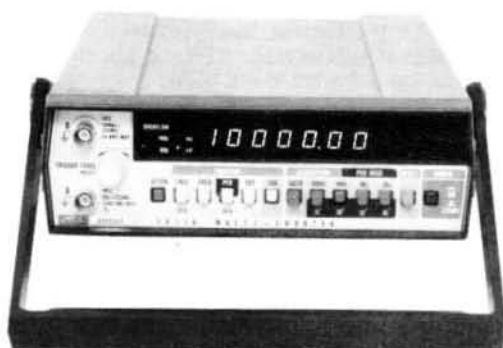
Service & Support

Multifunction Counters

1910A/1911A/1912A



1910A
(NSN 6625-01-092-8438)



(NSN 6625-01-064-3855) **1911A**



1912A

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 (Models 1911A and 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 timebases 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.

Specifications

Ch. A Attenuator: X1, X10 (approx.)

Ch. A Trigger Level: $\pm 0.5V$ 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 \div 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. Autorange 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

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 M Ω /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 M Ω /30 pF, ac coupled	dc + ac; <360V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	—
	B	50 MHz- 250 MHz	—	15 mV rms, 50 MHz - 175 MHz 30 mV rms, 175 MHz - 250 MHz	50 Ω , 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 M Ω /30 pF, ac coupled	dc + ac; <360V pk; 250V rms, 5 Hz - 1 kHz 10V rms above 1 kHz	—
	B	50 MHz- 250 MHz	—	25 mV rms, 50 MHz - 520 MHz	50 Ω , VSWR <2.5:1	dc + ac; <100V pk; 5V rms, fuse protected	4

Option Specifications

TCXO Options (-03, -04)
See Timebase Selection Guide

Timebase Selection Guide

Type (10 MHz)	Aging Rate	Line Variation ($\pm 10\%$)	Temperature Accuracy
			0 - 50°C
Standard	$\pm 5 \times 10^{-7}$ /mo	$\pm 1 \times 10^{-7}$	$\pm 5 \times 10^{-6}$ *
Option -03	$\pm 3 \times 10^{-7}$ /mo	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-6}$ *
Option -04	$\pm 3 \times 10^{-7}$ /mo	$\pm 2 \times 10^{-8}$	$\pm 5 \times 10^{-7}$ *

*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 k Ω

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, μ 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 k Ω

Power, Line Models: 100, 115, or 230V ac $\pm 10\%$, 48 Hz to 440 Hz, 8W maximum

Power, Battery Models

100V $\pm 10\%$, 48 Hz to 52 Hz, 8.5W max

100V $\pm 10\%$, 58 Hz to 62 Hz, 8.5W max

115V $\pm 10\%$, 58 Hz to 62 Hz, 8.5W max

230V $\pm 10\%$, 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 kgm (4.8 lb) max for battery models

Safety: Factory Mutual 3820 approved, CSA 556B certified
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) and Y9103 50-Ohm Terminator separately

Models

February 1987 prices

1910A 125 MHz Multifunction Counter

1910A-01 With Rechargeable Battery

1911A 250 MHz Multifunction Counter

1911A-01 With Rechargeable Battery

1912A 520 MHz Multifunction Counter

1912A-01 With Rechargeable Battery

Specify line voltage and frequency if other than 60 Hz and 115V ac

Options for 1910A, 1911A, 1912A

19XXA-03* 2 ppm TCXO

19XXA-04* 0.5 ppm TCXO

*Factory installation only.

Accessories (Also see page 284)

A53 Whip Antenna

Y7201 Attenuator/Low Pass Filter

Y9111 3 ft (0.93m) Coaxial Cable, 50 Ω

Y9103 50 Ω Feed-thru Terminator

C86 Carrying Case, Molded Plastic

Y8205 Soft Carrying Case w/shoulder strap

M00-200-611 3 1/2" Rack Adapter, Offset

M00-200-612 3 1/2" Rack Adapter, Center

M00-200-613 3 1/2" Rack Adapter, Dual

Service & Support

Digital Thermometers



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

Features	Panel Mount		Portable or Rackmountable									
	2160A	2170A	2165A	2166A	2168A	2175A	2176A	2190A	2180A	2189A	51	52
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 Limit	2162A	2162A	—	—	—	—	—	-006	-006	-006	—	—
Multiple Alarm Limit	—	—	—	—	—	—	—	Y2002	Y2002	Y2002	—	—
Selectable Input Points	1	1	1	10	—	—	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	30	**	—	**	**	**	100	100	100	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.

¹Also see 8520A/PRT Precision Thermometry Systems

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 degree or 0.1 degree resolution.

8520A/PRT: Best accuracy from -200°C to +350°C. A Rosemount 162N Platinum Resistance Thermometer Probe (PRT) and a Fluke 8520A 5½-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, multiple alarms, a battery pack, and a thermocouple calibrator.

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 optionally 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.

Digital Thermometers

Fluke 51/52



Recording Minimum and Maximum Temperatures. The new Fluke 52 Digital Thermometer features a unique recording mode that allows it to log both the minimum and maximum temperatures from either of its two thermocouple inputs (T1 or T2), or the difference between the two (T1-T2), for up to 1200 hours at a time. This Min-Max Recording feature provides a useful means to troubleshoot intermittent problems. Simply push the "Record" button

and the thermometer will begin updating and storing the hottest and coldest temperatures measured. A "REC" annunciator will appear in the display to inform you the record function has been activated. Min/Max readings can be viewed at any time during the measurement process by pressing the "View" button. A "Max" or "Min" annunciator will accompany the appropriately displayed temperature.

Available through Distributors (See page 302)

Ideal for the field, lab or factory, the Fluke 50 Series of digital thermometers combine lab-accuracy and performance features in an affordable series of handheld instruments. Both the 51 and 52 operate 1200 hours on one internal battery, and accept any K type or J type thermocouple having a standard mini-connector plug. They offer 0.1°C resolution and an exceptionally high level of accuracy. A general-purpose 4-foot bead probe is included with the 51; two with the 52.

The sophisticated Fluke 52 Digital Thermometer will measure temperature of two points simultaneously or display the difference only. The Min/Max storage feature and SCAN mode elevate the Fluke 52 to the ranks of the world's first (and smallest) handheld temperature data logger and scanner.



Fluke 51



Fluke 52

Fluke 51 and 52 Digital Thermometers

- Self-test
- J or K-type thermocouples
- °F or °C display
- Hold function
- Single thermocouple input
- 1°C or 0.1°C (1°F or 0.2°F) resolution, selectable

Additional Features for the Fluke 52 Digital Thermometer

- Dual thermocouple input
- Differential temperature (T₁-T₂)
- Scan function (T₁, T₂, T₁-T₂, ...)
- Min/Max record
- 1°C or 0.1°C (1°F or 0.2°F) resolution, selectable

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 (T₁ and T₂) allow two individual points to be monitored, and provide information for the differential mode (T₁ minus T₂). A MIN/MAX register is available for any input (T₁, T₂, or T₁-T₂). At power-up the user can select a "scan" mode, which scrolls through the three modes in a T₁, T₂, T₁-T₂ continuous sequence. Also selectable at power-up is the choice of high resolution (0.1°C or 0.2°F) or low resolution (1°C or 1°F) readouts.

Specifications

Temperature Scale: Celsius or Fahrenheit user-selectable
Resolution: 1°C or 0.1°C and 1°F 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 page 68

Digital Thermometers

Fluke 51/52

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 page 68

Model	Accuracy ±(% of Rdg + °C)		Accuracy ±(% of Rdg + °F)	
	Type K	Type J	Type K	Type J
51	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% + 0.7°C	0.1% + 0.8°C	0.1% + 1.3°F	0.1% + 1.4°F
	0.1% + 1.0°C	0.1% + 1.2°C	0.1% + 1.8°F	0.1% + 2.2°F

*Typical accuracy only

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 T₁ and T₂ 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)

General Specifications

Battery: Standard 9V battery (NEDA 1604, 6F22, or 006P)

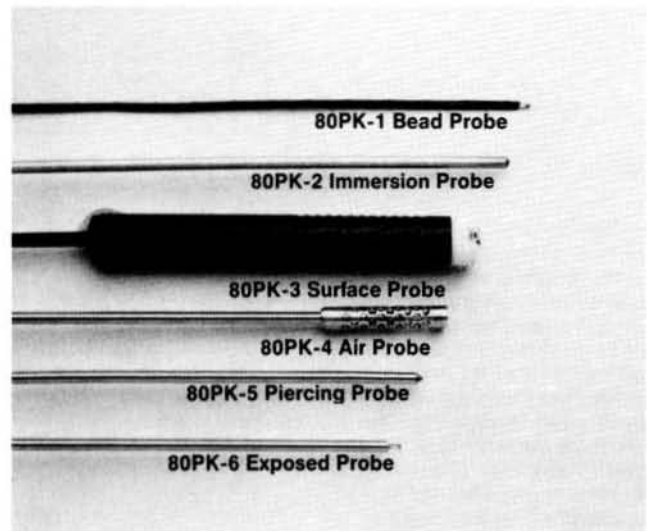
Battery Life: 1200 hours. Low battery indicator appears when less than 50 hours of battery life remain

Safety: Protection Class III as defined in IEC 348, Safety Requirements for Electronic Apparatus

Size: 2.84 cm x 7.49 cm x 16.64 cm (1.12 in x 2.95 in x 6.55 in)

Weight: 280 gm (10 oz)

Included: Battery, 80PK-1 probe for air type measurements (two with the 52), and operator's manual



See page 68 for specifications.

Models

February 1987 prices

51 Digital Thermometer	\$119
52 Digital Thermometer, 2 input, MIN/MAX Mode	189

Accessories (Also see page 284)

80PK-1 Bead Probe 0°C to 260°C	12
80PK-2 Immersion Probe -196°C to 927°C	32
80PK-3 Surface Probe -28°C to 260°C	69
80PK-4 Air Probe -196°C to 816°C	42
80PK-5 Piercing Probe -196°C to 816°C	36
80PK-6 Exposed Probe -196°C to 927°C	34
80CK-M Male Type K Mini Connector (pkg. of 2)	6
C50 Compact Soft Case	12
C70 Protective Holster	9

Service & Support



2160A



2170A

2160A/2170A Panel-Mount Thermometers

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 2170A are physically and electrically compatible with the 2161A Multipoint Selector and the 2162A Digital Limit Comparator.



2161A

2161A Panel-Mount Multipoint Selector

The Model 2161A Multipoint Selector is a panel-mounting, manually switched selector that allows 1 to 10 thermocouple probes of the same type to function as the input to the 2160A, or 2170A or other thermocouple thermometers. Two or more 2161As can be connected in series for monitoring more than ten inputs.



2162A

2162A Panel-Mount Limit Comparator

A panel-mounting, single-limit comparator with attached cable and plug compatible with 2160A or 2170A. Front panel thumb-wheel switches allow you to select polarity, four limit digits, and high or low limit. Resolution is $\pm 1^\circ$. An out-of-limit reading generates a visual indication and a contact closure. Two 2162As can be connected in parallel for two-limit requirements.



2165A

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 ($^\circ\text{F}/^\circ\text{C}$), and battery charge (ON-OFF). Resolution is 1°F or 1°C.



2166A

2166A Multipoint Digital 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

2168A Multitype Digital Thermometer

The 2168A is a portable, single-point instrument capable of accepting the output from any one of eight thermocouple types.

Digital Thermometers

2160A/2170A Series

Performance specifications are identical to the 2160A for each thermocouple type. Front panel controls include pushbutton power switch (ON-OFF) and temperature scale selection ($^{\circ}\text{F}/^{\circ}\text{C}$), 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**

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 ($^{\circ}\text{F}/^{\circ}\text{C}$), and battery charge. Resolution is 0.1°F or 0.1°C .



2176A

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

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 $^{\circ}\text{C}$ to $^{\circ}\text{F}$: 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 M Ω

Input Current: 500 pA

Source Impedance: 5 k Ω (5 k Ω causes $<0.2^{\circ}\text{C}$ 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 $\pm 0.1\%$ with 1 k Ω source impedance unbalance

Normal Mode Rejection: ≥ 60 dB at 50, 60, 400 Hz $\pm 0.1\%$

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 Specifications

Thermocouple Type	Applicable Temperature Range $^{\circ}\text{C}$	Maximum Error** ($\pm^{\circ}\text{C}$)			Applicable Temperature Range $^{\circ}\text{F}$	Maximum Error** ($\pm^{\circ}\text{F}$)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 66 to 86°F	1 Year 59 to 95°F
J	-200 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	-200 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	-200 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	-200 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 1778	1.5	2.5	3	32 to 3232	2	4	5
S	0 to 1778	1.5	2	3	32 to 3232	2	3.5	4.5
B	533 to 1844	1.5	2	2.5	992 to 3352	2	3.5	4.5
C*	0 to 2328	2.5	3.5	4	32 to 3999	4	6	6.5

* 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 Specifications

Thermocouple Type	Applicable Temperature Range $^{\circ}\text{C}$	Maximum Error* ($\pm^{\circ}\text{C}$)			Applicable Temperature Range $^{\circ}\text{F}$	Maximum Error* ($\pm^{\circ}\text{F}$)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 66 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.

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)

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 recharged 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 data. Output data is solicited by an 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 $\pm 0.5\%$ 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: $\leq 90\%$ from 0°C to 35°C, $\leq 80\%$ to 50°C, non-condensing

Line Operation: 115V ac $\pm 10\%$, 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

Weight

2165A 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: Instruction manual, power cord. Thermocouple or thermocouple probe not included

Models

February 1987 prices

2160A*	Thermometer (panel-mount)	\$440
2161A	Multipoint Selector (panel-mount)	200
2162A	Digital Limit Comparator (panel-mount)	370
2165A	Thermometer	575
2166A*	Thermometer (10 points)	680
2168A	Thermometer (8 types)	810
2170A*	Thermometer (panel-mount)	480
2175A*	Thermometer	675
2176A*	Thermometer (10 points)	800

* Specify thermocouple type to be used. Thermocouples or probes not included.

Options

2165A-01* Rechargeable Batteries

2160A-02** Digital Output (w/cable)

2160A-04** Analog Output (w/cable)

* For 2165A and 2175A only

** Mutually exclusive

Accessories (Also see page 284)

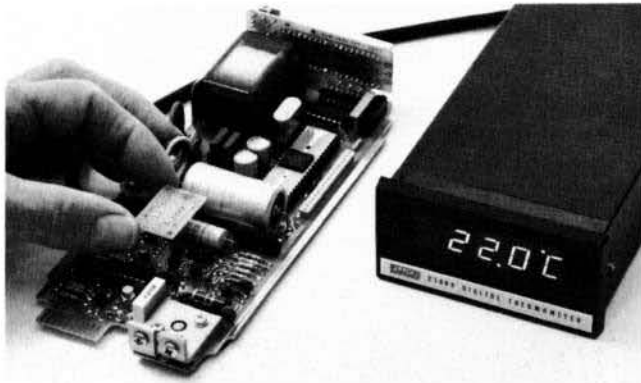
See next page.

Service & Support

Ordering Information (See page 306)

Digital Thermometers

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

Y2005

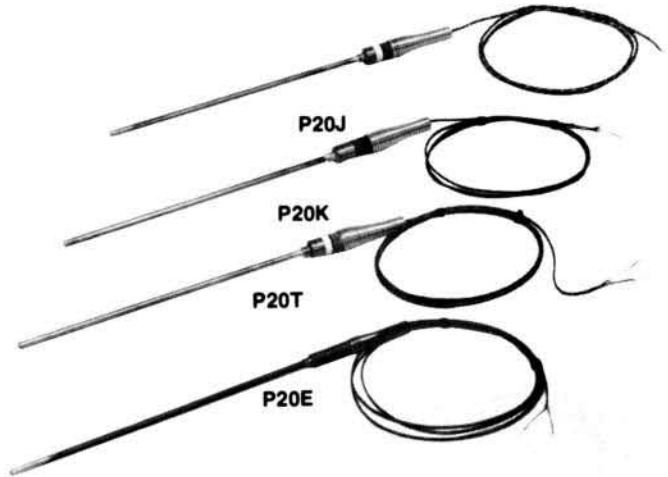
Y2004 & Y2005 Case and Battery Pack

The Y2004 consists of a case, 12-volt battery pack, and charger for use with the 2166A, 2168A, and 2176A. The Y2005 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.

Y2004 Case/Battery Pack & Charger

Y2005 Case



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 and 2170-Series Digital Thermometers.

The 80PK, Type K Series Probes shown on page 888 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 875°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



(NSN 6625-01-136-9346) **8520A/PRT**

Precision — with RTDs

- -183°C to +350°C (IPTS 68) range
- $\pm 0.010^\circ\text{C}$ accuracy -100°C to +100°C
- 0.001°C resolution
- Reading storage memory
- 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 degree 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.

162N PRT Characteristics

All PRTs exhibit hysteresis during temperature cycling, as with going from room temperature to boiling and back. The 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 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 page 21 for more information.

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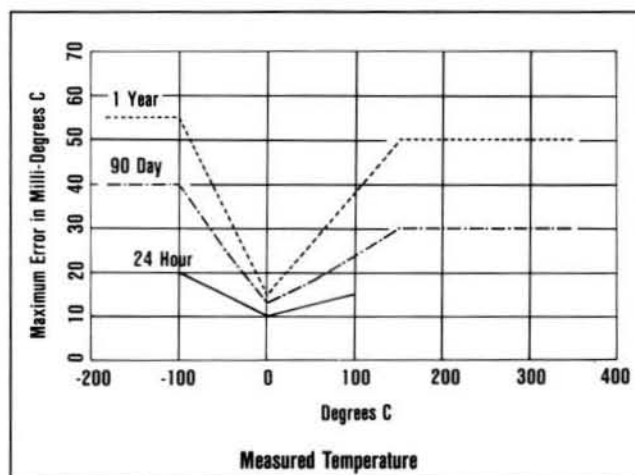
Accuracy

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, $\pm 10\%$, 50 to 60 Hz, $\leq 50\text{W}$

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)

Model

8520A/PRT

Option

8520A-010 Extended Software Package



2180A/2189A/2190A

IEEE-488

RS-232



2189A Thermometry System

2180A/2189A/2190A TempPak 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 through an integral latching system
- °C or °F is selectable via a front panel switch
- A full five digit LED display
- Analog and digital (RS-232-C or IEEE-488) output option is available
- The limits option allows peak and valley memory, alarms and delta
- The 2189A consists of a 2180A and a matched platinum RTD probe for greater accuracy
- Six different RTD types are switch selectable. Four platinum, one nickel, one copper (2180A only)
- Fifteen different thermocouple linearizations are supported including two DIN and three JIS standards (2190A Series)

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 platinum, one nickel, and one copper. Resolution is 0.01°.

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. Resolution is 0.1°. 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

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 preset maximum or minimum set-point is exceeded. Peak Memory stores the highest and lowest temperature readings for later recall. And Delta automatically subtracts a thumbwheel setting from the actual measurement and displays the difference.

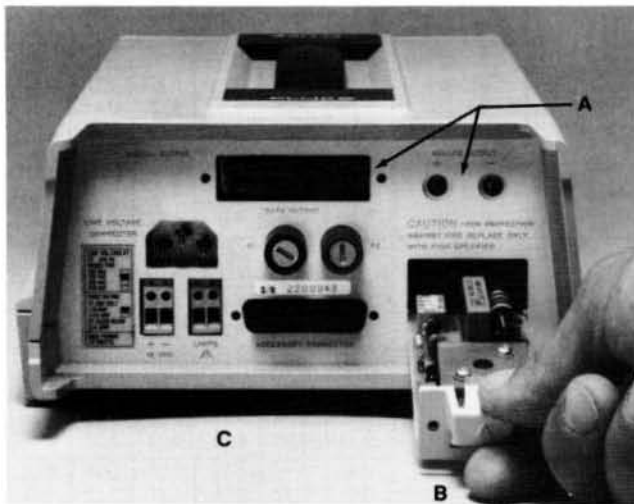
IEEE-488 Option (-004)

The 21X0-004 is an 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. Not for use in a 2300A Scanner System.

Output Option (-002)

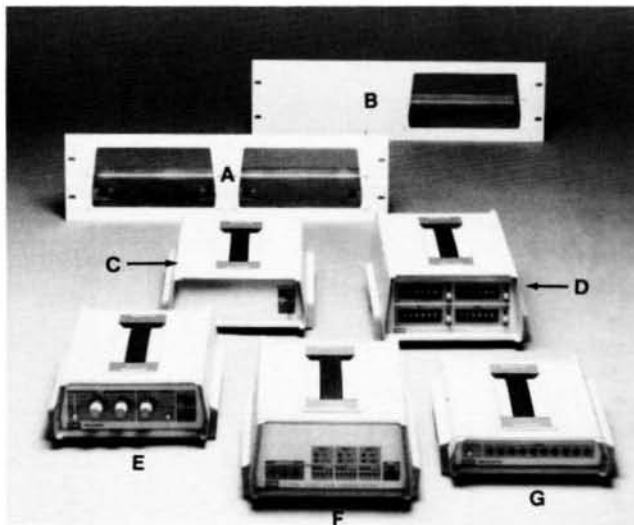
For recording temperature measurements with a 2180A, 2189A or 2190A, you can get Output Option -002. It provides both an analog output for chart recorders and a digital output for printers or computers, and may be installed in the field. The digital output is available in four forms, depending on connector 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.

A Family of Accessories



A — Y2001 Multipoint
B — Y2010 Rack Adapter
C — Y2009 Battery Pack
D — Y2002 Alarms Output

E — Y2003 Calibrator
F — 1120A Translator
G — Y2000 Multipoint



Y2000



Y2001

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 measurement 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



Y2009

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 the batteries are low, while an automatic out-off prevents damage to the cells from excessive discharge.

Specifications

2180A RTD Thermometer Specifications

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* = 0.0038994 DELTA* = 1.494 A4* = -0.265668×10^{-4} C4* = $-0.205984 \times 10^{-11}$
100Ω 3916 Pt	ALPHA* = 0.003916 DELTA* = 1.505 A4* = -0.099668×10^{-5} C4* = $-0.271142 \times 10^{-12}$
100Ω 392 Pt	ALPHA* = 0.0039221 DELTA* = 1.493 A4* = -0.38668×10^{-5} C4* = $+0.192912 \times 10^{-13}$
100Ω 617 Ni	DIN** 43760 Table
10Ω*** Cu	R0 = 9.042 Ohms R25 = 10.005 Ohms ALPHA = 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 10 ohm, 3 wire applications

2180A Accuracy (Type 2)*

Type	RTDs	Maximum Error*					
		±Degrees C			±Degrees F		
		At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C	At Cal	90 Days 68°F to 86°F	1 Year 59°F to 95°F
100Ω 385 Pt	-190 to 0	0.043	0.089	0.112	0.076	0.161	0.203
	0 to 204	0.043	0.132	0.173	0.076	0.239	0.314
100Ω 390 Pt	-190 to 0	0.11	0.12	0.14	0.18	0.21	0.24
	0 to 750	0.11	0.26	0.37	0.18	0.46	0.62
100Ω 390 Pt	-200 to 0	0.009	0.055	0.078	0.015	0.100	0.142
	0 to 204	0.009	0.098	0.139	0.015	0.177	0.252
100Ω 390 Pt	-200 to 0	0.08	0.10	0.11	0.13	0.16	0.19
	0 to 750	0.08	0.23	0.32	0.13	0.41	0.57
100Ω 3916 Pt	-200 to 0	0.040	0.086	0.109	0.071	0.156	0.198
	0 to 204	0.040	0.13	0.171	0.071	0.234	0.309
100Ω 3916 Pt	-200 to 0	0.11	0.12	0.14	0.17	0.21	0.24
	0 to 750	0.10	0.26	0.34	0.17	0.46	0.62
100Ω 392 Pt	-200 to 0	0.008	0.055	0.078	0.014	0.099	0.141
	0 to 204	0.009	0.098	0.139	0.014	0.177	0.252
100Ω 392 Pt	-200 to 0	0.08	0.10	0.11	0.12	0.16	0.19
	0 to 750	0.08	0.23	0.32	0.12	0.41	0.57
100Ω 617 Ni	-60 to 0	0.129	0.157	0.172	0.230	0.282	0.308
	0 to 93	0.129	0.176	0.199	0.231	0.317	0.359
10Ω Cu	-60 to 0	0.19	0.20	0.21	0.33	0.35	0.35
	0 to 177	0.19	0.22	0.25	0.33	0.39	0.44
Ohms	-75 to 0	0.16	0.18	0.19	0.27	0.31	0.34
	0 to 150	0.16	0.20	0.23	0.27	0.35	0.41
Ohms	0 to 196.99	0.005	0.042	0.059	All Units in Ohms		
	0 to 999.99	0.05	0.22	0.31			

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 Specifications

Includes Platinum RTD Probe Y2039.

Maximum System Error (±°C)

Temperature °C	At Calibration	90 Days 18°C-28°C Ambient	1 Year 18°C-28°C Ambient
-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*

Temperature °C	At Calibration	90 Days 18°C-28°C Ambient	1 Year 18°C-28°C Ambient
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
200°C to 350°C
350°C to 480°C

Total Exposure Time Before Adjustment
500 hours
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 Thermocouple Thermometer Specifications

Thermocouple Types: Five, switch selectable. Which thermocouple types depends on your choice of microcomputer type. See Accuracy chart below

2190A Accuracy*

Thermocouples		Maximum Error*					
		±Degrees C			±Degrees F		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days to 20°C to 30°C	1 Year to 15°C to 35°C	At Cal	90 Days to 68°F to 86°F	1 Year to 59°F to 95°F
Type 1							
J	-128 to 0 0 to 900	0.18	0.19	0.21	0.20	0.23	0.26
K	-132 to 0 0 to 1350	0.18	0.19	0.21	0.30	0.33	0.37
T	-243 to 0 0 to 400	0.18	0.20	0.22	0.30	0.35	0.39
R	0 to 1708	0.31	0.59	0.70	0.47	1.01	1.20
C**	0 to 2471	0.18	0.60	0.75	0.30	1.11	1.37
Type 2							
J	-128 to 0 0 to 900	0.18	0.19	0.21	0.20	0.23	0.26
K	-132 to 0 0 to 1350	0.18	0.19	0.21	0.30	0.33	0.37
E	-252 to 0 0 to 1000	0.18	0.20	0.22	0.30	0.35	0.40
R	0 to 1708	0.31	0.59	0.70	0.47	1.01	1.20
S	0 to 1685	0.22	0.50	0.60	0.38	0.92	1.10
Type 3							
J	-100 to 0	0.18	0.19	0.20	0.30	0.32	0.36
DIN***	0 to 760	0.18	0.28	0.33	0.30	0.52	0.61
K	-50 to 0 0 to 1372	0.18	0.18	0.20	0.20	0.22	0.25
T	-200 to 0	0.18	0.20	0.21	0.30	0.34	0.38
DIN***	0 to 400	0.18	0.22	0.25	0.30	0.41	0.46
B	420 to 1815	0.21	0.52	0.62	0.37	0.95	1.15
R	140 to 1700	0.18	0.46	0.46	0.20	0.74	0.93

* Total instrument accuracy. Does not include Thermocouple errors
** C designates Tungsten-5% Rhenium vs. Tungsten-26% Rhenium.
*** DIN is a European Standard.

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 a flashing "OC"

2190A/AM Multi-Linearization Thermometer

2190A/AMK Model 2190A/AM Retrofitting Kit

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 N and D linearizations.

Specifications are equivalent to those of the standard 2190A except for:
Thermocouple Types Supported: J, K, T, C, R, E, S, B, N and D, J DIN, T DIN, J JIS, K JIS, R JIS

Option Specifications

Output Option (-002)

Analog Output

Type: Linearized and isolated

Voltage: 1.0 mV/°C or °F from -425 mV to 4.5V, 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; not with Y2002

IEEE-488 Option (-004)

Repertoire: SH1, AH1, T6, L0, SR1, RLO, PPO, DCO, DTO, CO, E2

Service Request Usable: Yes

Power: Operates only when powered by AC line

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°

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

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)

2180A/2189A/2190A

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
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)

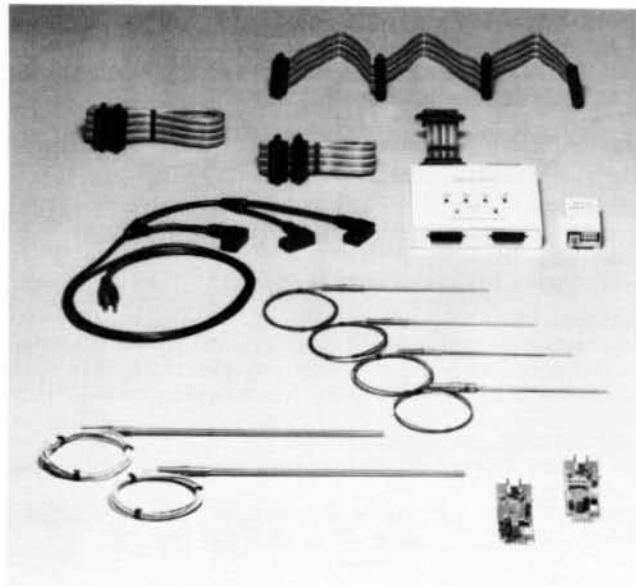
Y2003 Thermocouple Calibrator and Battery Pack

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 1/2-D-size cells in drip-proof case
Operating Time: 5 to 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 $\pm 10\%$ 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 ($\div 10$ or $\div 100$)
Input Voltage: 0-10V dc
Output Impedance: 100 Ω
Precision Resistor: 100 $\Omega \pm 0.01\Omega$, 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: 100 $\Omega \pm 0.1\Omega$ at 0°C
Temperature Range: -80°C to +480°C
Curve Conformity: $\pm 0.1\%$ of temperature using IPTS 68 with ALPHA = 0.0038994 and DELTA = 1.494
Stability: Periodic usage (20% of time) $\pm 0.03^\circ\text{C}$ if used from 0°C to 200°C and $\pm 0.22^\circ\text{C}$ if used from -80°C to +480°C
Hysteresis: Less than $\pm 0.08^\circ\text{C}$ when using 0°C and 200°C as end points
Immersion Effects: $\pm 0.005^\circ\text{C}$ 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: 100 $\Omega \pm 0.1\Omega$ at 0°C
Temperature Range: -183°C to +480°C
Performance Standard: $R_{100}/R_0 = 1.3922$, 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 m Ω /year when exposed at 200°C or 20 m Ω in 250 hours when exposed at 480°C measured with probe at 0°C. 4 m Ω = 0.01°C + 0.004% 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 Impedance: 1000 MΩ at dc
Accessory Connector: 25-pin rear panel receptacle interfaces thermometer to Y2000, Y2001, Y2002, 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
Weight: 2.1 kg (4.63 lb)
Safety: (2180A and 2190A only) Factory Mutual 3820 approved, CSA 556B certified
Included: Instruction manual, power cord. Probes are not included

Models

RTD Thermometers

2180A Type 2 Linearizations*
 2189A System

*Contact factory for 3-wire 10Ω copper applications

Thermocouple Thermometer

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
 Also see page 188, 2383A and 2393A Temperature Logging Systems

Options**

21X0A-002* Output, Analog and Multiple Digital
 21X0A-004 IEEE-488 Output
 21X0A-006 Limits

Note: Above options are field-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 2300A Scanner, unless analog output is also needed. Mutually exclusive with 21X0A-004.

** All options are customer installable.

Accessories (Also see page 284)

P20J* Thermocouple Probe
 P20K* Thermocouple Probe
 P20T* Thermocouple Probe
 P20E* Thermocouple Probe
 Y2000 Multipoint Selector for RTDs
 Y2001 Multipoint Selector for Thermocouples
 Y2002 Alarms Output Module
 Y2003 Thermocouple Calibrator/Battery Pack
 Y2009 Battery Pack, Rechargeable
 Y2022 Thermometer Calibration Divider
 Y2026B RS-232-C Cable Adapter
 Y2030 Thermocouple Input Module
 Y2031 RTD Input Module
 Y2023 Size C PTI Case w/drawer
 Y2024 3-Module Power Cord
 Y2036 PTI Polling Cable
 Y2037 RTD Probe 100Ω 390 PT
 Y2039 RTD Probe 100Ω 392 PT
 Y7203 2-ft 36-pin PTI Cable
 Y7204 5-ft 36-pin PTI Cable
 *See page 178 for specs

Also see page 191, 2030A Printer/Plotter; page 186, 2300A Scanner and page 134, IEEE-488 Translator.

Service & Support

Temperature Scanner

2300A TempPak Series



RS-232



2300A

2300A Temperature Scanner

- Can be used with either thermocouples or RTDs
- Capable of scanning 20 points, and 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 either through a switch setting or programmed from the front panel
- Two interface options. One provides remote programming capabilities
- LED display specifies the channel being monitored
- Two different types of thermocouples or RTDs can be used per input card
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- 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.

Scanning may be done manually one channel at a time, with keystrokes at the front panel, or automatically. Readings also may be printed at pre-selected intervals using either a Fluke 2030A Printer or a 2020A 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.

For preconfigured Temperature Logging System, see the 2383A and 2393A on page 188.

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 on page 200.

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.

Interface Card Options (-005 & -006)

Two interface options are available. One or the other is required and only one may be installed at a time. Either option will interface to either a 2180A or 2190A, and both provide RS-232-C output for communication to external printers or computers. Only Option -006 allows remote control of the Scanner, however, via either a bi-directional RS-232-C link or via the IEEE-488 bus (with the 1120A Translator). No interface option is required for a 2301A Scanner Extender.

The Y2026B RS-232-C 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. Or you can wire your own cable to the connector provided.

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: One Interface Option (-005 or -006) and at least one Scanner Card Option (-002 or -003). Also, one to three scanner card options per 2301A Extender Chassis

IEEE-488 System: Requires 1120A Translator with Option 2XXXA-522 installed and Y7203 PTI cable

RS-232-C Compatibility: Y2026B Cable/Adapter recommended

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

Interface Option (-005)

Interface Option -005 includes an attached accessory cable with a 25-pin male connector that plugs into the back of a 2180A or 2190A Digital Thermometer. The Option also provides a rear panel 36-pin connector for outputs to printers and computers

Interface & Remote Control Option (-006)

Option -006 provides all the features of Option -005 plus the capability to be remotely programmed via the 1120A IEEE-488 Translator or RS-232-C terminal

36-Pin Connector (option -005 or -006)

The Portable Test Instrument (PTI) connector is used to transfer information from a 2300A Scanner and 2180A or 2190A 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, temperature 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 Y20206B Cable/Adapter is strongly recommended for transmitting RS-232-C signals

RS-232-C Signals: Transmitted Data, Request To Send, Clear To Send, Data Set Ready, Data Terminal Ready, Ground. Source and controlled sink of 20 mA for TTY current loop operation. 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 2XXXXA-522 installed. Interface functions SH1, AH1, T6, L4 (with Option -006 only), SR1 can be implemented

I/O Connections: Same as Option -005 except 36-pin connector also used for remote control inputs

Signals: Same as Option -005 plus Received Data, Received Line Signal Detector, and Scanner Busy (for RS-232-C). TTY current loop is available as an output but cannot be used to send programming commands

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 lines of IEEE-488 bus via the 1120A Translator or on the Received Data line via an RS-232-C device

Command Characters & Meanings

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

General Specifications

Ambient Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤75% to 50°C, operating; ≤95% 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 2300A Scanner mainframe

Size: Style D PTI case, 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in) 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

2300A: Instruction manual, power cord, attached cable for 2180A or 2190A

2301A: Instruction manual, attached cable for 2300A or another 2301A

Models

2300A Scanner

2301A Extender Chassis

Interfacing a 2300A Scanner/Thermometer combination to the IEEE Bus requires a Y7203 or Y7204 Cable, the 1120A Translator and the 2XXXXA-522 Personality Card. The 21X0A-002 or 21X0A-004 thermometer options are not required.

Options

2300A-002 Thermocouple Scanner Card

2300A-003 RTD Scanner Card

2300A-005* Interface and Output

2300A-006* Interface, Output and Remote Control

** Includes attached ribbon cable for 2180A or 2190A. For factory or Service Center installation only.*

Accessories (Also see page 284)

1120A IEEE-488 Translator

2XXXXA-522* Personality Card for 1120A

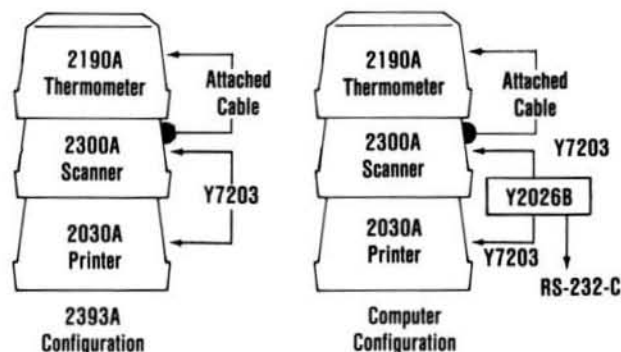
Y7203 36-Pin PTI Cable, 2 ft

Y7204 36-Pin PTI Cable, 5 ft

Y2026B** RS-232-C Cable/Adapter

** Required with 1120A Translator for IEEE-488 compatibility. Y7203 or Y7204 Cable also required.*

*** Includes cable for connection to 2300A. Has both male and female 25-pin RS-232-C connectors and switches for handshake flexibility. Also has second 36-pin connector for 2030A Printer.*



Service & Support

Temperature Logging Systems

2383A/2393A TempPak Series



2393A Temperature Logging System

2383A/2393A TempPak Series

- Completely configured and tested temperature logging systems
- Capable of running off of 12V dc or ac line power
- 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 2030A Printer 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 on page 200.

The following chart shows the component parts of the two systems.

System Components

Items Included	RTDs	Thermocouples	See Page
	2383A	2393A	
2180A Thermometer	1	—	180
2190A Thermometer	—	1	180
2300A Scanner	1	1	186
Option -005	1	1	187
Option -003*	1	—	186
Option -002*	—	1	186
2030A Printer	1	1	191
Y2203 Cable	1	1	
Y2024 Power Cord	1	1	

* Ten channels per option. One additional option may be installed in the 2300A. 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 listed above for the specifications and performance characteristics of the instruments and options comprising each system.

Models

2383A RTD System with 2030A Printer

2393A T/C System with 2030A Printer

Service & Support



RS-232



2020A With Option -006

2020A Universal Printer

- 20-column thermal printer for recording data from a variety of instruments
- Three different interface options are available: RS-232-C, 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

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. The following chart gives a quick comparison of the two printers.

2020A Universal Printer

The Fluke 2020A is a 20-column thermal printer with three interchangeable data interface options. Whether you need 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.

Comparison of 2020A and 2030A Printers

Features	2020A	2030A
Prints		
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 limit 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 Instrument Controller or similar computer.

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 through 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.

Specifications

Option Specifications

RS-232-C Interface (-002)

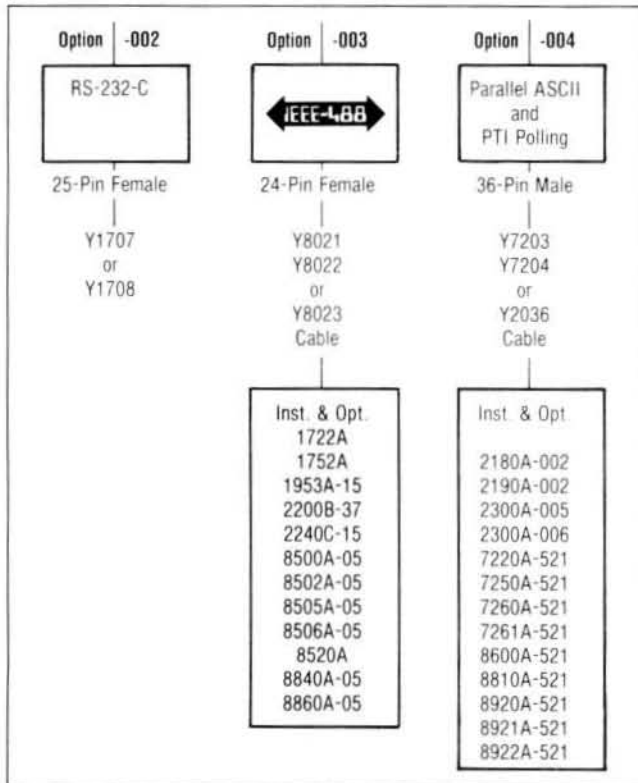
Input Connector: Standard 25-pin, female

Signals: Transmitted Data, Clear to Send, Data Set Ready, Signal Ground, Received Line Signal Detector

Universal & Computing Printer

2020A TempPak Series

Your choice of three field-installable interface circuit cards.



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)

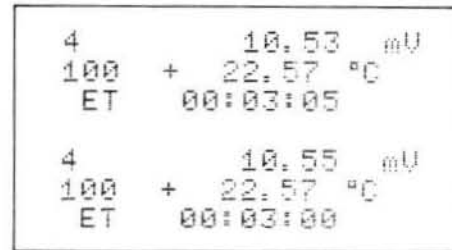
Input Connector: Standard 24-pin, female
Signals: Per IEEE Std 488-1978
Modes: Listen only or Addressable Listen, Switch-selectable
Repertoire: AH1, L1
Character Set: 64 upper case ASCII plus °, f, k, m, n, p, Ω, μ, z
Graphic Printing: Dotted trace activated by receipt of the following binary-coded decimal 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, 2300A; Adr 2 — 7250A, 7260A, 7261A; Adr 3 — 7220A; Adr 4 — 8920A, 8921A, 8922A; Adr 6,7,8,9 — 2180A, 2190A, 2300A
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.

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 (74 m)
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 x 8.05 in x 12.85 in)
Weight: Approximately 9 lb with paper
Included: Instruction manual, power cord, one roll of paper

Model

2020A Printer

Each printer requires one interface option and can only use one at a time.

Options

202XA-002 RS-232-C Interface
202XA-003 Interface for IEEE-488
202XA-004* PTI Polling Interface
202XA-006 Time Interval Print

All options field-installable. Cables not included.

*Accepts Y7203 or Y7204.

Accessories (Also see page 284)

Y2036* PTI Polling Cable
Y7203 2-ft Cable, 36-Pin, PTI
Y7204 5-ft Cable, 36-Pin, PTI
Y8021 1m Cable for IEEE-488 bus
Y8022 2m Cable for IEEE-488 bus
Y8023 4m Cable for IEEE-488 bus
Y2035 Thermal Paper, box of 10 rolls

*Used when 2 or 3 PTI instruments are to be simultaneously connected to 2020A via Option -004. Use two cables for 4 or 5 instruments.

Service & Support



2030A

2030A Computing Printer

- 20-column thermal printer for recording data from a variety of instruments
- Multi-instrument 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 one 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 the 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.

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

- 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.

Universal & Computing Printer

2030A TempPak Series

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 2½ 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-005, 2300A-006, 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 2300A 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.

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, 40VA maximum

Size: PTI style D case — 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)

Weight: Approximately 9 lb with paper

Included: Manual, power cord, one roll of paper

Model

2030A Printer w/Fluke PTI Interface

Interconnecting cables not included. Order Y7203 or Y7204

Accessories (Also see page 284)

Y2016 7" Rack Adapter, Single

Y2017 7" Rack Adapter, Double

Y2021 Panel Mounting Kit

Y2035 Thermal Paper, box of 10 rolls

Y2036* PTI Polling Cable

Y7203 2 ft Cable, 36 pin PTI

Y7204 5 ft Cable, 36 pin PTI

*Required when 2 or 3 measurement instruments are simultaneously connected to the 2030A. Use two cables for 4 or 5 instruments.

Service & Support



2190A/2030A Graphics Capabilities

Data Acquisition



Whether you need a complete system or an OEM component, Fluke has a reliable measurement and control solution for you. Aids like industry standard communications, software tools, and PC-compatible analysis packages make our data acquisition equipment simple to set up, integrate and use.

Our 1752A Data Acquisition System, with powerful real-time processing, is Fluke's highest-speed system for manufacturing and product testing. A touch-sensitive display presents a friendly interface and helps eliminate operator error.

Helios-I Computer Front End and Labtech Notebook team up for a complete PC-based system. Menu-prompted set-up 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 acquisition solution for a wide variety of tests and processes. It provides the user with the computing power of the 1752A and the 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.



Selection Guide

Measurement	2285B	2280B	1752A	2400B*	2452MCS	HELIOS-I*
Thermocouples	11 Types	11 Types	7 Types**	12 Types	12 Types	11 Types
RTDs	All Types	All Types	All 100 ohm pt. 385**	All Types	All Types	All Types
Resistance	To 64K	To 64K	—	To 64K	To 64K	To 64K
DC Voltage Ranges	64 mV-64V	64 mV-64V	100 mV-100V	100 mV-100V	100 mV-100V	64 mV-64V
Max DC Resolution	1 μ V	1 μ V	124 μ V	1 μ V	1 μ V	0.5 μ V
AC Voltage Ranges	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
Strain Gage	Yes	Yes	Yes**	Yes	Yes	Yes
BCD	Yes	Yes	Yes	Yes	Yes	Yes
Binary	Yes	Yes	Yes	Yes	Yes	Yes
Status (Contacts)	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
Event Totalize	Yes	Yes	Yes	Yes	Yes	Yes
Sequence of Events	—	—	—	Yes	Yes	—
Control						
Status or Alarms	0-100	0-1500	0-160	0-1024	0-1024	0-1500
Int Relays (Max)	1	1	—	0-1024	0-1024	—
User-Defined BCD	Yes	Yes	Yes	Yes	Yes	Yes
Analog Voltage	—	To \pm 10V	To \pm 10V	To \pm 10V	To \pm 10V	To \pm 10V
Analog Current	—	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	—
Stepper Motor	—	—	—	Yes	Yes	—

*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	2280B	1752A	2400B	2452MCS	HELIOS-I
Accuracy (dc V)	\pm .005%	\pm .005%	\pm .02%	\pm .002%	\pm .002%	\pm .005%
Speed (CH/S)	15	15*	1000*	25	25 (High Resolution) 1000 (Medium Resolution)	16*
Programming Environment	Menu Prompted	Menu Prompted	BASIC FORTRAN Assembly C	Fluke Measurement & Control Language	BASIC FORTRAN Assembly Pro Gen C	Dependent on Host
Operator Interface	Membrane Keypad	Membrane Keypad	Touch-Sensitive Display	Via Host	Touch-Sensitive Display	Via Host
Analog Input Channels	100	1500	128	1000	1128	1500
RS-232/IEEE-488	OPT	OPT	STD	OPT	STD	RS-232-C STD
12V DC Operation	Yes	Yes	No	No	No	Yes
Memory Expansion	None	None	3.0M + Bytes	None	3.0M + Bytes	None
Graphics	Plot	Plot	Dot Address	Via Host	Dot Address	Via Host
Permanent Data Storage	Host	Cartridge Tape	-Disk -Bubble	-Eprom -Host	-Disk -Bubble	Host
Built-in Printer	Yes	Yes	No	No	No	No
Battery Back-up	Program, Clock	Program, Clock	Clock	None	Clock	Definitions, Clock
Software for IBM PC	Yes	Yes	—	Yes	—	Yes

*Higher speeds possible with Multiple A/D Converters

Helios-I (2289A)

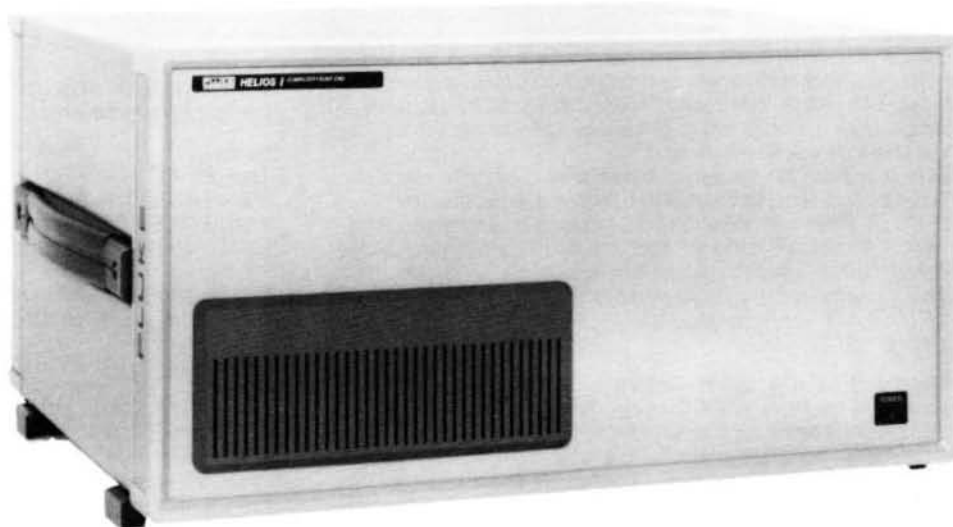


Speeding Up The Measurement Process. For automated thermal testing of power supplies, a major computer manufacturing company chose Fluke's Helios-I to speed up the measurement and analysis of temperature, humidity and DC voltage. Helios-I reduced system cost by also being able to control the environmental testing chambers' temperature. Helios' streamlined, self-documenting command set reduced programming time

and startup costs. The front-end's expandable channel count and highly-repeatable, noise-free measurements ensure meaningful data necessary to validate manufacturing procedures.

Helios-I is a precision data acquisition computer front end. It is a computer tool built to Fluke standards of precision, flexibility and ruggedness at a price that makes it the natural choice of system builders.

Helios-I is intended for the growing number of engineers who wish to add real-world measurement capability to their personal computer, mini-computer or mainframe. Helios-I is suitable for use in a wide range of applications from industrial process monitoring to laboratory measurements, engine testing to environmental testing.



Helios-I

Helios-I Computer Front End

- Wide range of measurement and control options
- Eliminates many hardware integration problems
- Simple and powerful instructions
- Supports modem communication
- Software available for total solution

Performance

You can use Helios-I to add high performance measurement capability to any of your computers, from lap-top to mainframe. Helios-I uses the same data acquisition and control options as the Fluke 2280 Series. These options have been proven in thousands of applications world-wide. You can be confident that your system will perform accurately and reliably for years to come.

Helios-I gives your computer the power to read:

- Voltage
- Frequency
- Temperature
- Flow
- Strain
- Pressure
- Speed
- Many, many more...

The high performance Analog to Digital Converter in conjunction with data conversion capabilities built into Helios-I means unsurpassed resolution, repeatability and accuracy in thermocouple, RTD and strain gage measurements.

These proprietary algorithms are both highly efficient and very

accurate. They are optimized for Helios-I hardware giving performance that would be hard to match if routines had to be written that run in the host computer.

Value

Helios-I is designed to give you best price/performance hardware solution available for computer based measurement and control applications. Combine this with Fluke's commitment to support and service and you have a system that will continue to return value for years to come.

Hardware Configuration

You can configure Helios-I to meet your exact needs. One Helios-I mainframe can house up to 6 I/O modules, each with 20 channels. Communication between the CPU and the I/O modules is by means of a high speed serial link.

A wide range of I/O cards is available. Several of them are multifunctional and as such are time and cost savers where a wide range of inputs is necessary or configuration changes frequently.

Extended Systems

Remote expansion chassis are available to bring the total configuration to 1500 channels. The distance between an extender chassis and the mainframe may be up to 1200 meters. Connections may be made in daisy chain, star and maze configurations so that cable routing can easily be adapted to the physical layout of your facility.

Multiple Helios-I units may be arranged in a multidrop configuration. This allows you to address up to 10 Helios-I units on a serial link.

Helios-I (2289A)

LabTech Notebook Software

Fluke and Laboratory Technologies Corp. have teamed up to create a complete system for data acquisition and control. LABTECH Notebook® transforms the IBM® PC, XT or AT and compatibles along with Helios-I into a powerful data acquisition, analysis and real-time display system which requires no programming.

Data generated using Helios-I and LABTECH Notebook® are recorded in formats compatible with major analysis, spreadsheet and database programs. These include LOTUS 1-2-3®, Symphony®, RS/1® and NWASStatpak.®

Menu driven format makes the operator interface easy to learn and to use. Complicated procedures can be reduced to single button operations. The result for you is fast system setup and increased efficiency in operation. Once the measurement and control activities are defined they can be stored on disk for easy recall.

Data acquisition can be started immediately or triggered externally. Data can be time stamped with either time of day or relative time.

LABTECH Notebook® allows other PC programs to be run concurrently. LABTECH Notebook® performs data acquisition and control in the background while another program operates in the foreground. Your efficiency is increased considerably especially during long tests.

Prologger_HCL

Prologger_HCL is a communications utility for the IBM Personal Computer and the Fluke Helios Computer Front End. This software tool establishes serial communication with Helios-I and links Helios-I and the IBM to provide data acquisition capability for the IBM. Extensive use of IBM function keys and windowing provide an easy to use package.

This software package provides an environment in which you can record data from Helios-I in LOTUS 1-2-3 format, log data to a printer, create and save definitions and Macros on disk, graph in real time a selected Helios-I parameter and remotely control Helios-I.

Prologger_HCL includes diskette and manual. Prologger_HCL is compatible with MS-DOS™ version 2.1 and above.

Helios-I is a trademark of John Fluke Mfg. Co., Inc. LABTECH is a registered trademark of Laboratory Technologies Corporation; IBM is a registered trademark of International Business Machine Corporation; Lotus 1-2-3 and Symphony are trademarks of Lotus Development Corporation; RS/1 is a trademark of BBN Software Products Company; NWASStatpak is a trademark of Northwest Analytical, Inc.

Command Set

If you desire to configure Helios-I with your own host computer software, Helios-I provides an environment that makes this interaction easy to create.

The Helios-I Operating System (HOS) resides in ROM together with the Helios-I Command Line Interpreter (HCLI). HOS takes care of task scheduling and contains driver software to control the functioning of the hardware. HCLI analyses the commands and translates them into appropriate actions.

Only six types of commands are necessary to control Helios-I. Each has various parameters to change the scope of operation giving a command set that is conceptually easy yet flexible.

ASSIGNMENT: Assigns a value to a system variable or output channel.
DEFINITION: Identifies the type of sensors connected to Helios-I and interpolation tables for each sensor.

LIST: Returns to the host computer channel definitions and user defined interpolation tables.

RESET: Resets system or specified channels to power up state.

SEND: Returns data to host computer.

TEST: Tests all or part of the system and reports any detected problems.

Specifications

Helios-I Mainframe (2289A)

The Helios-I mainframe is a cardcage unit that includes the CPU, power supply, RS-232 and RS-422 interfaces.

Controller

CPU: Texas Instruments TMS-9995, 16 bit, 12 MHz clockrate

Memory: 40K bytes ROM, 72K bytes non-volatile RAM

Clock/Calendar: Accuracy 0.003% or 2.6 seconds/day at 25°C; battery backed

Battery Back-Up: 90 days typical, 30 days minimum

Interface: On board command interpreter for high level instructions

Interfaces

Type: RS-232 or RS-422; asynchronous; selectable baud rate, parity, character bits and stop bits

Protocol: XON/XOFF or none; terminal or computer mode

RS-232: Compatible with auto-answer, full duplex modems; automatic hang-up

RS-422: Allows operation at extended distances from the host computer; allows point to point or multidrop configurations

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 accommodates 20 channels so that up to 100 channels per chassis is available. Each digital I/O option accommodates 20 channels so that up to 120 channels per chassis is available.

Power: 90-132V ac or 180-264V ac; 47-440 Hz; less than 40W

EMI and RFI Emissions: Tested to FCC part 15, Subpart J, Class A; VDE 0871, Class B

Operating Temperature: 0°C to 50°C

Storage Temperature: -40°C to 70°C

Relative Humidity: (without condensation) below 25°C, <95%; 25°C to 40°C, <75%; 40°C to 50°C, <45%

Altitude: 12 km (40,000 ft), non-operating; 3 km (10,000 ft), operating

Shock and Vibration: Meets MIL-T-28800C, Class 5, Style F Standard

Weight: 8.5 kg (18.7 lb) without options

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), (8.75 in H without feet)

2281A Extender Chassis

Capacity: Same as mainframe. Multiple extender chassis allow up to 1500 channels.

Power: Normally supplied by Helios-I via 2281A-402 cable or equal. An optional built-in power supply, 2281A-431, may also be used and may be required for some configurations.

Operating Temperature: -20°C to +70°C

Options

High Performance A/D Converter Option (-161)

One per 2289A and 2281A required for any analog measurement inputs.

Dynamic Range: 100,000 counts

Ranges: ±64 mV, ±512 mV, ±8V, and ±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: ≥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

Measurement and Output Selection Guide

	Connector	Scanner	Channels	Max Channels/ Chassis
Thermocouple	-175	-162 ¹	20	100
Direct Voltage	-175 or -176	-162 ¹	20	100
Direct Current	-171	-162 ¹	20	100
Alternating Voltage	-160	-162 ¹	10 ch. V= 10 ch. V=	50 ch. V= 50 ch. V=
RTD	-177	-163 ¹	20	100
RTD	-174	-164 ^{1,2}	20	40
Resistance	-177	-163 ¹	20	100
Resistance	-174	-164 ^{1,2}	20	40
Strain Gauge	-174	-164 ^{1,2}	20	40
Frequency/ Event Counting	Included	-167	6	36
Status Input	-179	-168	20	120
Binary Input	-179	-168	1	6
BCD Input	-179	-168	1	6
Status Output	-169	-168	20	120
Analog Output	Included	-170	4	24

¹ A/D Converter (-161) required in each chassis

² 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

Voltage, Thermocouple Current 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 M Ω on 64 mV and 512 mV ranges, 10 M Ω on 8V, and 64 ranges

Thermal Offset: ≤ 1 μ V 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

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: \pm (% of Rdg + Volts)*

Range	Resolution		90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year** 0°C to 50°C
	50 Hz	60 Hz			
64 mV	.83 μ V	1 μ V	0.005%+7 μ V	0.01%+8 μ V	0.03%+9 μ V
512 mV	8.3 μ V	10 μ V	0.005%+30	0.01%+40	0.03%+50
8 mV	83 μ V	100 μ V	0.005%+700	0.01%+800	0.03%+900
64V	.83 mV	1 mV	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

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

Temperature Measurement Accuracy, Thermocouples*

Thermocouples		Accuracy ^{1,3}		
Type & Range	Temperature	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year ² 0°C to 50°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 838	-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: 8 Ω \pm 0.02 Ω

DC Current Accuracy: \pm (0.25% of reading + 4 counts) for 90 days

Compatibility: Plugs onto scanner module, Option -162

AC 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 \pm 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; 256 Ω , 2048 Ω , and 64 k Ω (or user selectable), software programmed

Current Sources: Two; 1 mA and 32 μ A (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



Helios-I (2289A)

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	0.006°C	0.1°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°C**	0.04°C**
B	-200 to +150°C	0.006°C	0.10°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°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	0.28°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.

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 @ 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 mΩ	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	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.

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
100 Platinum RTDs	
-200°C to +200°C	0.1°C
200°C to 600°C	0.15°C
10 Copper RTDs	
-75°C to +150°C	1.0°C

* Total Instrument Accuracy. For 90 days, 13°C to 33°C.

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 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)

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 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 Option

Analog Output Option (-170)

Outputs: Four per module. Each output has a selectable choice of ranges: -5V to +5V, 0V to +10V, or 4 to 20 mA

Resolution: 2.44 mV in voltage ranges, 3.9 μ A in current range

Accuracy: \pm 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

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 Fluke 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

Models

2289A Helios-I Mainframe

22810A Helios-I (including -161, -162 and -175)

2281A Extender Chassis

Hardware Options

2289A-160 AC Voltage Connector

2289A-161 High Performance A/D Converter

2289A-162 Thermocouple/DC Voltage Connector

2289A-163 RTD/Resistance Scanner

2289A-164 Transducer Excitation Assembly

2289A-167 Counter/Totalizer, w/connector

2289A-168 Digital I/O Assembly

2289A-169 Status Output Connector

2289A-170 Analog Output Assembly w/connector

2289A-171 Current Input Assembly

2289A-174 Transducer Excitation Assembly

2289A-175 Thermocouple Input Connector

2289A-176 DC Voltage Connector

2289A-177 RTD/Resistance Connector

2289A-179 Digital/Status Connector

2289A-402 Extender Chassis Cable

2289A-403 Connector Pair for -402 Cable

2289A-431 Extender Chassis Power Supply

Software Options

S2289 ProLogger_HCL Application Software

S2290 LABTECH Notebook Application Software

Accessories (Also see page 284)

Y1702 RS-232C Null Modem Cable, 2m

Y1703 RS-232C Null Modem Cable, 4m

Y1705 RS-232C Null Modem Cable, 30cm

Y1707 RS-232C Standard Cable, 2m

Y1708 RS-232C Standard Cable, 10m

Y2044 24" Rack Slide and 8 $\frac{3}{4}$ " Rack Mount Kit

Y2045 8 $\frac{3}{4}$ " Rack Mount Kit

Y2047 Extender Chassis 3-Way Connector

Sales & Support

Data Loggers

2280 Series



RS-232

The 2280 SERIES, a family of advanced data loggers, combines high measurement accuracy, exceptional configurational flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2280B Data Logging System, offers solutions for demanding data acquisition and reporting problems.



2280B

2280B Data Logging System

- Fluke's most powerful data logger
- Expandable to 1500 channels*
- Precision measurements and control
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

The 2280B Data Logging System, Fluke's most powerful data logger, is expandable from a simple 20 channel data logger to a distributed 1500 point data acquisition system. The 2280B Data Logging System accepts all 2280 SERIES options, offers the ultimate in data logging power and flexibility.

*Depending on programming requirements.



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

For applications that do not require all the power or expansion capabilities of the 2280B 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), Cartridge Tape (-214), and Advanced Math (-211) options.

Programming Ease

Both the 2285B and 2280B 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 employ 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 offer 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.

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 character vacuum fluorescent display, or logged on the wide format 40 character internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232-C or IEEE-488 interfaces. An optional DC100 magnetic tape drive is also available for the 2280B Data Logging System, allowing 500K bytes of data and/or programs to be saved on each tape.

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. 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

Extender Chassis: As many 2281As as needed

Maximum Inputs & Outputs: ≤ 1500 points per system (2280B); ≤ 100 points per system (2285B)

Analog Inputs: ≤ 1500 channels per system (2280B), ≤ 100 channels per system (2285B)

Status, Binary, or BCD Inputs: ≤ 1500 lines per system (2280B), ≤ 100 lines per system (2285B)

Status Outputs: ≤ 1500 points per system (2280B); ≤ 100 points per system (2285B)

Alarm Outputs: ≤ 1500 points per system (2280B); ≤ 100 points per system (2285B)

Analog Outputs: ≤ 600 points per system (2280B only)

Computation Power: Besides built-in thermocouple and RTD linearizations, the 2280 SERIES will handle equations involving addition, subtraction, multiplication, division, and parentheses. Advanced Math Option (-211) (2280B 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 Option

Up to 30 channels per second with 2 A/D Options

Up to 42 channels per second with 3 A/D Options

Up to 65 channels per second with 5 A/D Options

Temperature: 0°C to 50°C operating (2280B/2285B); -20°C to 70°C operating (2281A)

System Communications: High speed digital data transferred between 2281As and a 2280B/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 2280B/2285B

Failures: System component failures are reported as an alarm. All properly operating equipment continues with normal tasks

2280 SERIES Mainframe

CPU: Uses multiple 8-bit microprocessors with 128K bytes of ROM

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, each 2280B/2285B 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 (2280B); 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 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 $\pm 10\%$, 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

Included: 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 2280B/2285B

Power: Normally supplied by 2280B/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

DC 100 Tape Drive Option (-214) (2280B only)

Used to store both scanned data and data logger programs. A single tape can contain multiple files of programs and/or data as the operator chooses. The tape is formatted with a directory which may be listed on the printer.

Four data compression formats are selectable for data recorded. Storage capacity is 500K bytes which is 11,300 to 41,600 channel readings dependent upon format selection.

Recorded data may be transferred to the internal printer or peripheral devices. The data transfer function permits data recorded at full speed to be transferred to a slower device such as the internal printer. The operator may transfer an entire file or part of a file based upon the time the data was recorded. For example, if a file contains data from a 24-hour test, the operator may only be interested in printing information gathered between 2:00 p.m. and 3:00 p.m. The operator enters these "start" and "stop" times and the 2280B searches for and transfers only those scans which were executed in the 2 to 3 p.m. time span.

One blank DC 100 tape cartridge is included with Option -214.

Advanced Math Option (-211) (2280B 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 2280B/2285B and 2281A required for any analog measurement inputs. ≤ 15 total per system

Dynamic Range: 80,000 counts

Ranges: ± 64 mV, ± 512 mV, ± 8 V, and ± 64 V dc

Resolution: 1 μ V on 64 mV range, 10 μ V on 512 mV range, 100 μ V on 8V range, 1 mV on 64V range

Common Mode Noise Rejection: ≥ 170 dB at 50 or 60 Hz $\pm 0.1\%$; ≥ 160 dB at dc; 100 ohm unbalance

Normal Mode Noise Rejection: ≥ 60 dB at 50 or 60 Hz $\pm 0.1\%$

Operating Temperature: -20°C to +70°C

2280B/2285B & 2281A Input Options

For These Inputs	Use Connector Option	With Scanner Option	Maximum Inputs Per Scanner
Thermocouples	-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	None Req.	-167	6 (2280B only)
Totalize Events	-179	-167/AA	4
Totalize Events	None Req.	-167	6 (2280B 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 Current 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 M Ω on 64 mV and 512 mV ranges, 10 M Ω on 8V, and 64 ranges

Thermal Offset: ≤ 1 μ V 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

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: \pm (% of R_{dg} + Counts)*

Range	90 Days 15°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
8 mV	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

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

Temperature Measurement Accuracy, Thermocouples*

Thermocouples		Accuracy ^{1 2}		
Type & Range	Temperature	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year ² -20°C to 70°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	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: 8 Ω \pm 0.02 Ω

DC Current Accuracy: \pm (0.25% of reading + 4 counts) for 90 days

Compatibility: Plugs onto scanner module, Option -162

AC 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 \pm 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	0.006°C	0.1°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°C**	0.04°C**
B	-200 to +150°C	0.006°C	0.10°C**	0.04°C**
	+150 to +420°C	0.006°C	0.15°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	0.28°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 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	0.6 mΩ	0.06% ±1.22 Ω	0.0075% ±1.22 Ω

* 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 2280B/2285B 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	0.02% + 7	1 mΩ	1 mA
512Ω	0.02% + 30	10 mΩ	1 mA
Other ranges that may be set by user			
5.12 kΩ	Depends on user's resistor	0.1Ω	0.1 mA
51.2 kΩ		1Ω	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: 0.02ΩC

Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100 Platinum RTDs	
-200°C to +200°C	0.1°C
200°C to 600°C	0.15°C
10 Copper RTDs	
-75°C to +150°C	1.0°C

* Total Instrument Accuracy. For 90 days, 13°C to 33°C.

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 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) (2280B 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. Pseudo channels are used for count accumulation

Connector: Screw terminal connector supplied

Frequency Measurement and Event Totalization (-167/AA)

Channels: Four

Functions: Event counting and frequency, selectable by channel

2280 Series

Inputs

Signal Types: TTL or contacts

Adjustments: None

Isolation: Each group of four channels isolated from ground

Frequency Measurement: 1000 Hz 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 1000 Hz

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 Option

Analog Output Option (-170) [2280B only]

Outputs: Four per module. Each output has a selectable choice of ranges: -5V to +5V, 0V to +10V, or 4 to 20 mA

Resolution: 2.44 mV in voltage ranges, 3.9 μ A in current range

Accuracy: $\pm 0.1\%$ 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, 2400, 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 accessible 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 Extender Chassis Option (-431)

Although power for a 2281A is normally supplied by a 2280B/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 Fluke 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

Y2042: Package of five DC 100 tape cartridges certified for use with Tape Drive Unit (Option -214).

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 2280B/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.

A22-300: A heavy-duty transit case constructed from high-density polyethylene specifically for the 2280B/2285B. Foam padding, cut to conform to the 2280A/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 x 25.1 in x 30.1 in).



S2280 ProLogger Software

- For use with an IBM®-PC and the Fluke 2280 SERIES Data Loggers
- Accommodates full operation of the 2280B or 2285B from the IBM®-PC, XT, AT or compatibles
- Transfers data from the 2280 SERIES to disk in Lotus 1-2-3™ format

ProLogger Software is a tool which links the IBM®-PC, XT, or AT with a Fluke 2280 SERIES Data Logger to form a powerful 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 2280B's 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 a -341 RS-232-C Interface Option.

Models

- 2280B Data Logging System
- 2285B Data Logger
- 2281A Extender Chassis

2280 SERIES Options

- 2280A-160 AC & DC Input Connector
- 2280A-161 High Performance A/D Converter
- 2280A-162 Thermocouple & DC Voltage Scanner
- 2280A-163 RTD & Ohms Scanner
- 2280A-164 RTD, Ohms, Strain Excitation
- 2280B-167 Counter/Totalizer, 6 Channel
- 2280A-167/AA Counter/Totalizer, 4 Channel
- 2280A-168 Digital or Status Input/Output
- 2280A-169 Status Output Connector
- 2280A-170 Analog Output
- 2280A-171 Current Input Connector
- 2280A-174 Transducer Excitation Connector
- 2280A-175 Isothermal Input Connector
- 2280A-176 DC Voltage Input Connector
- 2280A-177 RTD, Ohms, Connector
- 2280A-179 Digital/Status Input Connector
- 2280A-211* Advanced Math Processor
- 2280A-214* DC 100 Tape Drive Unit
- 2280A-341 RS-232 Interface
- 2280A-342 IEEE-488 Interface
- 2281A-402 Connecting Cable (per meter)
- 2281A-403 Connectors for Option -402
- 2281A-431 Power Supply for 2281A

*Factory or Service Center installation only. Others user-installable.

2280 SERIES Accessories (Also see page 284)

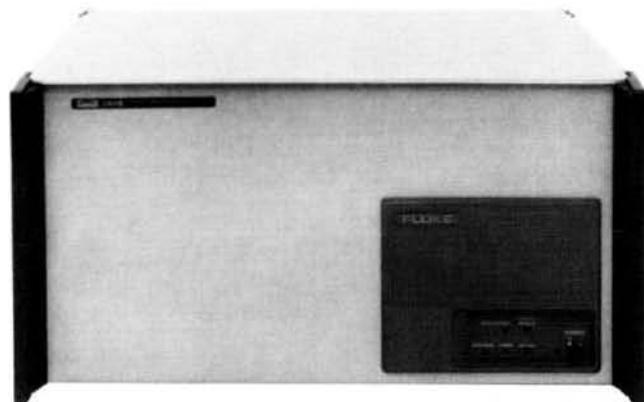
- Y2042 Pack of 5 DC 100 Cartridges
- Y2044 Rack Slide Kit and Rack Mount Kit
- Y2045 Rack Mount Kit
- Y2046 Pack of 10 Rolls Printer Paper
- Y2047 Extender Chassis Multi-Connector
- A22-300 Transit Case for 2280 SERIES
- S2280 ProLogger Software

Service & Support

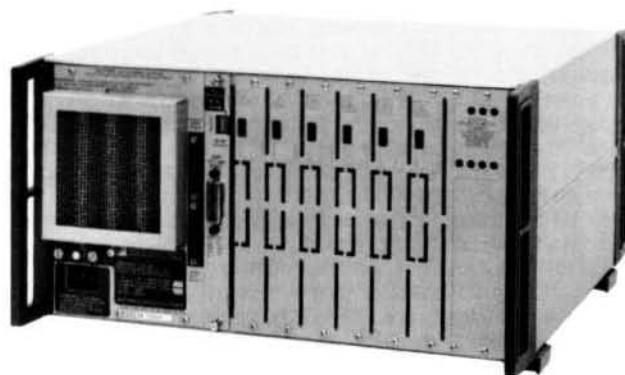
2400B



RS-232



2400B



2400B Rear Panel

2400B Intelligent Computer Front End

- Handles nearly any I/O requirement with an extensive selection of options
- Modularly expandable (over 3000 total channels) to meet future application demands
- High accuracy analog measurements — even in electrically noisy environments
- Interface to nearly any computer via RS-232-C, RS-422, IEEE-488, or current loop
- Self documenting, structured program language — optimized for measurement and control
- A data acquisition "computer" unto itself — measures, alarms, and controls independent of host
- 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 with programmable control output signals. The system serves as an interface between a computer and 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. This intelligent system 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, IEEE-488, or 20 mA current loop compatibility. The Fluke 1722A Instrument Controller interfaces well with the 2400B and the combination (called a 2452MCS) is described in the 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), and strain, or certain other transducers.

Built-in linearizations are available for a wide variety of thermocouples. RTD linearizations are software-selectable by individually programming the parameters for different probes, assuring best possible 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 fast-changing events immediately while the Sequence of Events Option records events with up to 0.1 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.

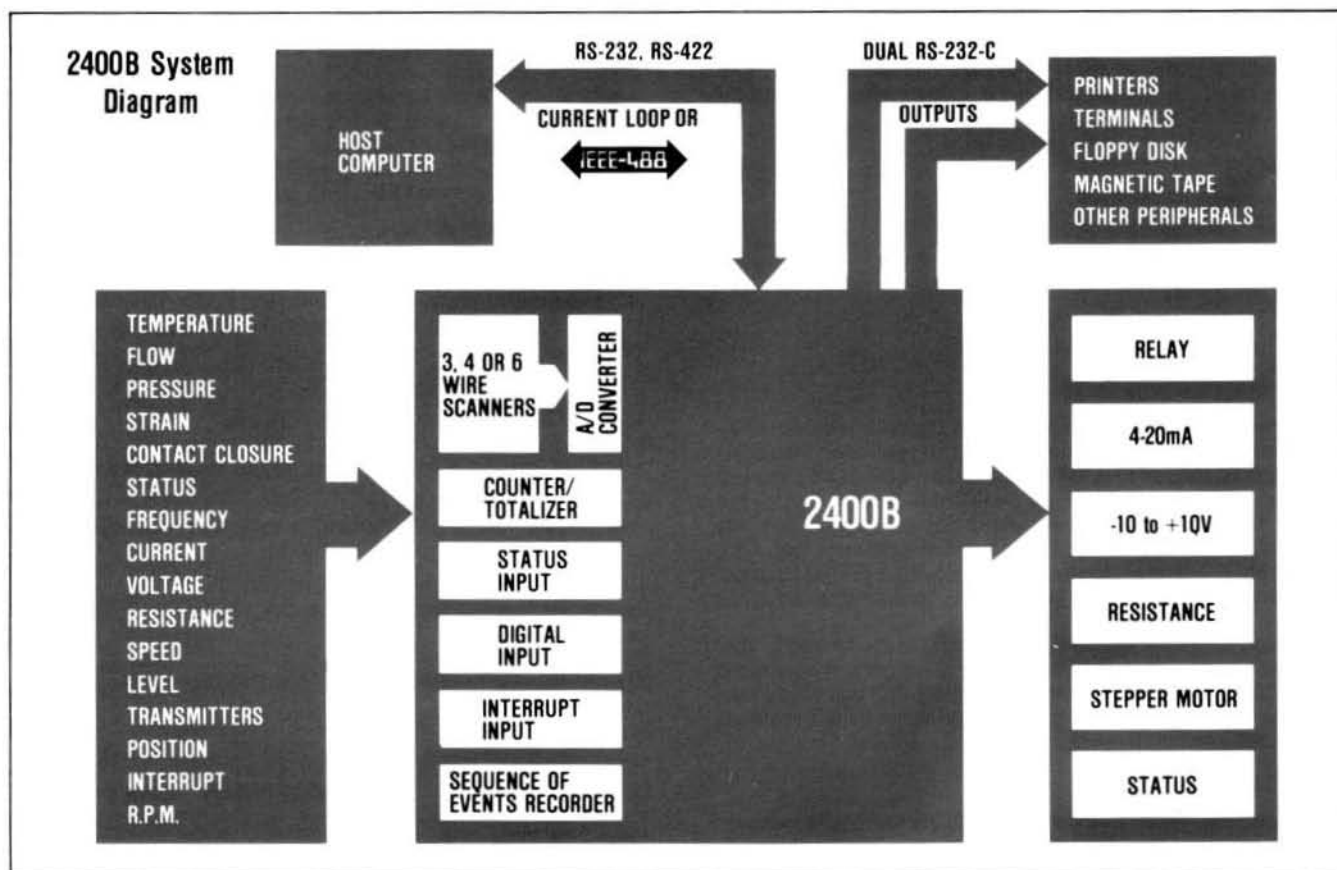
Outputs

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 output 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 or deceleration 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 mainframe 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.

Immediate Mode

Immediate-mode (host) commands cause an immediate response in the 2400B. For instance, if the host computer tells the 2400B to:

```
SEND AI(16)!
```

the 2400B will perform a reading on analog input channel 16 and return the result to the host computer. (Immediate-mode commands end with the "!" character). The command

```
AO(0)=0.155*AI(2)-1.2!
```

will cause the 2400B to read Analog Input channel 2, multiply it by 0.155, subtract 1.2 and set Analog Output channel 0 to that value.

To gain maximum flexibility from the 2400B's wide range of input and output options, the definition-bus command is used (DEFN). To define analog input channels 10 through 29 as type "J" thermocouples, you would send the 2400B the following command:

```
DEFN
AICHAN=10 TO 29,SENSOR=TC,TYPE=JNBS;
!
```

This command, however, differs from the previously discussed commands: It is stored in the 2400B's memory, and is used whenever readings on channels 10 to 29 are requested. So, when the command

```
SEND AI(11)+AI(15)!
```

is sent to the 2400B, the measurements (complete with autozero, range selection, and thermocouple linearization) would be performed on analog inputs 11 and 15, returning the sum to the host in degrees Celsius.

Stored Program Operation

The second level of 2400B software is the stored program, a set of instructions downloaded to the 2400B at start-up. This program allows the 2400B to operate independently, with only occasional communication with the host computer. A full set of mathematical functions enables the 2400B to perform complex linearizations, data averaging, proportional integral derivative loops, and more, on its own.

The "IF-THEN-ELSE" statement allows conditional execution of statements or program segments. LOOP and AGAIN statements allow repeated execution of program tasks. The command

```
SCAN POINTS(0), 0 to 199;
```

reads channels 0 to 199 in accordance with their respective definitions with a single instruction, avoiding the necessity of writing a complete subroutine — often necessary in other less intelligent systems.

Experienced programmers will appreciate the modularity and readability added to programs due to function and procedure (subroutine) constructs. Procedures may be called directly from the stored program or invoked by external or time-triggered interrupts.



Since the stored program is resident in the 2400B itself, communications to the host computer are minimized or non-existent. This results in less complex programs, as well as faster execution speeds. For example, the following simple program performs a complete proportional control loop with limit checking:

```
PROG
SETPT=150;
LIMIT=185;
OFFSET=7.5;
GAIN=0.15;
LOOP:
  TEMP=AI(10);
  IF TEMP > LIMIT THEN SO(6)=1;
  AO(4)=GAIN*(TEMP-SETPT)+OFFSET;
AGAIN;
!
```

In this program, the LOOP and AGAIN cause repeated execution of the three statements nested inside them. The first of these stores the reading on analog input channel 10 in the variable TEMP. If the DEFN statement shown above had been sent to the 2400B prior to execution of this program, this reading would have been in degrees Celsius. Next, the second statement checks to see if the temperature is above the limit. If so, status output 6 will be set to one, which could ring a bell, for instance. Finally, analog output 4 would be set to the voltage computed in the formula.

While this program is executing, a bus command can be used to alter any of the variables used in the program. For instance, the command SETPT=155! could be used to change the setpoint. This capability allows interactive reprogramming of the 2400B, while the 2400B continues program execution.

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 1780A InfoTouch® Display 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 troublefree 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 wire-pairs
Interrupt Inputs: ≤32 electrically isolated wire pairs
Counter-Totalizer Inputs: ≤32 isolated analog and ≤32 non-isolated TTL inputs
Status Outputs: ≤1024 electrically isolated wire-pairs
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: ≤32 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

CPU: 16-bit microprocessor, 32K-byte EPROM, 28K-byte RAM

Serial Outputs: EIA Standard RS-232-C, two ports, output only

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. Listed in order of increasing level of error detection capability they are

- Simple terminal
- Simple terminal with XON/XOFF
- Simple terminal with XON/XOFF and timeout
- Blocked format with acknowledgements
- Blocked format with acknowledgements and check character

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: 15 meters (50 feet) from 2400B or 2403A. A 2-meter cable included

Power: From 2400B or 2403A

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

Power: Line power required

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 2401s. 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)

Power: Line power required

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

Overrange: Autoranges, unless autorange defeated. Overload causes front panel ERROR light to turn on and message available to host computer
Resolution: 17

Voltage, Current, Thermocouple Inputs

High Performance Scanner Option (-101)

Ten 3-wire dry reed relays (Hi, Lo, shield).

Life: Rated for >10⁸ operations with ≤50V ac rms applied; >10⁷ operations with ≤250V ac rms applied

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 snap-apart plastic safety housing. Integral reference junction correction for 0°C. Plugs into Scanner Module (Option -101).

Temperature Measurement Accuracy Option (-101, -102)

Measurement may be performed in Celsius, Fahrenheit, Kelvin, or Rankine

Thermo-couple Type	Measured Temperature °C	Maximum Instrument Error (±°C)*					
		24 Hours 21°C-25°C Rdgs/Sec		90 Days 18°C-28°C Rdgs/Sec		1 Year 13°C-33°C Rdgs/Sec	
		3	25	3	25	3	25
J NBS	-200 to +200 +200 to +760	0.2 0.2	0.3 0.3	0.25 0.35	0.35 0.45	0.3 0.4	0.4 0.5
K NBS	-225 to +200 +200 to +1350	0.2 0.2	0.3 0.3	0.25 0.4	0.35 0.5	0.3 0.5	0.4 0.6
T NBS	-230 to +200 +200 to +400	0.2 0.2	0.3 0.3	0.25 0.25	0.35 0.35	0.3 0.3	0.4 0.4
E NBS	-250 to +250 +250 to +1000	0.2 0.2	0.3 0.3	0.25 0.35	0.35 0.45	0.3 0.5	0.4 0.6
R NBS	0 to +200 +200 to +1767	0.4 0.4	0.65 0.65	0.9 0.7	1.15 0.95	1.1 0.9	1.35 1.15
S NBS	0 to +200 +200 to +1767	0.4 0.4	0.65 0.65	0.9 0.7	1.15 0.95	1.1 0.9	1.35 1.15
B NBS	+200 to +1820	0.4	0.75	0.7	1.05	0.9	1.25
J DIN	-200 to +200 +200 to +900	0.2 0.2	0.3 0.3	0.25 0.35	0.35 0.45	0.3 0.4	0.4 0.5
T DIN	-200 to +200 +200 to +600	0.2 0.2	0.3 0.3	0.25 0.25	0.35 0.35	0.3 0.3	0.4 0.4
R JIS	0 to +200 +200 to +1770	0.4 0.4	0.65 0.65	0.9 0.7	1.15 0.95	1.1 0.9	1.35 1.15
N** NBS	-200 to +200 +200 to +1300	0.2 0.2	0.3 0.3	0.25 0.4	0.35 0.5	0.3 0.5	0.4 0.6
C***	0 to +2315	0.4	0.55	0.7	0.85	0.9	1.05

* 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 Input Connector Option (-108)

Ten 3-wire sets of screw terminals for input wires enclosed in snap-apart plastic safety housing. Plugs into scanner module (Option -101)

Range: -100V to +100V

Maximum Voltage: 350V dc or peak ac. See Option -101

DC Voltage Measurement Accuracy: ±(% Rdg+Counts+µV)*

Readings per sec	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			
3	±(0.002%+2+2)	±(0.005%+3+2)	±(0.015%+4+6)
25	±(0.002%+4+4)	±(0.005%+5+4)	±(0.015%+6+6)
100V Range			
3	±(0.008%+2+0)	±(0.01%+3+0)	±(0.02%+4+0)
25	±(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 snap-apart safety housing. Plugs into scanner module (Option -101).

Voltage Range: 5V rms to 250V rms

Frequency Range: 45 Hz to 450 Hz

Conversion Method: ½-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, ¼-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

¼-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

Signal Conditioner Option (-701)

For Ohms, RTD, ¼-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)

Life: >10⁸ operations with <50V applied; >10⁷ operations with <170V peak applied

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 snap-apart plastic safety housing. Plugs into Scanner Module Option (-115)

Maximum Voltage: Same as for Option -115.

½- and Full-Bridge Strain Measurements

Total System Accuracy*

½-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 ½- 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)

Life: $\geq 10^6$ operations with $< 50V$ applied; $> 10^7$ operations with $< 170V$ peak ac applied

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 snap-apart 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

Isolation: Both Analog Input and Isolated Common are isolated from the 2400B and/or ground up to 30V and up to 1.0 V/ μ s maximum slew rate

Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)

Period Range

TTL Input: 1.1 μ s to 6.7s

Analog Input: 5 μ s to 0.1s

Period Resolution: 400 ns

Time Interval Range

TTL Input: 1 μ s to 3.82 hr

Analog Input: 2 μ s to 50 ms

Time Interval Resolution: 819 μ s (≤ 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 μ s to 50,000s

Totalizer Capacity: 4,999,999

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 2400A-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 2400A-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

Interrupt Signal Input Option (-114)

Number of Inputs: 16, isolated in common from the 2400A and/or system ground up to 30V dc or peak ac and 1.0 V/ μ s maximum slew rate

Input Logic: Contact closures or TTL level, switch-selectable

Direct Input Sensitivity: Pulse duration $> 20 \mu$ s

Input Debounce: 5 ms to 88 ms, switch-selectable

Interrupt Transition: Software-selectable by input

Connector Option: Use 2400A-110 or 2400A-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

Resolution: 2.5 mV (13 bits) or 5 μ A (12 bits)

Isolation: $\leq 30V$ dc or peak ac, channel to channel

Max Load: ± 5 mA in voltage mode; $\leq 750\Omega$ in current mode

90-Day Accuracy: ± 20 mV in voltage mode and $\pm 20 \mu$ A in current mode for ambient temperature of 18°C to 28°C

Rate: 250 changes per second

Connector Option: Use 2400A-110 or 2400A-111

Status Output Control Option (-301)

Outputs: 32, open collector, diode clamped. 100 mA at ≤ 1.1 volt each. Common return line.

Isolation: $\leq 30V$ dc or peak ac, channel to channel or channel to ground

Rate: Set or reset at 250 bits per second

Connector Option: Use 2400A-110 or 2400A-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: Connector block integral to Option -301/AA (screw terminals)

Resistance Output Control Option (-305)

Outputs: Two

Isolation: $\leq 30V$ dc or peak ac channel to channel or channel to ground

Values: 0 to 4095 Ω in 1 Ω increments

Power Dissipation: 0.125W maximum

90-Day Accuracy: $\pm 0.1\%$ of full scale 18°C to 28°C ambient

Connector: Four screw terminals supplied with option

Resistance Output Control Option (-306)

Outputs: Two

Isolation: $\leq 30V$ dc or peak ac, channel to channel or channel to ground

Values: 0 to 102,375 Ω in 25 Ω increments

Power Dissipation: 0.125W maximum

90-Day Accuracy: $\pm 0.1\%$ of full scale 18°C to 28°C ambient

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

Input Logic: Contact closure or TTL level

Direct Output Signals: Four-Phase Unipolar Drive, Flyback Protected

Direct Output Current: 375 mA maximum

Logic Output Signals: CW/CCW direction and Step Clock, or CW and CCW Clock Outputs; Busy/Done

Output Logic: Open-collector TTL outputs. Interface to voltages up to 15V dc
Output Pulses: 1 to 1,048,575 CW or CCW
Slew Frequency: 1 Hz to 25.6 kHz, software-selectable
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 3 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 x 16.9 in x 14.96 in) 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: Manual Set, Getting Started Guide and power cord

Models

2400B* Intelligent Computer Front End
 2401A Scanner Extender Chassis
 2402A I/O Extender Chassis
 2403A Remote A/D Extender

Options

2400B-001 Serial Interface
 2400B-002 IEEE-488 Interface
 2400A-101 High Performance Scanner
 2400A-102 Thermocouple Input Connector
 2400A-103 Digital Signal Input
 2400A-104 Status Signal Input
 2400A-104/AA Sequence of Events Recorder
 2400A-106 Current Input Connector
 2400A-108 DC Voltage Input Connector
 2400A-109 High Performance A/D Converter**
 2400A-110 Screw Terminal I/O Connector
 2400A-111 Solder Pin I/O Connector
 2400A-113 Counter/Totalizer Signal Input
 2400A-113/AA 4 Channel Counter/Totalizer
 2400A-114 Interrupt-Signal Input
 2400A-115 Four-Wire Scanner
 2400A-116 Four-Wire Input Connector
 2400A-117 Six-Wire Scanner
 2400A-118 Six-Wire Input Connector
 2400A-119 AC Voltage Input Connector
 2400A-301 Status Output
 2400A-301/AA Relay Output
 2400A-302 Current/Voltage Analog Output
 2400A-305 Resistance Output (1Ω to 4 kΩ)
 2400A-306 Resistance Output (25Ω to 100 kΩ)
 2400A-307 Stepper Motor Control Output
 2400A-401 Scanner Extender Interface
 2400A-402 Extender Cable (custom length)
 2401A-403 Connectors for 2401A-402 Cable
 2402A-501 I/O Extender Interface
 2402A-502 I/O Cable (with connectors, 9m)

2403A-601 Remote A/D Extender Interface
 2403A-602 A/D Extender Cable (custom length)
 2403A-603 Connectors for 2403A-602 Cable
 2400A-701 Signal Conditioner for Ohms, RTD's
 1/4- & 1/2-Bridge Strain Measurements
 2400A-702 Signal Conditioner for 1/2- and Full-Bridge Strain Measurements
**Option -001 or -002 is required*
***Required for analog measurements*

Accessories (Also see page 284)

1780A InfoTouch® Display
 Y8022 2m Cable for RS-232-C
 Y1705 RS-232-C Null Modem Cable
 Y8002 2m Cable for IEEE-488
 Y2053 Rack Adapter w/24" slides
 Y2054 19" Rack Adapter w/o slides
 Y2055 RS-422 Multi-connector

Service & Support

2452MCS

IEEE-488

RS-232-C



2452MCS

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
- Touch sensitive 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 (H) cabinet
- Choice of 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 a double-sided floppy disk. 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 μ V, 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 in to an optional analog measurement processor in the 1752A for 14 bit resolution at 1000 readings per second.

Digital inputs accommodated by the 2452MCS include 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 all 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, Fluke can help — with training classes held either at our offices or at your site. We can also arrange for one of our in-house experts to assist you personally in creating your application-solving software.

Turn-Key Systems

If a turn-key system is what you require, Fluke has an extensive list of recommended software consultants that are experienced with Fluke equipment and capable of fulfilling your needs. The Fluke Customer Support Group is also available to write custom application software and combine with Fluke hardware for a complete system. Information on training classes, Systems Lab, software consultants, and the Customer Support Group is available from your Fluke Sales Engineer or Representative.

Specifications

For complete specifications please refer to the pages in this catalog describing the 1752A and the following pages that describe the 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 2.6M bytes)

Memory, 2400B: 28K bytes of RAM for program storage

Mass Storage

- Double-sided 5¼-inch floppy disk stores 400K bytes
- 800K bytes more with dual floppy disk drive (optional)
- 10M bytes with Winchester Disk (optional)
- 1.3M-byte bubble memory (optional)

1752A Communications Interfaces: One IEEE-488 port and one RS-232-C port is standard. May be expanded to include six additional RS-232-C, RS-422, and/or 20 mA serial ports or 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 x 24 in x 27.8 in)

Weight: 84 kg (185 lb) approximately, not including options

The rack cabinet has a lockable storage drawer and keyboard drawer, a rear door, and associated hardware. Also included are:

- 1752A-1 with Keyboard
- Fluke enhanced BASIC Interpreter, Advanced Editor, File Utility Program
- ProLink II application software package (see page following for description)
- ProComm application software package (-03, -04 only) (see page following 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 and Version	Rack Cabinet 71 cm (28 in) High	2400B Interface and 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)

Models

2452MCS-01

2452MCS-02

2452MCS-03

2452MCS-04

Options

See 2400B and 1752A pages

Accessories (Also see page 284)

A24-89 71 cm Instrument Rack (28 in)

A24-75 183 cm Instrument Rack (6 ft)

A24-90 Wheeled based, 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)

1765B/10 10M-byte Winchester Disk Drive

1765B/20 20M-byte Winchester Disk Drive

1761A External Disk Drive, 2x400K bytes

1760A External Disk Drive, 400K bytes

Service & Support

Measurement & Control Software



RS-232-C

Measurement & Control Software

For the first time, 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 PC,™ PC XT,™ or IBM compatible.

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

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-232-C 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.

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 connected to single 1722A/1752A
- Provides built-in error detection and recovery capability
- Supports communications via modems as well as "hard-wired"

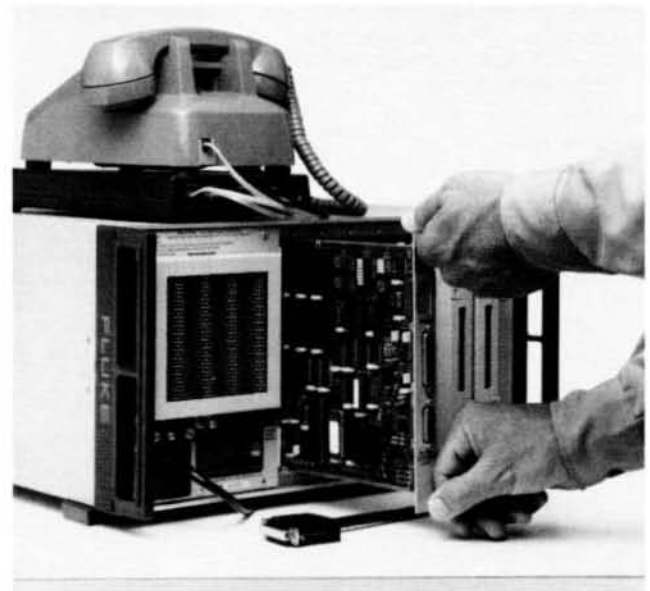
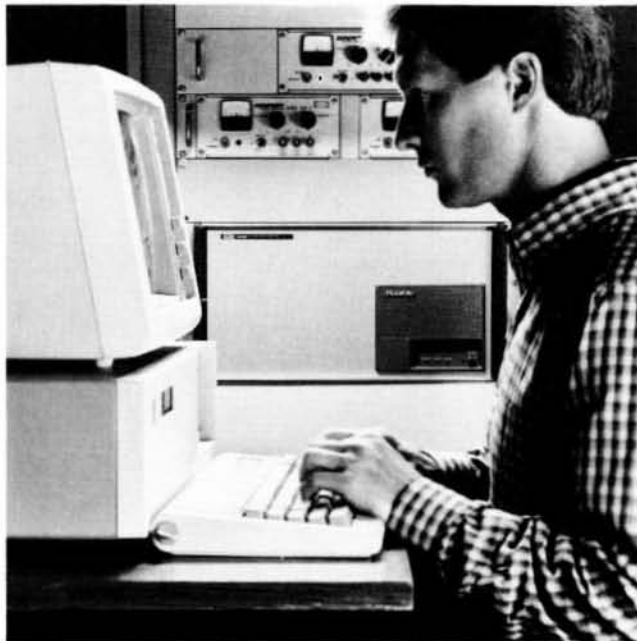
ProComm™ Serial Communications Utility Package comes standard with both serial versions of the 2452MCS, -03 and -04.

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 also 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 autoanswer modem across an RS-232-C interface, ProComm software will automatically hang up the phone line on demand.



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 IEEE-488. A 17XXA-007 512K byte 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 operator can, however, choose to monitor all data, some data, or alarms only. Alarm data is automatically recorded.

ProGen software is the easy way to get your 2452MCS up and running.

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 an optional serial interface installed. Since the PC XT has this interface standard, ProLink PC software will operate directly on the XT. 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-232-C 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
- A data acquisition program

ProLogger 24 is a communications utility and a data acquisition program for the IBM Personal Computer and the Fluke 2400B. Extensive use of IBM function keys and windowing make an easy to use package.

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 use 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 compatible must have a serial interface and MS-DOS 2.1 or higher. A color monitor is not a necessity, 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 option -001 and a serial cable.

ProLogger 24 allows full use of the 2400B stored program capability if desired.

** IBM PC and IBM PC XT are trademarks of International Business Machines, Inc.*

*** MS-DOS is a trademark of MicroSoft, Inc.*

**** LOTUS 1-2-3 is a trademark of Lotus Development Corporation.*

Software Packages

S2400* ProLink II Application Software for 1722A/1752A

S2401 ProLink PC Application Software for MS-DOS

S2402 ProLogger 24 Application Software for MS-DOS

S2417* ProComm Serial Communications Package for 1722A/1752A

S2452 ProGen Application Software for 1722A/1752A

**Included with all 2452MCS Systems*

***Included with 2452MCS-03 and -04*

Data Acquisition System

1752A



RS-232



1752A With Keyboard

1752A Data Acquisition System

- 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
- BASIC. Programmable with real-time and measurement and control extensions
- IEEE-488, RS-232/422, Current Loop and Parallel Interfaces
- Rack mountable with removable keyboard
- Analog Control Option (voltage or current)
- Status Input/Output Option
- Counter/Totalizer Option
- Signal conditioning for dc/ac volts, thermocouples, RTD, strain

The Fluke 1752A Data Acquisition System is a powerful micro-computer-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 IEEE-488 compatible instrument control.

Its touch screen replaces a keyboard or switch panel, allowing the operator to respond to prompts one at a time. System control may then be accomplished by simply 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.

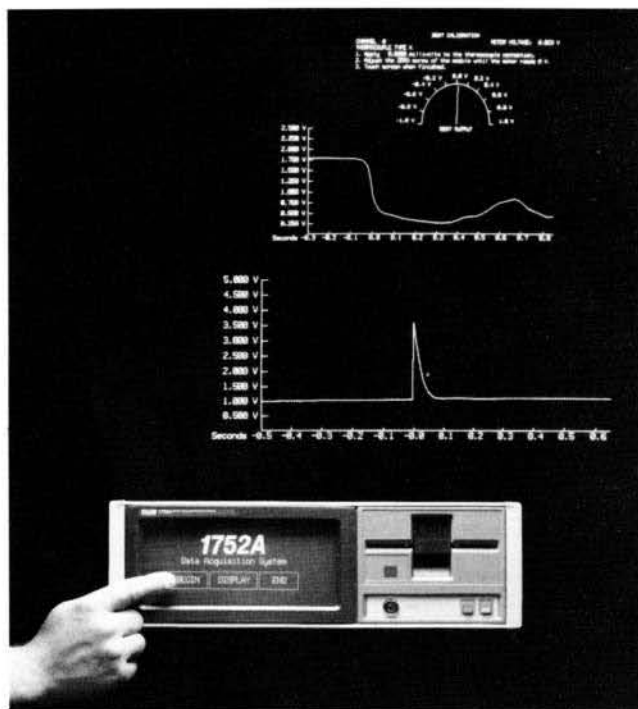
The 1752A's high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory workspace, functions as an independent graphics display terminal for the central processor.

When started up, the 1752A 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 1752A 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 you never need to bring a disk near it.

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. 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 1752A includes four slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. An external Winchester Disk Drive System brings 10 or 20 megabytes of file capacity on-line. Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of non-volatile 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 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 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 readings 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 $\pm 10V$ 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-232-C 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-232-C serial data port. The 1752A can accommodate up to two IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial-data 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 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)

These options provide either 256K bytes (-018) or 512K bytes (-019) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM — over 1M bytes. Up to 2.5M bytes non-volatile RAM may be installed in the 1752A.

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. 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.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1752A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

Winchester Disk Drives

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1752A Data Acquisition System:

1765B/10	10M byte Winchester Disk Drive
1765B/20	20M byte Winchester Disk Drive
1765B/20R	10M byte Fixed/10M byte Removable Winchester Disk Drive
1765B/20M	Multi-User 20M Byte Winchester Disk Drive

All four models provide for easy connection to the Data Acquisition System 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

The 1752A offers an environment specifically suited to the development of real-time control programs. Interpreted BASIC, Compiler 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.

Module-Level Diagnostics

The 1752A 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 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 Fluke 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 Fluke Sales Engineer or Representative to let you evaluate the 1752A through its manuals. You will be pleasantly surprised.

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) $\pm 1.0158V$; $\pm 10.158V$; $\pm 65\text{ mA}$; 4 to 20 mA displayed as 0 to 100% of scale

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 to 40°C operating) 10V Range $\pm(0.02\%$ of reading + 1.24 mV); 1V Range $\pm(0.02\%$ of reading + 248 μV); 65 mA Range $\pm(0.05\%$ 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 Option (-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: $\leq 30V$ dc or peak ac, channel to channel

Max Load: $\pm 5\text{ mA}$ in voltage mode; $\leq 750\Omega$ in current mode

90-Day Accuracy: $\pm 20\text{ mV}$ in voltage mode and $\pm 20\text{ }\mu A$ in current mode for ambient temperature of 18°C to 28°C

Rate: 1000 changes/sec

Connector Option: Use 2400A-110 or 2400A-111

Counter/Totalizer Signal Input Option (-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 μ s (\leq 3.82 hours); 400 ns (\leq 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 2400 Ω to +5V, 5000 Ω 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
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 x 17 in x 21.5 in) plus feet
Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)
Included: 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

Model

1752A Data Acquisition System
 (with one 1752A-010 Analog Measurement Processor)
1752A-1 Data Acquisition System
 (without 1752A-010 Analog Measurement Processor)
1702A Extender Chassis (Requires 1752A-013)

Options

17XXA-002 Parallel Interface
17XXA-006 256K byte RAM Expansion
17XXA-007 512K byte RAM Expansion
17XXA-008 IEEE-488/RS-232-C Interface
17XXA-009 Dual Serial Interface
1752A-010 Analog Measurement Processor
1752A-011 4 Channel Analog Output
1752A-012 Counter/Totalizer
1752A-013 Extender Interface
17XXA-016 1M Byte RAM Expansion
17XXA-017 2M Byte RAM Expansion
17XXA-018 256K Byte Non-Volatile RAM
17XXA-019 512K Byte Non-Volatile RAM

1700 Series Language Systems (Also see page 223)

17XXA-201 Assembly Language Development System
17XXA-202 FORTRAN Development System
17XXA-203 Compiled BASIC Development System
17XXA-205 Extended BASIC Development System
17XXA-912 Non-ANSI C Development System
17XXA-913 Non-ANSI C Compiler

Fluke Application Software (Also see page 225)

17XXA-900 Binder
17XXA-901 Gabby
17XXA-902 Touchscreen Toolbox
17XXA-903 Compiled MenuBASIC
17XXA-905 Extended MenuBASIC

17XXA-907 Transport->PC
S1703 Compiled MenuBASIC Development Package
S1705 Extended MenuBASIC Development Package

Peripherals

1760A Disk Drive System, 400K byte
1761A Dual Disk Drive System, 800K byte
1765B/10 10M byte Winchester Disk Drive
1765B/20 20M byte Winchester Disk Drive
1765B/20R 10M byte Fixed/10M Byte
 Winchester Disk Drive
1765B/20M Multi-User 20M byte Winchester Disk Drive
1780A InfoTouch Display

Accessories (Also see page 284)

Y1700 Programmer Keyboard
Y1702 RS-232-C Null Modem Cable, 2m
Y1703 RS-232-C Null Modem Cable, 4m
Y1705 RS-232-C Null Modem Cable, 0.3m
Y1706 Certified Blank Disks Unformatted (pkg of 10)
Y1707 RS-232-C Interface Cable, 2m
Y1708 RS-232-C Interface Cable, 10m
Y1709 Printer Cable, 2m
Y1717 Parallel Interface Cable
Y1750 Input Terminal Block with Cable
Y1751 Replacement Cable Set for Y1750
Y1752 Line Frequency Sync Transformer
Y1790 Rack Mount Kit with 24" Slides
Y1791 Rack Mount Kit for 1780A (requires 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

Service & Support

Instrument Controller

1722A



RS-232



1722A With Keyboard

1722A Instrument Controller

- Microcomputer architecture designed for system control
- Touch display operator interface
- BASIC, FORTRAN, and Assembly programming language options
- Rack mountable with removable keyboard
- 136K RAM memory expandable to over 3.0 megabytes
- High resolution graphics with graphics print capability
- RS-232-C, IEEE-488, RS-422, or 20 milliampere 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 1980 — the concept of using a touch-sensitive CRT display 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. As we continue to develop microcomputer products at Fluke, the software investments made by our customers remain a foremost design consideration.*

*The 1722A has been incorporated into a number of Fluke calibration systems. See pages 112 through 129.

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 workspace, 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.

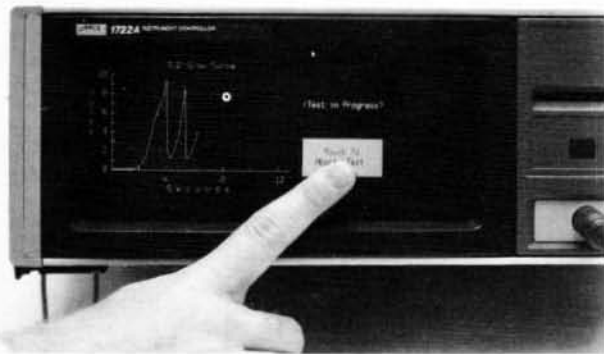
The 1722A includes five slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 3.0 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. The 1765B Series of Winchester disk

Non-volatile RAM options can be installed for rugged, permanent file storage, especially suited for harsh environments. Up to 2.5M bytes of non-volatile memory, may be installed.

Touch-Sensitive Display System

With its touch-sensitive 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 touch-sensitive display overlay goes back to 1980. It has proven to be a rugged, reliable component.



Touch-sensitive 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 whatever 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 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 configuration, 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.

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 accommodate up to two 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 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)

These options provide either 256K bytes (-018) or 512K bytes (-019) of file-structured, non-volatile RAM memory. Transfer rates are comparable to RAM — over 1M bytes. Up to 2.5M bytes non-volatile RAM may be installed in the 1752A.

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. 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.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1722A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

Winchester Disk Drive

The 1765B Series of Winchester disk drives provides high-capacity hard disk file storage for the 1752A Data Acquisition System:

1765B/10	10M byte Winchester Disk Drive
1765B/20	20M byte Winchester Disk Drive
1765B/20R	10M byte Fixed/10M byte Removable Winchester Disk Drive
1765B/20M	Multi-User 20M Byte Winchester Disk Drive

All four models provide for easy connection to the Data Acquisition System 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 Fluke 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 Fluke 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 touch-sensitive graphics display and a high performance microcomputer system, call your Fluke Sales Engineer or Representative for more information.

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 x 17 in x 21.5 in) plus feet

Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)

Included: 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

Model

1722A Instrument Controller

1722A-1 Instrument Controller w/o Keyboard

Options*

17XXA-002 Dual 16 Bit Parallel Interface

17XXA-006 256K-Byte RAM Expansion

17XXA-007 512K-Byte RAM Expansion

17XXA-008 IEEE-488/RS-232 Interface

17XXA-009 Dual Serial Interface

17XXA-016 1M-Byte RAM Expansion

17XXA-017 2M-Byte RAM Expansion

17XXA-018 256K-Byte Non-Volatile RAM

17XXA-019 512K-Byte Non-Volatile RAM

*All options are customer installable

Language Systems (See page 223)

17XXA-201 Assembly Language Development System

17XXA-202 FORTRAN Development System

17XXA-203 Compiled BASIC Development System

17XXA-205 Extended BASIC Development System

17XXA-912 Non-ANSI C Development System

17XXA-913 Non-ANSI C Compiler

Fluke Application Software (See page 225)

17XXA-900 Software Binder

17XXA-901 Gabby

17XXA-902 Touchscreen Toolbox

17XXA-903 Compiled MenuBASIC

17XXA-905 Extended MenuBASIC

17XXA-907 Transport->PC

S1703 Compiled MenuBASIC Development Package

S1705 Extended MenuBASIC Development Package

Peripherals

1760A 400K Byte Disk Drive

1761A 800K Byte Dual Disk Drive

1765B/10 10M Byte Winchester Disk Drive

1765B/20 20M Byte Winchester Disk Drive

1765B/20R 10M Byte Fixed/10M Byte

Removable Winchester Disk Drive

1765B/20M Multi-User 20M Byte Winchester Disk Drive

1780A InfoTouch® Display

Accessories (Also see page 284)

Y1700 Programmer's Keyboard

Y1702 2m RS-232-C Null Modem Cable

Y1703 4m RS-232-C Null Modem Cable

Y1704 Circuit Board Extender

Y1705 0.3m RS-232-C Null Modem Cable

Y1706 Double-Sided Blank Disks (package of 10)

Y1707 2m RS-232-C Interface Cable

Y1708 10m RS-232-C Interface Cable

Y1709 2m Printer Cable

Y1711 Shipping Case

Y1790 Rack Mount Kit with 24" Slides

Y1795 Carrying Handle for portability

Y8021 1m Interface Cable for IEEE-488 bus

Y8022 2m Interface Cable for IEEE-488 bus

Y8023 4m Interface Cable for IEEE-488 bus

Service & Support

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
- FlexSys Test Software (ATLAS)
- Assembly Language
- Non-ANSI C
- FORTRAN

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	Interpreted BASIC	Compiled BASIC	Extended BASIC
Program Size	28K bytes	35K bytes	>2M bytes
Execution Speed Ratio (approximate)	1	3-5	2
Program Expansion Method	Chaining	Overlays	None req'd
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 mini-computers. 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 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.

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.

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

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	Adv ⁵	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM ⁴
Extended	17XXA-205	to 3M bytes	to 3M bytes	Adv ⁵	Complete	Structured BASIC	~2400	Yes	17XXA-016 1M byte RAM ⁴
FlexSys/ATLAS									
ATE System Development Software	1790A-500	to 5000 lines ²	to 1M bytes ²	Adv ⁵ Adv ⁵	Resource Descriptors	IEEE Std 416-1984 Subset. Supports development of resource descriptors, TPSs, configuration, simulation, and execution.	~500	Yes ⁶	17XXA-016 1M byte RAM ³ 17XXA-017 2M byte RAM ⁴ 1765B/10 10M byte Disk ⁴
TPS Development Software	1790A-400	to 5000 lines ²	to 1M bytes ²	Adv ⁵ Adv ⁵	Resource Descriptors	IEEE Std 416-1984 Subset. Supports development of TPSs, configuration, simulation, and execution.	~500	Yes ⁶	17XXA-016 1M byte RAM ³ 17XXA-017 2M byte RAM ⁴ 1765B/10 10M byte Disk ⁴
Test Execution Software	1790A-300	to 5000 lines ²	to 1M bytes ²	Adv ⁵	Resource Descriptors	IEEE Std 416-1984 Subset. Executes TPSs developed on 1790A-400, -500.	n/a	Yes ⁶	17XXA-007 512K byte RAM ³ 17XXA-016 1M byte RAM ⁴
FORTRAN	17XXA-203	64K bytes ¹	to 3M bytes	Std	Complete	FORTRAN IV	~300	No	17XXA-016 1M byte RAM ⁴
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	Adv ⁵	Complete	Whitesmith C I/O	~1000	Yes	17XXA-016 1M byte RAM ⁴

¹ Can be increased using overlays or chaining

² These numbers are representative of an average TPS and data size which can be used with the 1722A. Larger TPS's may be accommodated through use of structured programming

³ Required hardware

⁴ Recommended hardware

⁵ Advanced Support available through optional libraries

⁶ Interrupt handling for service requests as defined by the Resource Descriptor

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-912 Non-ANSI C Compiler or as the 17XXA-913 C Development System, which includes both the 17XXA Non-ANSI C Compiler and the 17XXA Assembly Language Development System.

FlexSys Test Software (ATLAS)

To speed development and reduce software maintenance costs of test systems, the ATLAS language is available for the 1722A. More information is available in the following FlexSys section.

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.

Fluke Application Software

- Gabby
- MenuBASIC
- Touchscreen Toolbox
- TransPort-->PC



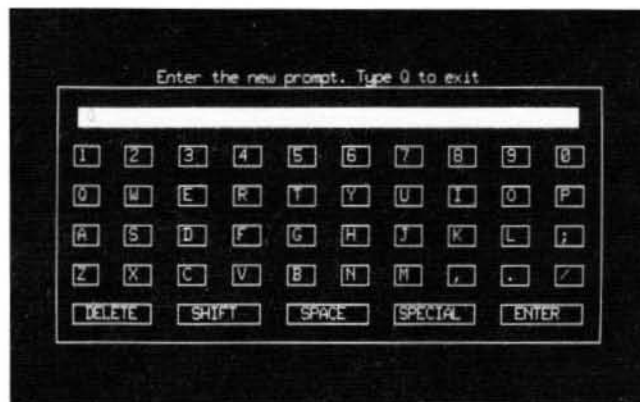
Gabby

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 four appendices showing step by step instructions for use with the UNIX,* RSTS,* VAX/VMS* and IBM PC* operating systems.

*UNIX is a trademark of AT&T Bell Laboratories
RSTS and VMS are trademarks of Digital Equipment Corporation
IBM PC is a trademark of International Business Machines, Inc.



Gabby



Touchscreen Toolbox

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 multi-level 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
 - Advanced 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.)

Selection Guide — Application Software

Package Name	Item Number	Features	Required Hardware	Required Software
Gabby	17XXA-901	<ul style="list-style-type: none"> ● 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 MS-DOS 	1722A with graphics print capability (all units shipped after February 1, 1985) or all 1752As	Cable to Host Computer
Touchscreen Toolbox	17XXA-902	<ul style="list-style-type: none"> ● 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 Compiled BASIC or 17XXA-205 Extended BASIC
MenuBASIC	17XXA-903 or S1703 ³ 17XXA-905 or S1705 ³	<ul style="list-style-type: none"> ● 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 17XXA-006 256K byte RAM Expansion ¹ 17XXA-016 1M byte RAM Expansion ²	17XXA-203 Compiled BASIC or 17XXA-205 Extended BASIC
TransPort-->PC	17XXA-907	<ul style="list-style-type: none"> ● 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
MS-DOS is a trademark of Microsoft, Inc.
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

MenuBASIC Options

- 17XXA-903 Compiled MenuBASIC: Compiled MenuBASIC software and manual.
- 17XXA-905 Extended MenuBASIC: Extended MenuBASIC software and 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.

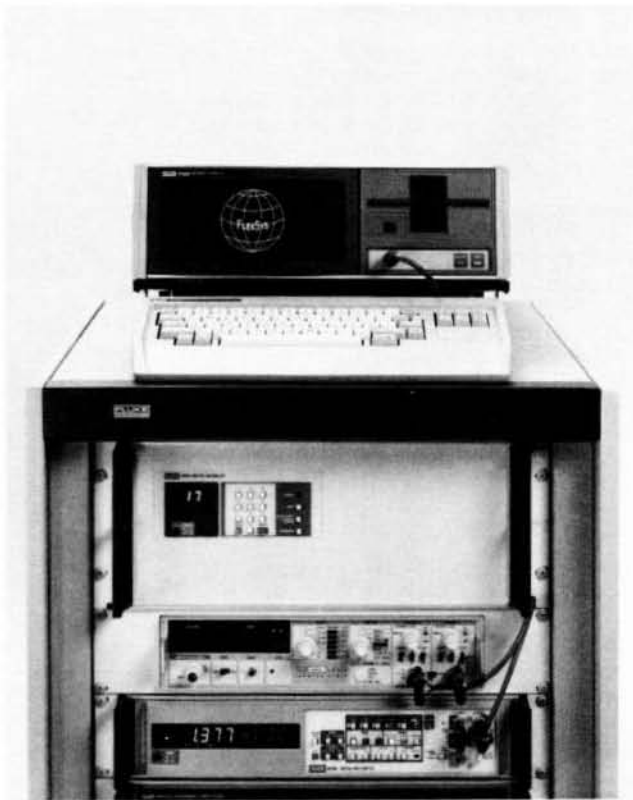
The export utility provided with TransPort-->PC allows you to transfer numeric virtual arrays from the 1700 Series to the personal computer. Programs such as Lotus 1-2-3 can be used to display the file in spreadsheet form or as a bar, stacked-bar, pie, line or XY graph.

1700 Series Language Systems

- 17XXA-201 Assembly Language Development System
 17XXA-202 FORTRAN Development System
 17XXA-203 Compiled BASIC Development System
 17XXA-205 Extended BASIC Development System
 17XXA-912 Non-ANSI C Development System
 17XXA-913 Non-ANSI C Compiler

1700 Series Application Software

- 17XXA-900 Binder
 17XXA-901 Gabby
 17XXA-902 Touchscreen Toolbox
 17XXA-903 Compiled MenuBASIC
 17XXA-905 Extended MenuBASIC
 17XXA-907 TransPort-->PC
 S1703 Compiled MenuBASIC Development Package
 S1705 Extended MenuBASIC Development Package



FlexSys ATE Workstation Software (For 1722A)

- Allows reconfiguration (changing system hardware elements) without recompiling or modifying test programs
- Provides the advantages of ATLAS language at a fraction of the cost of current solutions
- Touch-sensitive, menu-driven user interface means easy training and use
- Compact workstation fits on bench or in the rack
- Includes programming tools such as syntax checking, utilities for efficient debugging, and easily customized screen menus
- Integrates a wide range of ATE equipment via IEEE-488
- High-speed compile — typical 500 ATLAS statements per minute

FlexSys is a complete ATLAS software package that runs on Fluke's powerful IEEE-488 controller, the 1722A. For both large and small system applications, it provides the benefits of the ATLAS language at a fraction of the cost of other systems.

With FlexSys, reconfiguration is rapid and easy without recompiling or modifying test procedures or test program sets through the use of Resource Descriptions (RD's). The result is lower cost for software development.

The Resource Description, the heart of FlexSys is a data base of instrument characteristics utilized by the system at run time. RD's define

the codes and formats for a given instrument as well as the accuracies, ranges, timeouts and delays. The use of RD's at run time facilitates the rapid and straightforward configuration of the ATE system. Test program set development is independent of the specific hardware elements in the ATE system.

FlexSys provides for:

- ATLAS Test Program Set (TPS) development
- Resource Description development
- ATE configuration
- Test execution in a real-time or simulated mode of operation

Test Program Set Development

A touchscreen, menu-driven interface allows the FlexSys user develop test program sets and retain a history of inputs easily and efficiently.

A parsing editor provides both manual and automatic syntax checking during development of ATLAS test program sets.

The **ATLAS Compiler** prepares ATLAS test procedures for execution through:

1. Verification of ATLAS syntax, semantics.
2. Generation of executable binary files.
3. Covering or comparing signal statement requirements to corresponding require statements to verify that the defined virtual resources can meet test program requirements.
4. Cross-reference table listing the connections between instrument ports and unit under test (UUT) pins.

The **Non-ATLAS procedure** capability is used for the following:

1. Access to 20 predefined IEEE-488 bus drivers. The bus drivers allow direct control of 13 lines of the bus — the eight data lines and five control lines. The most common use of these drivers would be to manipulate a UUT which is controlled through the 488 interface. The drivers may also be used to control ATE functions not currently supported by IEEE ATLAS.
2. Perform user defined procedures displaying custom screen menus through a library of touchscreen drivers. Utilization of touchscreen menus allows full operator interaction with a running ATLAS TPS without the need for a keyboard.
3. Perform user defined procedures that utilize the pixel graphics capabilities of the 1722A.

The user can create Non-ATLAS Procedures in FORTRAN, C, or Assembly language.

Resource Description Development

With FlexSys actual resources used at run time need not be predefined — a feature unique among ATE systems. Instead, real resources (station test equipment) which meet the conditions of ATLAS REQUIRE statements are specified after compilation of the ATLAS test procedures. Information contained in the Resource Description Data Base specifies the following:

- Available functions and capabilities.
- Native IEEE-488 bus codes that control the instrument.
- The data format of information returned to the controller.
- Miscellaneous information such as settling times, instrument error codes, etc.

This data is used at run time, allowing compilation to be accomplished independent of real resources. RDs for system resources may be written by the user, or may be purchased from Fluke.

System Configuration

The System Configuration gives the user the ability to configure and reconfigure his system with minimal cost and effort by allowing the test program sets to be run without modification after reconfiguration of the test station. Configuration integrates the instruments on the 488 bus into a functional ATE test station.

The configuration process identifies the instruments connected to the bus and creates a Resource Description Table. This table is a collection of resource descriptions, for each instrument in the test station taken from the RD library. ATE configuration is independent of the ATLAS test program set so that the ATE configuration need not be re-established as long as the instruments on the bus do not change.

Resource assignment establishes the logical mapping of the real resources on the bus to the virtual resources specified by the ATLAS test program set to perform the following:

- Assign a real instrument resource for each virtual resource in the test program set.
- Check that the real resources on the bus do, in fact, satisfy the virtual resources specified in the ATLAS REQUIRE statements.
- Choose signal paths which are defined in the system interface RD for use at run time.

Test Execution

Test Execution provides for:

- TPS Selection
- Simulation
- Execution
- Debug Monitoring

TPS Selection

TPS Selection allows the test operator to select from available test programs. This is conveniently done using the touch-sensitive screen to page through possible selections and designate which test program to execute.

Simulation

The Simulation Option is provided to allow a test programmer to verify correct operation of test procedures and resource descriptions without actual use of the ATE system.

Test Execution

The test equipment is controlled using the programming codes extracted from a resource description to perform the operations defined by the ATLAS signal statements.

Debug Monitor

The debug monitor commands include single step execution, setting break points, enable program trace and examination of program variables. The test engineer may examine and alter system flags and the command buffers sent to the instruments. The debug monitor allows debugging to take place at the ATLAS statement level.

Documentation

Documentation is presented for both the novice and advanced users. Product documentation includes:

- Getting Started Manual
- System Guide
- System Configuration Manual
- ATLAS Program Development Manual
- Resource Description Development Manual

The FlexSys manual set is organized in reference form, with tab dividers, indexes, section headers on each page, and a consistent readable format. The manuals are supplemented with tutorial introductions and numerous examples.

The FlexSys ATE Workstation is available in three configurations:

Model 1790A-500

ATE System Development Software: Provides all capabilities required for resource description development, station configuration, TPS development and test execution, simulation, and non-ATLAS module linkage, complete with sample RDs.

Model 1790A-400

TPS Development Software: Provides the capabilities required for TPS development configuration and execution (for the user who does not develop his own RDs).

Model 1790A-300

Test Execution Software: Provides all capabilities required for execution of ATLAS TPS.

Options

1790A-301 Configuration (available only as an option for 1790A-300) (Included in -500 and -400)

This option allows for the rapid reconfiguration of hardware within the test station without recompilation of ATLAS Test procedures.

Model

- 1790A-500 Development System Software
- 1790A-400 Integration System Software
- 1790A-300 Test Execution Software
- 1790A-301 Configuration

Touch Control Screens

1020 Series



Getting In Touch With Automated Production Test. The Fluke 1020 Series of Touch Control Screens provides excellent operator interface in manufacturing environments such as production test. The Touch Control Screen provides a menu-based interface that guides technicians through complex test procedures. The operator no longer has to recall pushbutton sequences or lengthy commands; one merely recognizes the appro-

priate option from what is currently displayed, and makes the appropriate selection with a light touch on the screen.

Operator training time is reduced. Complex test procedures are executed faster too, due to less operator confusion.

Fluke 1020 Series Touch Control Screens eliminate confusing sequences and memorization required by traditional control panels. Instead, they present a list of preset options to save training time and cost. Powerful built-in software makes these units simple to install and to use.

The Fluke 1020 and 1021 are both fully integrated subsystems for manufacturing control. The 1020 Model includes a desk-top enclosure, a complete manual set and an optional tilt swivel base and programmer's keyboard. The 1021, mountable into a panel or rack, can be installed with a NEMA 12 seal for use in harsh environments. Both units can also include a fan for extending their operating temperature range.

These units have durable touch-sensitive front panels. 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 any environment. Based on a decade of touch control experience, these screens bring the latest technology to OEM applications and in-house turn-key projects.



1020

1021

High Reliability, Low Cost, Operator Interfaces

- Touch Panel consists of 120 touch cells (12x10)
- Advanced programming commands
- Rack mountable
- Optional NEMA 12 panel mounting kit
- Selectable character attributes — highlight, blinking, reverse video, underline (or any combination of these)
- High contrast, green (or optional amber) phosphor 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.

Software Integration

Enhanced command software provides unique features that allow for flexibility and programming ease. Region commands allow the programmer to create various rectangular touch targets with a single command. Other commands allow the host to erase an entire region or modify the character 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 Touch Control Screen reports to the host that a touch has been made.

Communications

The Touch Control Screen (TCS) has an RS-232-C/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. Fluke TCS use ANSI standard display codes (ANSI x3.64-1979) and is powered from standard ac line voltage. (See specifications.)

Mechanical Integration

Mounting the TCS is as simple as cutting a hole, tightening 3 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, rack mount 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

The 1020 Series' 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 TCS components.



1020

1020 Options

Amber Phosphor Display (1020-10)

The amber monochrome P134 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

1021 Options

Amber Phosphor Display (1021-10)

The amber monochrome P134 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 0°C to 60°C.

Enclosure (1021-30)

An attractive plastic enclosure is available for operating the Touch Control Screen on a desk-top.

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.

Accessories

Alphanumeric Keyboard (Y1000)

The Alphanumeric Keyboard is provided for programming or data entry applications with the 1020 Series.

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" Rack Mount 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" Rack Mount Kit with 18" Slides (Y1081)

The Y1081 is used for complete slide-mounting of the TCS with 18" slides.

19" Rack Mount 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 rack mounting 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.

1020 Series

Specifications

Temperature: 0°C to 50°C without plastic enclosure; 0°C to 60°C without plastic enclosure, with optional fan; 0°C to 40°C with plastic enclosure; 0°C to 50°C with plastic enclosure, with optional fan

Voltage: 90V to 132V ac, 180V to 264V ac, 47 Hz to 440 Hz

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

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); P134 Phosphor (amber), optional

Models

1020 Touch Control Screen Package (includes Touch Control Screen, 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)

1021-90 1020 Series Manual Set

**Customer installable*

Accessories (Also see page 284)

Y1000 Alphanumeric Keyboard

Y1070 NEMA 12 Panel Mounting Kit

Y1080 19" Rack Mount Kit

Y1081 19" Rack Mount Kit w/18" Slides

Y1082 19" Rack Mount Kit w/24" Slides

Y1085 Keyboard Extender Cable

Y1090 Contrast Enhancement Overlay

Y1702 2m RS-232-C Null Modem Cable

Y1703 4m RS-232-C Null Modem Cable

Y1705 0.3m RS-232-C Null Modem Cable

Y1707 2m RS-232-C Cable

Y1708 10m RS-232-C Cable

Service & Support



(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 overlaying 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. Information presented to the operator at any particular time is under program control, allowing the system to guide the operator through the correct sequence of operations. 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.

In the simplest implementation, the InfoTouch Display's integration of a display and touch sensitive overlay can be used to provide a more natural alternative to conventional function keys. Use of graphics characters and the flexibility afforded by the InfoTouch Display allows replacement of analog or digital readouts, toggle switches, rotary controls, pushbuttons, and annunciators. Application of the InfoTouch Display to a wide variety of information and equipment control processes is limited only by your imagination.

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 x 11.35 in x 13.55 in).

Standard 5¼-inch rack height

Weight: 9.7 kg (22 lb)

Model

1780A InfoTouch Display

Options

1780A-001* Keyboard Interface

1780A-002* Keyboard Interface with Y1720 Keyboard

1780A-201 Expanded Graphics Character Set

**Customer installable*

Accessories (Also see page 284)

Y1702 2m RS-232-C Null Modem Cable

Y1703 4m RS-232-C Null Modem Cable

Y1705 0.3m RS-232-C Null Modem Cable

Y1707 2m RS-232-C Cable

Y1708 10m RS-232-C Cable

Y1720 Keyboard

Y1791* Rack Adapter

Y1792* Rack Adapter 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.*

Service & Support



1761A Dual Disk Drive

1760A/1761A Disk Drive Systems

- Compatible with IEEE-488 bus controllers
- Software supported for Fluke 1720A, 1722A, and 1752A Instrument Controllers
- 400K bytes of on-line capacity (1760A)
- 800K bytes of on-line capacity (1761A)
- Low EMI and RFI emissions, designed for lab environments
- Rack mountable
- Automatic self-test
- Double-density, double-sided format
- 1720A single-sided format also supported

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage for IEEE-488 bus systems. Rack mountable and supported with software for 1700 Series Instrument Controllers, you will find them easy to install and use. Installation is a matter of mounting and connecting the IEEE-488 bus cable. When used with a Fluke 1720A or 1722A Instrument Controller or the 1752A Data Acquisition System, you will not need to be concerned with events and protocol on the IEEE-488 bus: available software for the Controllers allows either disk drive to be treated by application programs as if it were simply an additional drive installed in the controller.

Support software available for the 1722A Instrument Controller and 1752A Data Acquisition System is provided with the controller. For use with the 1720A Instrument Controller, the Configured System Software Option (1720A-700) must be separately ordered. When ordering Option -700 for the 1720A, be sure to include a complete list of options and peripheral devices used. The Configured System Software works even if the supported devices are not yet installed.

Specifications

Access Time: 505 ms, average
Transfer Rate: 50K bytes per second, burst; 12K bytes per second, average, with typical sector interleave
On-Line Capacity: 400K bytes with 1760A, 800K bytes with 1761A
Track Density: 48 tracks per inch
Speed: 300 revolutions per minute
Recording Format: 512 bytes per sector, 10 sectors per track, and 40 tracks per side (80 total). Double-density encoding
Disk: Fluke-qualified industry-standard 5.25 inch, certified double-density, 40 tracks, both sides
Disk Life: More than 3×10^6 revolutions with head contact, per track
Error Rates: 1 bit per 10^9 , recoverable; 1 bit per 10^{12} , non-recoverable

General Specifications

Signal Emissions: FCC Part 15, Subpart J, Class A; VDE 0871, Class B; CISPR 11-1975
Temperature: 10°C to 40°C, operating; -10°C to 60°C, non-operating
Relative Humidity: 20% to 90% from 10°C to 30°C, 20% to 80% from 30°C to 40°C, operating; 5% to 95%, non-operating
Power: 90V to 110V ac, 108V to 132V ac, 198V to 242V ac, or 216V to 264V ac, selectable, 47 to 63 Hz. 55W for 1760A, operating; 70W for 1761A, operating
Size: 13.3 cm H x 43.2 cm W x 39.6 cm D (5.25 in x 17.0 in x 15.6 in), both models
Weight: 1760A is 7.7 kg (17 lb), 1761A is 9.1 kg (20 lb)

Models

1760A Disk Drive System
 1761A Disk Drive System

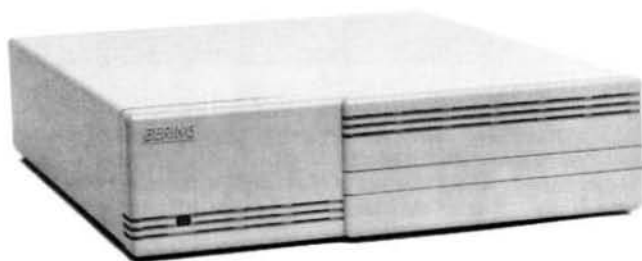
Options

1720A-700 Configured 1720A System Software
 Y1706 Double-Sided Blank Disks (pkg. of 10)
 Y1790 Rack Mount Kit with 24" Slides
 Y1794 Rack Mount Kit with 18" Slides
 Y8021 1m IEEE-488 Cable
 Y8022 2m IEEE-488 Cable
 Y8023 4m IEEE-488 Cable

Service & Support

Disk Drive Systems

1765B/10, 1765B/20



1765B/10

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. All four models provide for easy connection to the Controller or Data Acquisition System through a standard IEEE-488 interface. All four 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. A new system generation program is supplied with each Winchester drive which will automatically reconfigure the FDOS operating system of the 1722A or 1752A to accommodate the new drive. After connecting the 1765B to IEEE-488 port 0 of the controller or data acquisition system, you will have up to 20 megabytes of on-line storage. The diagnostic disk supplied with the 1765B Series contains software which allows full testing of the drive.

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 system generation program supplied with the 1765B Series allows the Winchester drive to be treated by applications programs as if it were simply an additional drive installed within the mainframe.

For users of the original Fluke Winchester Disk Drive, the 1765A/AB, the new software supplied with the 1765B Series is completely compatible with the 1765A/AB.

Model Number	Capacity M Bytes	Removable	Number of Users	Storage/ User M Bytes	Maximum Distance From Controller
1765B/10	10	No	1	10	4m
1765B/20	20	No	1	20	4m
1765B/20R	10+10	Yes	1	10 + 10	4m
1765B/20M	20	No	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/10 10M-Byte Winchester Disk Drive

The Fluke model 1765B/10 is divided into four logical devices of 2.5M bytes each. These logical devices are addressed as WD0: thru WD3:.

1765B/20 20M-Byte Winchester Disk Drive

Like the 1765B/10, the 1765B/20 is divided into eight 2.5M byte logical devices. These devices are designated as WD0: thru WD7:.

1765B/20R Winchester Disk Drive

The 1765B/20R contains 10M bytes of fixed Winchester disk storage, and 10M bytes of removable storage. The fixed drive is divided into four logical devices, designed WD0: through WD3. The removable drive is a single logical unit designated as RD0:. The removable drive can be used for backing up the fixed drive, as well as an independent unit.

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 1765B/10 and 1765B/20

Maximum Sustained Transfer Rate: 30K bytes/second
On-line Capacity: 10M bytes divided into four logical devices of 2.5M bytes each (1765B/10); 20M bytes divided into eight logical devices of 2.5M bytes each (1765B/20)
Track Density: 612 tracks per inch (1765B/10); 588 tracks per inch (1765B/20)
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 15.5 in W x 15.5 in D)

Models

February 1987 prices

1765B/10 10M-Byte Winchester Disk Drive

1765B/20 20M-Byte Winchester Disk Drive

1765B/20R 10M-Fixed/10M-Byte Removeable Winchester Disk Drive

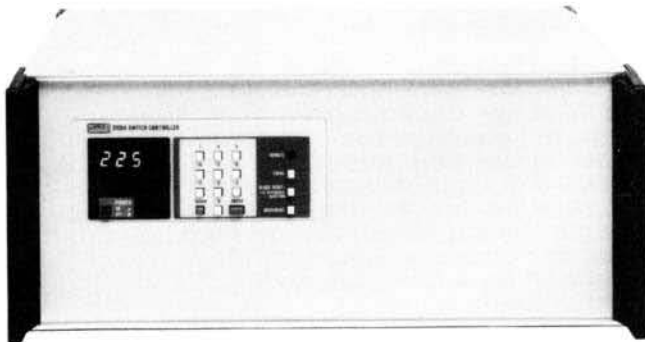
1765B/20M 20M Multi-User Winchester Disk Drive

Accessories (Also see page 284)

1765B/20R-1 10M Byte Removeable Disk Cartridge
 (For use with 1765B/20R)

Y1765M 16m IEEE-488 Interface Cable
 Rack Mount Kit for 1765B Series

Service & Support



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 IEEE Std 488-1978 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 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 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

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) 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.

Option Specifications

Actuator Control Module Option (-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 Option (-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 -210 and -009K.



Switch Controller Scanner

2205A

General-Purpose Scanning Module Option (-300)

Relays: Ten, reed type, DPST with unswitched guard

Scan Rate: 125 channels per second, maximum*

Rating: 40 mA maximum. A 0.5A fuse in each input line

Thermal Offset: <10 μ V

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 -310K and -009K.

Low-Level Scanning Module Option (-600)

Relays: Ten, reed type, 3PST, 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 μ V

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 Option (-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 application 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: \leq 80% to 40°C, operating

Power: 100, 120, 220, or 240V ac \pm 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 x 17 in x 17.4 in)

Safety: IEC 348 Protective, Class 1

Weight: 7.1 kg (15.6 lb)

Included

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

Models

2205A Switch Controller including IEEE-488 Interface

2201A Extender Chassis

2202A Extender Chassis

Options

2205A-100 Actuator Control

2205A-200 Matrix Latching

2205A-300 General-Purpose Scanning

2205A-400 4-Wire Ohms Scanning

2205A-600 Low-level Scanning

Accessories (Also see page 284)

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

2200A-7001* Connector and Assembly of -7002

2200A-7002* Remote Scanner Cable (per foot)

Y8021 1m Cable for IEEE-488 Bus

Y8022 2m Cable for IEEE-488 Bus

Y8023 4m Cable for IEEE-488 Bus

Y8013 Trigger Output Cable, 4-foot

Y8076 Analog Interface Cable (included w/2205A) 3-foot

M07-205-600 7" Rack Adapter

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

Service & Support

Board Testers and Troubleshooters



Most electronic equipment designed in recent years uses at least one microprocessor. While these components make it possible to design very sophisticated equipment at a low cost (such

as personal computers), there are drawbacks in troubleshooting and repairing circuit boards with microprocessors. It is very difficult for even highly skilled technicians to find circuit faults using conventional troubleshooting instruments.

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 up-based equipment, using any one of over 50 different types of microprocessors.

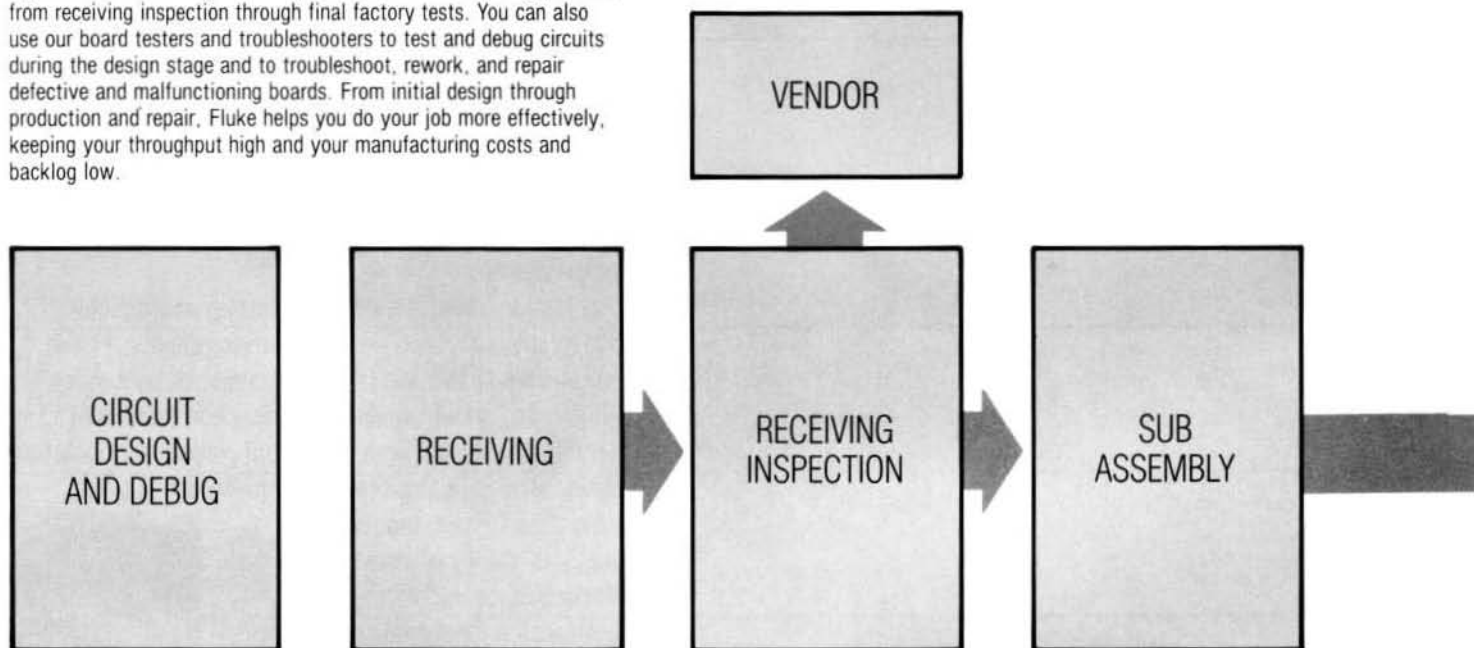
For higher levels of automated testing and troubleshooting in production lines or in service depots, Fluke offers the new 9100 Digital Test System, today's most sophisticated, most capable emulative board tester. The 9100 features easy programming and guided fault isolation techniques to speed up the testing process. Fluke's solutions go further, too, with the Fluke 3000 family of board testers for high-confidence, high-throughput digital/analog functional testing and manufacturing defects analysis.



Board Testers & Troubleshooters

IEEE-488

Fluke's PC board testers and troubleshooters provide you with high-confidence testing for each phase of the manufacturing process, from receiving inspection through final factory tests. You can also use our board testers and troubleshooters to test and debug circuits during the design stage and to troubleshoot, rework, and repair defective and malfunctioning boards. From initial design through production and repair, Fluke helps you do your job more effectively, keeping your throughput high and your manufacturing costs and backlog low.



Circuit Design and Debug. Use the 9010A Micro-System Troubleshooter during the design engineering stage to test and debug prototype circuits, so you'll know they function as intended before building them into a product.

Receiving Inspection. Use the 3200B Manufacturing Defects Analyzer to make sure your bare boards are fault-free before they leave receiving inspection. That way, you won't waste time and money loading good components onto defective boards.



9000 Series Micro-System Troubleshooters



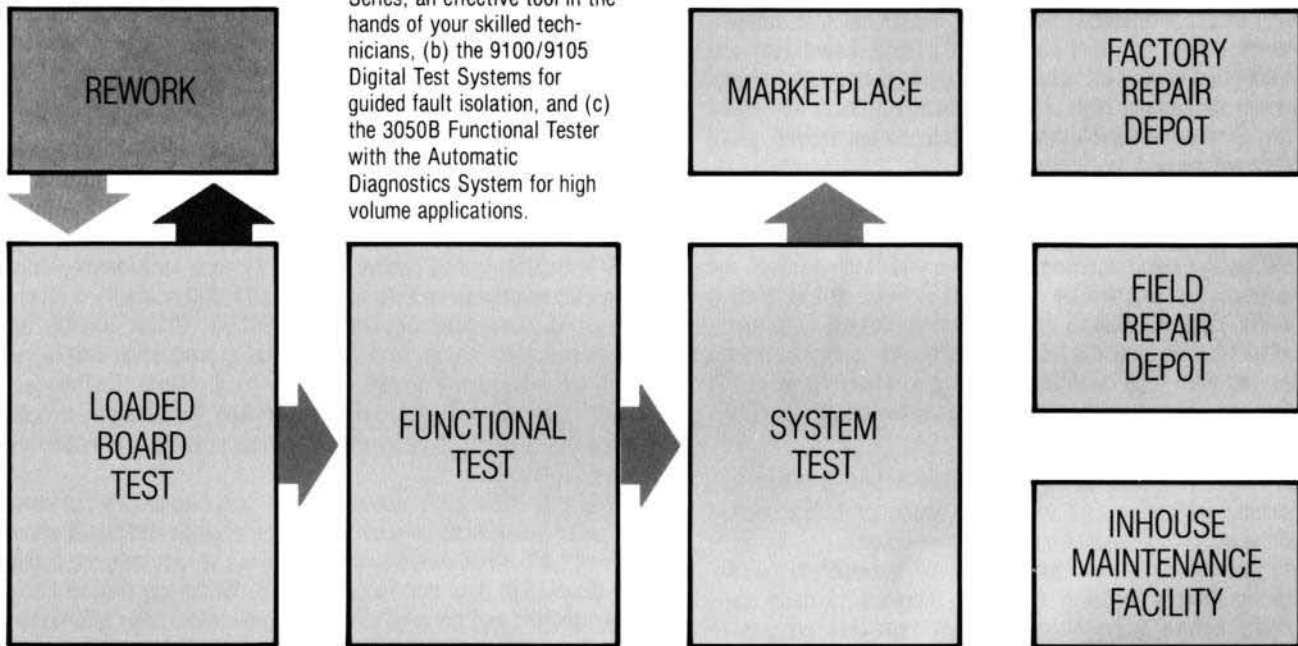
3200B Manufacturing Defects Analyzer



3050B Functional Test System

Rework. You can substantially lower your manufacturing costs by reworking defective boards instead of discarding them.

Several options are available depending upon your anticipated workload, the UUT technology, and the desired degree of automation: (a) the 9000 Series, an effective tool in the hands of your skilled technicians, (b) the 9100/9105 Digital Test Systems for guided fault isolation, and (c) the 3050B Functional Tester with the Automatic Diagnostics System for high volume applications.



Loaded Board Test. Use the 3200B Manufacturing Defects Analyzer after components have been inserted on the board to quickly locate opens and shorts as well as missing, incorrect, inverted, dead components before going on to the more complex process of functional testing.

9020A with a system controller and analog test instrumentation, you can configure your own custom ATE system geared to your particular troubleshooting applications.

For high-volume applications, the powerful, high-speed 3050B Functional Tester will give you rapid throughput, fully testing an entire board for dynamic faults in five seconds or less. And, if your product uses hybrid boards, adding a 3053B Analog Test Station to your 3050B will give you high-volume troubleshooting of both digital and analog circuitry.

Whatever your production environment, Fluke board testers and troubleshooters will handle your toughest functional testing challenges with confidence levels of 98% or higher.

3rd PARTY SERVICE CENTER

INHOUSE MAINTENANCE FACILITY

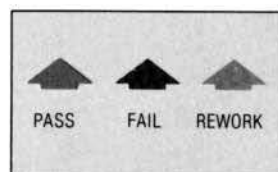
FIELD REPAIR DEPOT

FACTORY REPAIR DEPOT



9100A Digital Test System

Functional Test. For low to medium volume applications on microprocessor-based systems, use the 9100A Test Station to perform comprehensive functional tests, isolating dynamic faults with the board running at speed. Or, for testing products combining digital and analog circuitry, choose the 9020A, with an RS-232C or IEEE-488 interface. By integrating the



Repair Depots. Whether your repair application is in factory or field, at a third-party service center or an in-house maintenance facility, you'll find the 9000 Series is a powerful tool to isolate and repair the most challenging digital faults. To apply the same test strategies and implement a fully automated test and repair procedure, select the new Fluke 9100A Digital Test System, or the even more affordable 9105A designed for test execution of automated procedures.

Increase Your Productivity With Affordable Board Testers and Troubleshooters

High Confidence Testing From Start to Finish

From initial circuit design and debugging and on through receiving inspection, loaded board test, functional test, rework, and factory, field, or third-party repair, Fluke board test and troubleshooting equipment helps you do your job more effectively. You'll keep throughput high and manufacturing costs and board float low. And when troubleshooting and repair are needed, you'll reduce downtime and repair costs.

Early Defects Screening in Manufacturing

In electronics manufacturing, the earlier you catch a defect, the lower production costs will be — and the easier it will be to meet production quotas. Fluke's manufacturing defects analyzers, functional testers, and digital troubleshooters and accessories provide you with high confidence testing at every stage of the manufacturing process. Using Fluke board testers and troubleshooters, you can:

- Make sure your bare boards are fault-free before they leave receiving inspection, so you don't waste time and money loading good components onto defective boards.
- Test your boards after components have been inserted, quickly locating shorted, missing, incorrect, inverted, or dead components before going on to the more complex process of functional testing.
- Perform comprehensive functional tests on your loaded boards before installing them in your final system, locating those troublesome dynamic faults that appear only when components are interacting in sequence and at rated speed.
- Test hybrid boards as well as standard printed circuit boards, isolating analog faults down to the component level.

Easy Troubleshooting and Repair

In electronics servicing, the faster you find the problem, the lower your repair costs and downtime will be. Fluke equipment makes it easy to troubleshoot microprocessor-based circuits. We've reduced both the cost and the complexity of troubleshooting these systems, giving you the ability to quickly locate faults in either the kernel or peripheral circuitry. In fact, we've made the process so easy that you'll be successfully isolating and repairing faults the first day. Using Fluke's board testers and troubleshooters, you can:

- Troubleshoot and rework defective boards in your production facility, lowering your manufacturing costs by reducing both repair times and the percentage of waste.
- Test and service boards already installed in existing systems, isolating digital faults down to the component level.

In factory rework centers, factory repair depots, field service centers, third-party service centers, and in-house maintenance facilities, Fluke troubleshooting equipment and accessory simplify and speed-up the fault isolation and repair of the digital circuitry in microprocessor-based equipment.

Fluke Means Peace of Mind

When you choose Fluke board testers and troubleshooters, you choose reliability. Fluke has been designing successful test instrumentation for nearly 40 years, and we know how to build systems that will keep on working under the heaviest loads. Our 3050B Digital/Analog Functional Test System, for example, has a mean time between failures in excess of 1,000 hours — a record you'll find unmatched anywhere. Our 9005A, 9010A, and 9020A Troubleshooters are at work in demanding production and repair facilities around the world. And the 9100 Series Digital Test Systems which are introduced in this catalog, have been developed in the Fluke tradition to meet the highest standards in reliability and performance.

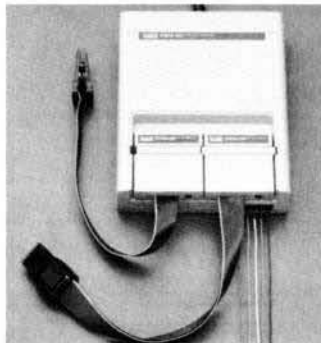
We also back each product with a commitment to customer support — a commitment evident in the breadth and depth of our training, in the worldwide availability of our service centers, and in the thoroughness of our documentation. When you choose Fluke board testers and troubleshooters, you get more than affordable, effective equipment: you also get the peace of mind that comes only with a supplier committed both to high-quality products and comprehensive support.

Selecting the Right Fluke Product

The preceding pages will help you find the Fluke board-testing products that best meet your needs. The flow chart on pages 240 and 241 shows you which Fluke equipment is appropriate for each stage of manufacturing and service. For your convenience, we've grouped product descriptions into four broad categories:

- **9000 Series Micro-System Troubleshooters**, for functional testing, rework, and repair of a high variety of microprocessor-based products under low-volume conditions.
- **Manufacturing Defects Analyzers**, for locating faults on bare and loaded boards, backplanes, card cages, and cables, before going on to functional testing.
- **Functional Testers**, for high-volume functional testing, rework, and repair.
- **The 9100 Series Digital Test Systems**, for an automated functional test and guided fault isolation of the digital circuitry of microprocessor-based equipment.

9100 Series



Speeding Up Circuit Fault Isolation. One striking new feature of the Fluke 9100 Digital Test System is the innovative I/O module, which dramatically increases the testing efficiency and speed of the system. Each I/O module can test up to forty independent test points — essentially forty individual probes through which nodes can be stimulated or logic levels, signatures, frequency and counts can be measured. Measurements can be taken simultaneously at

each point, offering extremely fast data acquisition. Four I/O modules can be connected to each 9100 System, creating a possible 160 test points.

An optional set of specially designed clip leads is available which clip directly over individual chips. All the standard chips from 14 to 40 points are covered by an appropriate clip. This allows direct pattern stimulus and response measurements for individually selected chips.

The Fluke 9100 Series can be put to work on virtually any digital circuit board, quickly and effectively searching out circuit faults. Two important features, its ability to be easily programmed for full Guided Fault Isolation (GFI) routines, plus its unique board interface devices, make it the best emulative board tester available today.

Because of these features, the 9100 Series is a cost effective solution for comprehensive test program generation, for a wide variety of test and troubleshooting applications in both production and service environments.

Fluke's 9100A functions as a Digital Test System for both program generation and execution. The execute-only Fluke 9105A Digital Test Station programs generated on the 9100A, linking the capability of the 9100A to multiple test sites.

Fluke, the world leader in emulative board testing offers a total solution for 9100 Series users to get to the test mode fast. Included are specialized training classes on programming, seminars on the art of troubleshooting, support for over 50 different microprocessors, and more.

RS-232



9100A

9100 Digital Test System

- Emulative Board Test: test microprocessor-based digital circuitry from the microprocessor outward
- Automated Functional (GO/NO GO) Tests and Guided Fault Isolation (GFI) Test
- Integrated program development environment
- Automatic functional tests of μ P kernel
- Automatic generation of GFI decision tree
- Support for 50 microprocessors
- I/O module and single point probe to "close the loop" in measurement or stimulus

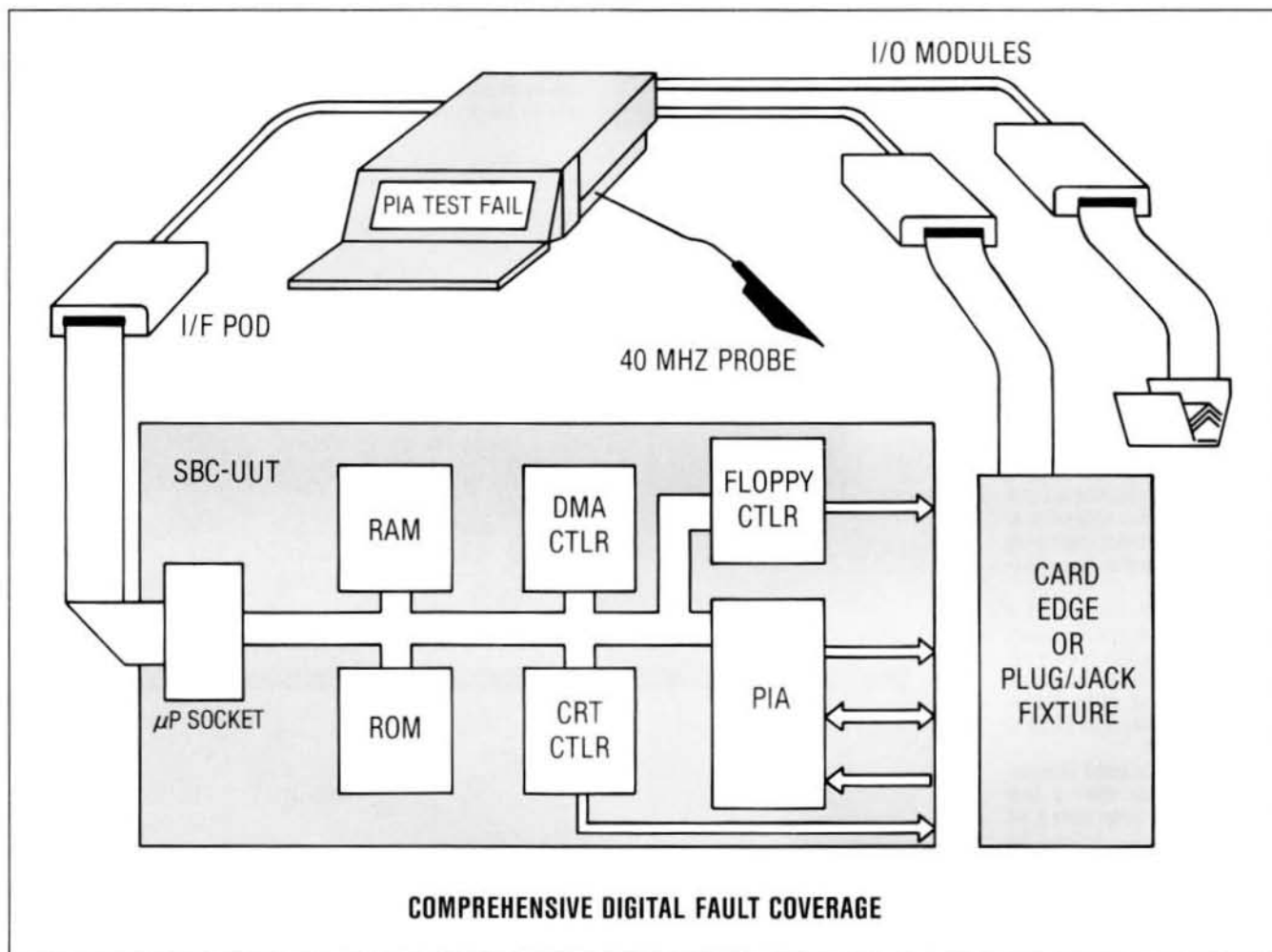
The 9100 Series is the newest member of Fluke's family of digital testers and troubleshooters. It is designed for fast, cost-effective automation of your test and troubleshooting procedures for microprocessor-based digital circuit boards.

Included in the 9100 Series are two testers: the 9100A Digital Test System, which can be used both for developing test software and as a stand-alone test station, and the 9105A Digital Test Station, an execute-only tester that can be used to execute programs developed on the 9100A.

The 9100A offers fast and easy development of functional test and troubleshooting programs which stay ahead of the increasing complexity of digital boards. 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 created in record time.

The 9105A Digital Test Station turns a powerful test solution into an economical one. At very low cost, the 9105A delivers powerful automated tests, developed on the 9100A, to the factory floor or service center. An easy to use interface allows any operator to quickly test and troubleshoot. Guided Fault Isolation (GFI) programs isolate faults to the node level, so both functional testing and troubleshooting can truly be automated. The 9100A and 9105A combine to offer unmatched power, flexibility, and economy to factory board test and service center repair.

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Both testers interface with the unit under test (UUT) through the following hardware components:

- A microprocessor interface pod: the pod emulates the microprocessor actions on the UUT.
- A 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 which allow testing of up to 160 nodes simultaneously.

Test Techniques For Every Part of the Board

The 9100 Series can detect and isolate faulty components on all types of microprocessor-based circuit boards. Types of tests include built-in functional testing of the microprocessor BUS, RAM, and ROM. The 9100 Series will also isolate faults in both synchronous and asynchronous circuitry and, through its microprocessor interface pods, can emulate a broad range of microprocessor chips. Together, these capabilities let you test your products more thoroughly and with a higher degree of confidence than ever before — at the design stage, during production, and in the field.

And, you can automate your troubleshooting procedures with minimal programming; the tester's built-in Guided Fault Isolation decision tree does most of the work.

Emulative Board Testing for the Kernel

At the heart of Fluke's approach is a technique known as emulative board testing — so called because it involves emulation of the board's microprocessor. This technique is preferred by board manufacturers the world over for finding faults in kernel circuitry, because it is the only technique that tests a board from the "inside out." Consequently, it lets you locate more faults, more quickly, than any other approach.

Microprocessor interface pods. To emulate the board's microprocessor, you select the microprocessor interface pod that corresponds to the microprocessor on the board. Pods are available for over 50 microprocessor chips, including the new 80286. All existing Fluke microprocessor interface pods can be used with the 9100 Series.

The 80286 Pod with the 9100A/9105A mainframe allows a single instruction breakpoint and provides 8 K-bytes of overlay RAM, including the advanced pod features (see page 254 for pod information).

Total control of the bus. In addition to containing its own microprocessor, each pod has its own RAM, ROM, and I/O, making it a complete kernel. The pod replaces the board's microprocessor, allowing the pod to control all bus-related devices on the board. Plugging in the pod also causes the clock circuit of the board under test to be channeled to the pod's microprocessor, so that tests can be performed with the board running at its normal speed. A RUN UUT function allows you to execute programs residing in the UUT's memory. This allows execution of initialization programs and diagnostics, speeding troubleshooting.

Automatic bus-line monitoring. Bus-line monitoring takes place automatically when the pod accesses the unit under test. 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.

Built-in BUS, RAM, and ROM tests. Using the pods, you can quickly execute the 9100 Series' built-in BUS, RAM, and ROM test routines. Because these circuits operate the same way on all microprocessor-based boards, you can run these tests as soon as you plug in the pod, without writing any code at all. At the conclusion of each test, the system reports its findings to the operator via specific fault messages.

Functional Testing Beyond the Kernel

All of the devices interfacing with the UUT may be used to stimulate circuitry beyond the microprocessor kernel. Typically the majority of stimulus will be generated from the microprocessor socket via the interface pod.

Since the pod can emulate any activity which the microprocessor on the UUT can perform, functional testing may be performed in the following steps. Partition the UUT into functional areas, excite or stimulate a functional partition from the pod, the single point probe or the I/O Module, measure the output response from the functional partition and compare the response to the expected response from a known good UUT.

The measurement may consist of signatures gathered concurrently at several nodes or it may be the circuit response measured by the pod. Functional testing may be automated by fixturing the nodes critical for functional testing. I/O Modules are available in several termination configurations which offer flexible alternatives to wire an I/O Module into a test fixture for functional testing.

The 9100 Series testers provide flexibility, several ways and alternatives to exercise circuitry on the UUT to perform reliable functional tests with a high degree of fault coverage and confidence.

Node-oriented Troubleshooting

If any of the built-in tests or functional tests indicate that faults exist, your next step is to perform node-oriented troubleshooting to isolate the fault to a particular component. One of the test techniques used in this process is signature analysis, in which the electrical "signature" of a node on the unit under test is compared with that of the same node on a known-good board. Other response factors may also be compared, including logic levels, event count, and frequencies.

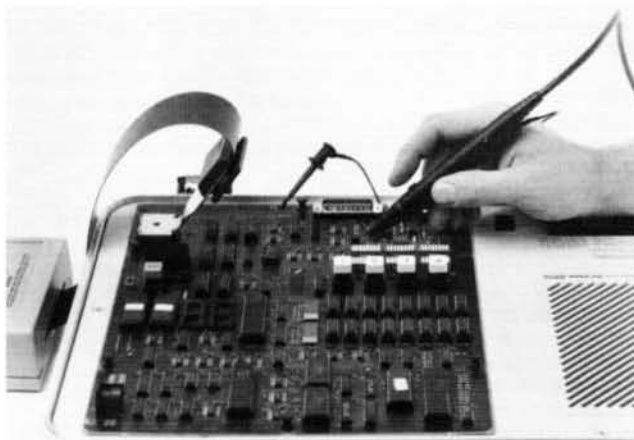
I/O modules for rapid fault isolation. One of the innovations offered with the 9100 Series is the new type of circuit interface device for node-oriented troubleshooting: the I/O module. This module, which lets you test all pins on a chip at once, provides a quick means of detecting and isolating faults for signals up to 10 MHz. It works with both synchronous and asynchronous circuitry, on or off the bus. And, because you can use up to four I/O modules at a time, you can test as many as 160 pins simultaneously.

Modules may be clipped directly over the chip via a DIP clip, available in configurations ranging from 14 to 40 pins. Or you can use the 9100 Series 20-line flying lead module to develop your own custom connections, connecting the tester to the board edge, a bed-of-nails fixture, or a customized test fixture.

The I/O module lets you use a variety of test techniques. You can use it to drive a node high or low or to stimulate it with a string of data patterns. It can also gather a wide range of response data, including taking a node's signature, sensing its logic level, and counting activity on the node — either frequencies or events. Built-in clock connectors let you synchronize the module to an external clock when troubleshooting asynchronous circuitry.

Single-point probe for high-frequency signals. You can use the single-point probe instead of the I/O module for higher-frequency signals, up to 40 MHz. You can also use it for parts of the board that cannot be accessed with an I/O module. Like the I/O module, the single-point probe can be used to drive a node high or low, to stimulate a node, and to gather various

types of response data. It can take signatures, sense logic levels, and count events or frequencies. An external clock module provides leads for testing asynchronous circuitry.



Get as much — or as little — automation as you want.

With the 9100 Series, you choose the degree of automation you want: Immediate Mode, for manual operation; Guided Fault Isolation, for complete automation of the troubleshooting process; or Unguided Fault Isolation, for semi-automated troubleshooting. If you do decide to automate, you'll find that many of the 9100 Series' special features — including the programming workstation, high-level programming language, and built-in Guided Fault Isolation decision tree — make the process easier and faster than you ever thought possible.

Manual operation lets you start testing immediately.

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 complete the built-in kernel tests. Then you can go on troubleshooting, using your knowledge of the unit under test to guide you. The mainframe keypad includes both hexadecimal and alphanumeric keys, so you can manually enter whatever data is needed.

To troubleshoot in Immediate Mode, select the first node you wish to test and attach the selected interface device (I/O module or probe). Then synchronize the interface device to the appropriate bus cycle. Next, key in the stimulus data and measure the response. The I/O Module and Probe measurement results are shown on the mainframe's three-line display. In the case of the single-point probe, color annunciators on the probe itself indicate logic levels: high, low or tri-state.

After completing the testing of the first node, you select another node and repeat the process. When you locate the circuit at which the input data is good but the output data is bad, you have successfully isolated the fault.

Obviously, to be able to work effectively in Immediate Mode, you need a high degree of familiarity with the board under test — both to determine the best probing sequence and to recognize whether the response is good or bad.

Fully automatic operation guides the operator from start to finish.

The 9100 Series' Guided Fault Isolation capability allows full automation of the troubleshooting process. 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 to do at each step of the process and interprets all response data.

Once a Guided Fault Isolation program has been written, the only action required to initiate it, is to tell the system which nodes are suspected of being faulty, so it will know where to start the node-oriented troubleshooting. This information can either be entered by the operator or passed to the GFI program from a prior functional test.

At each step of the process, the system tells the operator which node to probe, using a graphic display to assist in locating the pin in question. As soon as the operator indicates that the interface device is attached, the system runs the appropriate stimulus program, reads the response, and compares it with the known-good response for that node. If the response is good, the system directs the operator to the next suspect node. If it is bad, the system uses its built-in back-tracing algorithm, together with the reference data in its files, to locate the chip driving the input to the bad node. This process continues until the system has traced the fault back to its source.

A key advantage of the system's Guided Fault Isolation capability is that all operators can benefit from the knowledge of your most experienced test engineers. Once your test engineers write the Guided Fault Isolation procedures, lower-level operators can execute them, saving you considerable labor costs.

Semi-automatic operation lets you choose the troubleshooting sequence. For semi-automatic troubleshooting, you can use the 9100 Series to perform Unguided Fault Isolation. This mode is like Guided Fault Isolation, except that the operator decides which node to probe. However, much of the manual activity is removed from the process, so you can troubleshoot more rapidly.

Once a node is selected, the appropriate stimulus routine is executed and the results of the stimulus are displayed along with a suggestion on the next node to probe. You can either take the suggestion or type in a node of your own choosing. In this way, the operator guides the fault tracing procedure.

For experienced troubleshooters who prefer to follow their instincts rather than moving through a set troubleshooting sequence, Unguided Fault Isolation is the best technique.

The 9100A Programming Environment (With Option -004)

From its built-in back-tracing algorithm to its easy-to-use programming language, the 9100 Series lets you develop fully automated test and troubleshooting routines in a matter of days or weeks, as opposed to the months of development time required by many other systems.

Built-in GFI decision tree. The 9100A's specially designed back-tracing algorithm makes all the decisions about the troubleshooting sequence, allowing the programmer to enter the necessary information in simple data-base format and a stimulus program for each of the nodes on the unit under test. Information is stored in five kinds of files:

- **Stimulus programs to test each node.** The programs are designed to reveal all possible faults that could cause a particular node to fail. They don't need to be elaborate, however; in many cases, a series of reads or writes at the appropriate address is sufficient.
- **Known-good responses to compare with UUT responses.** After developing a stimulus program for a node, the programmer can use it on a known-good board to determine what a good response looks like. For each node, the programmer can select the most appropriate type of response: signature, logic level, frequency count, or event count. An interactive program provides guidance in developing these files.
- **A reference list relating the device number to the type of device.** This is a simple matter of linking each device reference number on the UUT to the type of device used (e.g., U2 = 2114), so the system will know which part to look up in the parts library.
- **A parts library that explains the relationship of input pins to output pins.** GFI requires a parts library with a description of each part on the UUT. A part description specifies all input pins which are related to each output pin. A library of the most common parts is provided with the 9100 programming software. A field-oriented editor allows you to add custom parts or other parts not included in the standard library.

Node Signal Src	Learned With	SIS	Response Data			Counter Range	Priority Pin
			Reyno LVL	Clk LVL	Counter Mode		
U3-6	I/O MODULE	FBS0	1 0	1 0	COUNT	96	
U3-6	I/O MODULE	56C7	1 0	1 0	COUNT	96	
U3-7	I/O MODULE	4496	1 0	1 0	COUNT	96	
U3-6	I/O MODULE	ACA3	1 0	1 0	COUNT	96	
U3-5	I/O MODULE	480B	1 0	1 0	COUNT	96	
U3-4	I/O MODULE	C900	1 0	1 0	COUNT	96	
U3-2	I/O MODULE	5688	1 0	1 0	COUNT	96	
U3-11	PROBE				COUNT		
U3-12	PROBE				COUNT		
U3-13	PROBE				COUNT		
U3-14	PROBE				COUNT		
U3-15	PROBE				COUNT		
U3-16	PROBE				COUNT		
U3-17	PROBE				COUNT		
U3-18	PROBE				COUNT		

- **Interconnectivity data, indicating which devices and pins make up each node.** The back-tracing algorithm uses this information to isolate the fault to a single component. If this information already exists in a CAD/CAE file, you may be able to download it directly, saving data-entry time.

```

*****
|BUS BUFFER WIGGLE
option = getspace space "MEMORY", type "WORD"
setoption option 1
state = gfi control
if state = "yes" then
  devname = gfi device
else
  devname = "/mod1"
end if
sync device devname, mode "pod"
sync device "pod", mode "DATA"
threshold device devname, level "TTL"
counter device devname, mode "gated"
arm device devname
  rampdata addr 20000, data 0, mask 1F
  rampdata addr 20000, data 0, mask 1F0
  rampdata addr 20000, data 0, mask 1F00
  rampdata addr 20000, data 0, mask F000
readout device devname
end program
  
```

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 program 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 module, and probe. A debugger is provided with breakpoint and single step capabilities to help you quickly locate any problems. You can also write administrative programs — for example, to track board failures and the associated faulty components for future analysis.

Programming for the 9100A is performed through an 80-column, 24-line CRT and a standard computer-style keyboard. The keyboard also includes nine soft keys with built-in functions to speed program development.

2Mb total memory (approximately 500Kb of working memory) lets you develop large applications. The 9105A has 1.5Mb memory.

Clear, easy-to-read three-line vacuum fluorescent display has a line length of 42 characters. Display is bit-addressable, allowing routines to include graphics (e.g., showing where to probe a particular chip).

Five soft-keys are user-programmable in Guided Fault Isolation and Unguided Fault Isolation Modes. In Immediate Mode, the default values of these keys are used. Soft-key labels are displayed on the bottom line of the three-line display.

Powerful Motorola 68000 microprocessor allows fast execution of all tests.

Microprocessor pod gives you direct control of the microprocessor bus circuitry. Pods are available for more than 50 microprocessor chips, including the new 80286.

Single-point probe/pulser can measure signals up to 40 MHz and generate stimulus signals up to 35 kHz. The probe is particularly useful for portions of the board that cannot be accessed with the I/O module. A clock module (not shown) provides connections to external clock signals for troubleshooting asynchronous circuitry.

16 hexadecimal keys as well as alphanumeric keys allow programmers to easily respond to system prompts.

Two RS-232-C serial ports allow data transfer to and from the tester. One is isolated, for use with the UUT. The non-isolated port is typically used for connection to a computer or printer.

Micro floppy disk drive allows the transfer of programs and data between 9100s and 9105s.

20-Mb hard disk allows convenient storage of multiple programs. (Standard on 9100A only).

Annunciators display mainframe status (BUSY, STOPPED, RUN UUT), show when a disk is being accessed, and indicate the availability of more display information (MORE SOFT KEYS, MORE INFORMATION).

HELP key provides context-oriented help in Immediate Mode.

Mode control keys control application of test routines: Loop, Repeat, Stop, Continue.

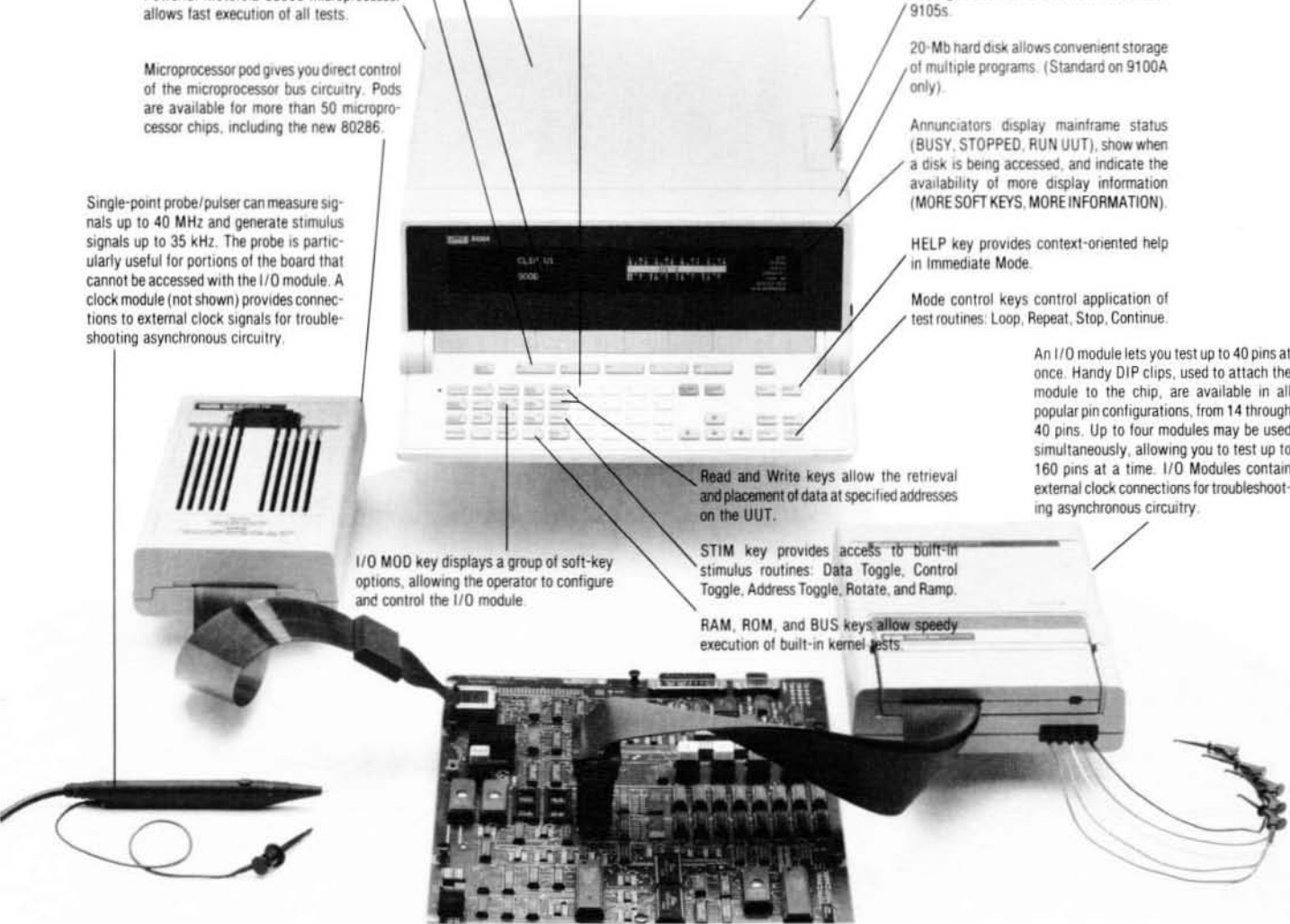
An I/O module lets you test up to 40 pins at once. Handy DIP clips, used to attach the module to the chip, are available in all popular pin configurations, from 14 through 40 pins. Up to four modules may be used simultaneously, allowing you to test up to 160 pins at a time. I/O Modules contain external clock connections for troubleshooting asynchronous circuitry.

I/O MOD key displays a group of soft-key options, allowing the operator to configure and control the I/O module.

Read and Write keys allow the retrieval and placement of data at specified addresses on the UUT.

STIM key provides access to built-in stimulus routines: Data Toggle, Control Toggle, Address Toggle, Rotate, and Ramp.

RAM, ROM, and BUS keys allow speedy execution of built-in kernel tests.



The 9105A Test Program Execution

The 9105A is an execute only version of the 9100A. It performs the same immediate mode operations as the 9100A and it will execute all programs written on the 9100A but you can not write programs with the 9105A. It has 1.5 Mbyte of RAM memory space and two floppy disk drives rather than a hard disk drive.

Applications and Programming Support

Fluke's application and programming support programs are designed to meet the needs of a wide variety of users.

Applications course. The 9100 Series offers you a choice of test techniques as well as a variety of circuit-interface devices. The best choice for a particular situation depends both on the type of circuitry involved and on your objective (functional test, fault isolation, etc.) Fluke's applications course shows you how to apply the 9100 Series to a wide range of circuits commonly found in microprocessor-based systems, so you can select the most appropriate test technique and interface device for each application.

Programming course. Programming the 9100 Series is easy, but you may still benefit from guidance in how to develop effective Guided Fault Isolation routines for different types of test and troubleshooting procedures. Fluke's programming course will help you get the most from the system's Guided Fault Isolation capabilities.

Contract consulting and programming. Fluke's contract consulting and programming services offer still other options for applications and programming support. You can contract with us for consulting help as you work on your own applications and programs, or you can have us simply develop programmed routines for you, customizing them to your particular products and procedures. Contact your local Fluke representative for availability.

Maintenance Support.

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. Your 9100 Series tester comes with a 90-day warranty, including both time and materials. Warranty service is available at any Fluke technical center, worldwide.



Maintenance options. After the expiration of the warranty period, you have a choice of several maintenance options:

- A flat-rate repair price (available in the U.S. only).
- An annual maintenance agreement, covering service and repair at any Fluke technical center.
- An annual on-site maintenance agreement, covering service and repair at your location.
- A module exchange program, allowing you to swap defective modules for good ones at a lower price than if you just purchased the new module.

9100 Features

Mainframe: 20 Mbyte Hard Disk for program development and storage (9100A). Single (9100A) or Dual (9105) 3.5 inch 687 K-byte MicroFloppy Drives for software loading, storage and copying. 16 bit μ P with 2.0 Mbytes (9100A) or 1.5 Mbytes (9105A) of internal RAM for program and data storage. Plug-in slots for 1 pod and 4 Parallel I/O Modules. Dual RS-232 Interfaces, one system referenced, one earth referenced.

Display: 3 line, 42 characters vacuum fluorescent dot matrix with graphics capability.

Keypad: User keyboard allows access to all functions. Seldom used functions are called with soft keys.

Built-In Tests

RAM: Allows selection of one of three possible tests for finding faults associated with RAM circuitry.

ROM: Reads ROM and computes CRCs and compares with stored CRC.

Bus: Checks the integrity of address, data and control bus.

Built-in Troubleshooting Functions

Read: Reads data from a specified location.

Write: Writes 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 data 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 from 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; .ip 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 break-point, 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 are identical. Procedures generated on the 9100A will also run on the 9105A. Procedures are transported from the 9100A to the 9105A on a 3.5 inch micro-floppy disk.

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 Manual: How to write test or troubleshooting programs using the 9100A's TL/1 programming language.

9100A/9105A Electrical Specifications

Single Point Probe Input Thresholds

TTL	CMOS	RS-232	
5.0V	5.0V	30V	GUARANTEED HIGH high or invalid
2.6V	3.7V	3.2V	
2.2V	3.3V	2.8V	GUARANTEED INVALID low or invalid
1.0V	1.2V	-2.8V	
0.6V	0.8V	-3.2V	GUARANTEED LOW
0.0V	0.0V	-30V	

Input Impedance: 70 k Ω shunted by less than 33 pF

Data Timing for Synchronous Measurements

Maximum Frequency: 40 MHz

Minimum Pulse Width (H or L): 12.5 nsec

Minimum Pulse Width (tri-state): 20 nsec

Setup Times

Data to Clk: 5 nsec

Start, Stop or Enable to Clk: 10 nsec

Hold Time

Clk to Enable: 10 nsec

Clk 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 \pm 20 nsec

RS-232: 2000 nsec \pm 400 nsec

Transition Counting

Maximum Frequency: 40 MHz minimum

Maximum Count: 16777216 +overflow

Maximum Stop Count: 65536 clocks

Frequency Measurement

Maximum Frequency: 40 MHz minimum

Resolution: 20 Hz

Accuracy: \pm 250 ppm \pm 20 Hz

Output Pulsar

High: $>$ 3.5V @ 200 mA for less than 10 μ s; @ 1% duty cycle $>$ 4.5 @ 5 mA continuously

Low: $<$.8V @ 200 mA for less than 10 μ s; @ 1% duty cycle $<$.4V @ 5 mA continuously

Clock Module Specifications

Input Threshold: 1.6V \pm 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, 19600

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

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: 90 to 132V ac 47 to 440 Hz; 180 to 264V ac 47 to 63 Hz

Power Consumption: Mainframe, 150W max; monitor, 50W max

Size:

Mainframe: 14.0 cm H x 34.3 cm W x 50.8 cm D (5.5 in x 13.5 in x 20.0 in)

Monitor: 305.3 cm H x 335.3 cm W x 330.0 cm D (12.02 in x 13.2 in x 13 in)

ASCII Keyboard: 5.02 cm H x 21.15 cm W x 47.2 cm D (2.0 in x 8.33 in x 18.51 in)

Weight:

Mainframe 40 kg (18.2 lb)

Monitor 40.9 kg (18.6 lb)

ASCII Keyboard 1.59 kg (3.5 lb)

Safety: Designed to meet the following safety standards: ANSI/UL 478, IEC 348, IEC435, and CSA 5568

Options

9100A-003 Parallel I/O Module

Features:

CRC signatures with external Start, Stop, Enable clocked on pod sync 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 during overdrive.

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.

Drive of any arbitrary pattern of 0, 1, or 3-state.

Comparison of any arbitrary 40 bit pattern with a programmable 40 bit pattern of 0s and 1s. 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.

Electrical Specifications

Data Output Specifications:

Current, time >10 mS: ± 200 mA

Current, <10 mS: ± 2 A

Pattern Rate, 1 module driven: 35 kHz

Pattern Depth, (1 module driven during 10 mS high current pattern drive mode): 256 patterns

Max current, per pin (driving high): 275 mA

Max current, per pin (driving low): 150 mA

Data Inputs: Input Impedance: 50 k Ω min

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 max; Logic high 2.0V min

Input Current: ± 1 μ A

Input/Output Overvoltage Protection: ± 15 V for one minute maximum, any pin, one at a time

Transition Counter

Max Frequency: 10 MHz minimum

Max Count (Transition Mode): 8388608 counts (+overflow)

Freq Accuracy (Freq Mode): ± 250 ppm ± 2 Hz

Stop Counter

Max Frequency: 10 MHz

Max Count: 65536 clocks

Clock:

Max Frequency: 10 MHz

Min Pulse Width: 50 nsec

Timing for Synchronous Measurements

Max Frequency of Clock: 10 MHz

Max Frequency of Data: 5 MHz

Data Setup Time: 30 nsec

Data Hold Time: 30 nsec

Minimum Pulse Width (Data): 75 nsec

Minimum Pulse Width (Start/Stop/Enable/Clock): 50 nsec

Start Edge Setup Time (before clock edge, for clock edge to be recognized): 9 nsec

Stop Edge Hold Time (after clock edge, for clock edge to be recognized): 10 nsec

Enable Setup Time (before clock edge, for clock edge to be recognized): 0 nsec

Enable Hold Time (after clock edge, for clock edge to be recognized): 10 nsec

Data Timing for Asynchronous Measurements

Max Frequency: 10 MHz

Minimum Pulse Width (high or low): 50 nsec

Min pulse width (tri-state): 150 nsec

Data Compare Equal (DCE): Min pulse width of Data and Enable 75 nsec

Models

9100A/SYS Digital Test Programming System

- 9100A Digital Test System
- 004 Programmer's Station
- 003 Parallel I/O Module
- Y9100A-DCS Dip Clip Set

9100A Digital Test System

- Probe with accessories
- Clock Module with accessories
- Manuals

- Getting Started
- Automated Operations
- Technical Users
- Applications
- System Software Disk #1 and #2
- Master User Disk
- Y8091 10 Micro-Floppy Diskettes
- One 2-Day Training

9100A-004 Programmer's Station

- Programmer's System Disk
- Monochrome Monitor
- Manuals

- Programmer's TL/1 Reference
- Video Card (monochrome config.)
- Video Cable
- Programmer's Keyboard
- One 5-Day Training Certificate

9100A-005 Programmer's Station

- Less Monochrome Monitor
- Programmer's System Disk
- Manuals

- Programmer's TL/1 Reference
- Video Card (color config, IBM color compatible)
- Programmer's Keyboard
- One 5-Day Training Certificate

9105A Digital Test Station

- Probe with accessories
- Clock Module with accessories
- Manuals

- Getting Started
- Automated Operations
- Technical Users
- Applications
- System Software Disk #1 and #2
- Master User Disk
- Y8091 10 Micro-Floppy Diskettes

9100A/9105A Options

- 9100A-003 Parallel I/O Module
- 9100A-009 Monochrome Video
- 9100A-011 Color Video Card

9105A Options

- 9105A-007 512K Memory Expansion
- 9105A-008 Real-time Clock

Accessories

- Y8091 3.5 inch Micro-Floppy Diskettes
- Y9100A-14D High Quality Dip Clip Module, 14 Pin
- Y9100A-16D High Quality Dip Clip Module, 16 Pin
- Y9100A-18D High Quality Dip Clip Module, 18 Pin
- Y9100A-20D High Quality Dip Clip Module, 20 Pin
- Y9100A-24D High Quality Dip Clip Module, 24 Pin
- Y9100A-28D High Quality Dip Clip Module, 28 Pin
- Y9100A-40D High Quality Dip Clip Module, 40 Pin
- Y9100A-14S SO Clip Module, 14 Pin
- Y9100A-16S SO Clip Module, 16 Pin
- Y9100A-20S SO Clip Module, 20 Pin
- Y9100A-24S SO Clip Module, 24 Pin
- Y9100A-20L Flying Lead Module, 20 Lead
- Y9100A-DCS Dip Clip Set

Service & Support

Micro-System Troubleshooters

9000 Series

IEEE-488

RS-232



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 IEEE 488 is standard for 9020A)

Special Functions

(A) Preprogrammed functional tests, offer structured testing and troubleshooting of the μ p's BUS, RAM, ROM and I/O Registers.

(B) TROUBLESHOOTING functions read, write patterns used for programming and stimulating peripheral devices such as PIAs, CTCs, UARTs, etc.

(C) Optional RS-232 controls for easy downloading of programs and test results to storage mediums, printers and other testers at remote locations. Optional IEEE-488 for computer controller operation (9020).

(D) TAPE deck controls for storing and reading programs and UUT memory maps with the mini-cassette.

(E) LEARN function which is used on a "known good" system, finds and maps RAM, ROM and read/writable I/O addresses.

(F) Hexadecimal entry of address descriptors.

(G) MODE control of tests and programs.

(H) TEST SEQUENCING and ARITHMETIC keys for creating unique user-generated test routines.

(I) PROBE controls used for synchronizing the troubleshooting probe to μ P cycles and to drive nodes high and/or low.

(J) Pod design provides for easy servicing. 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.

Partial List of Processors Supported

1802	6802NS	8035	8050	8741	Z8001
1804	6808	8039	8051	8741A	Z8002
1805	6809	8040	8052	8742	Z8003
1806	6809E	8041	8080	8744	Z8004
6502	80186	8041A	8085A	8748	Z800A
6800	80188	8042	8085-2	8749	Z80B
68000	New 80286	8044	8086	8751	
68010	8031	8048	8088	9900	
6802	6802	8049	8344	8032	

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 downloaded from a minicassette 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 IEEE 488 port.

Read/Write Emulation

The 9000 Series Micro-System Troubleshooters eliminate tedious, 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.

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 location 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 download it from a minicassette — 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 minicassette for later use (9005A/9010A).

Beyond the Bus

The 9000 Series Troubleshooters aren't limited to finding bus-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 specified 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 minicassettes 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 page 255.

A Powerful Test System Using the Fluke 9020A

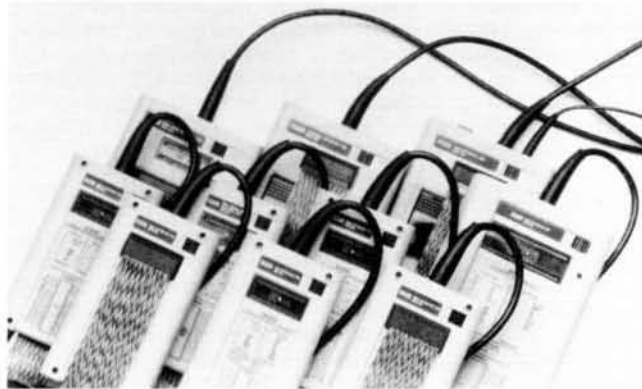
The combination of a Fluke 9020A Micro-System Troubleshooter with an IBM or IBM-compatible personal computer and Fluke's TestWriter™ software (see page 256 for more information) gives you a powerful system for performing large-scale guided fault-isolation. In this system, the 9020A is used to stimulate 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.



Micro-System Troubleshooters

9000 Series



Interface Pods

- 50 microprocessors supported (April 1987)
- Adapter kits available for other microprocessors
- Easy connection to unit under test
- Intelligent pods with built-in software*
- Quick memory tests*
- Quick looping Reads and Writes*
- Built-in self-diagnostics

*Available on some pod models only. See Table 1 for a listing of pods offering these features.

How the Interface Pod Works

The interface pod functions as the test interface between the suspect circuit board and the troubleshooter mainframe, adapting the general architecture of the mainframe to that of the specific microprocessor system under test. When you plug the pod into the unit under test, you are effectively replacing the microprocessor in that unit with the microprocessor in the pod.

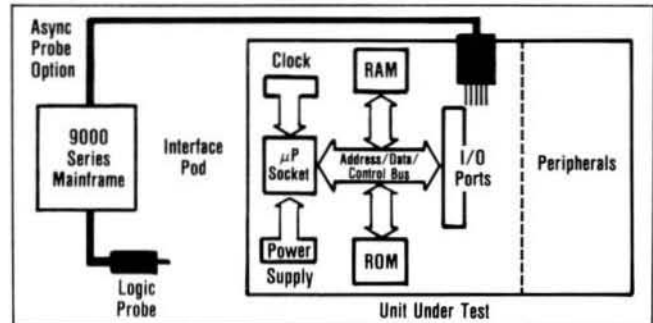
This unique test connection gives the Fluke troubleshooter mainframe the ability to access board and system components *directly*, through the central control element of the entire system — the microprocessor. As a result, you get exceptionally high-confidence test results.

Unlike emulators and development systems intended for software debugging, these interface pods are designed specifically for hardware troubleshooting. Each pod is a self-contained system with its own microprocessor, RAM, ROM, and I/O memory space. This means that the unit being tested does not need to be operating for the Fluke troubleshooter to begin testing. It also means that you can test for multiple faults by simply disabling each faulty line as it is identified and continuing to run the tests.

Each pod includes a RUN UUT function to let you test the unit's operation as through it were operating under its own microprocessor. When this function is activated, it electrically disconnects the unit being tested from the pod, letting it perform as if its microprocessor were still in the socket.

Microprocessors Supported

Fluke interface pods currently support an extensive range of microprocessors, as shown in Table 1. New pods are added regularly to support additional microprocessors as they are introduced.



Product Concept: The shaded areas in the diagram are tested by the 9000 Series automatic functions; Asynchronous Signature Probe extends coverage to I/O ports and peripherals.

The interface pod obtains its clock signal from the unit under test and runs at the same speed as the unit. Since manufacturers often build a particular microprocessor in different versions, each running at a different clock speed, Fluke selects the fastest clock speed available when designing its pods. In this way, it ensures the pod's ability to test any processor in that family, regardless of clock speed.

Advanced Pod Features

As microprocessor technology advances, Fluke has made its pods correspondingly larger and more powerful. Accordingly, the newer pods (indicated by an * in Table 1) offer advanced features not available in some of the earlier models. These include more intelligence, interrupt features, quick memory tests, and quick looping read and write tests.

Table 1. Microprocessors Supported by Fluke Interface Pods

System μ P	Pod Model #	System μ P	Pod Model #
1802	9000A-1802*	8048	9000A-8048*
1804	9000A-1802*	8049	9000A-8048*
1805	9000A-1802*	8050	9000A-8048*
1806	9000A-1802*	8051	9000A-8051*
6502	9000A-6502	8052	9000A-8051*
6800	9000A-6800	8080	9000A-8080
68000	9000A-68000*	8085A	9000A-8085
68010	9000A-68000*	8085A-2	9000A-8085
6802	9000A-6802	8086	9000A-8086*
6802NS	9000A-6802	8088	9000A-8088*
6808	9000A-6802	8344	9000A-8051*
6809	9000A-6809	8741	9000A-8048*
6809E	9000A-6809	8741A	9000A-8048*
80186	9000A-80186*	8742	9000A-8048*
80188	9000A-80188*	8744	9000A-8051*
8031	9000A-8051*	8748	9000A-8048*
8032	9000A-8051*	8749	9000A-8048*
8035	9000A-8048*	8751	9000A-8051*
8039	9000A-8048*	9900	9000A-9900
8040	9000A-8048*	Z8001	9000A-Z8000*
8041	9000A-8048*	Z8002	9000A-Z8000*
8041A	9000A-8048*	Z8003	9000A-Z8000*
8042	9000A-8048*	Z8004	9000A-Z8000*
8044	9000A-8051*	Z80A	9000A-Z80
New 80286	9000A-80286*	Z80B	9000A-Z80/AA

* Incorporates one or more advanced features (see discussion under "Advanced Pod Features" in this section.)

Note: For microprocessors not found in this table, contact your local area Fluke Sales Office or Representative for a copy of Technical Data B0156, "User-Designed Interface Pod Adapters."

IBM is a registered trademark of International Business Machines Corporation.
Kay Pro II is a registered trademark of Non-Linear Systems, Inc.

More Intelligence. Many of the newer 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 newer pods also 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.

Quick Memory Tests. Fluke has increased the speed of memory testing in many of its newer pods, including the 8051, 8086, 8088, Z8000, 68000, 80186, 80188, and 80286 building Quick RAM and Quick ROM tests into the pod software. In addition to greatly reducing the test time, these tests provide:

- A choice of byte or word test for the 16-bit microprocessors
- A choice of address increment size
- More flexibility under program control

The Quick RAM test consists of two parts. The first rapidly tests the read/write capabilities of either small segments of memory or the entire block of RAM. The second, a pattern verification test, verifies that memory addresses are being properly decoded and checks dynamic RAM memory for refresh problems, verifying its ability to retain accurate information.

The Quick ROM test uses a checksum procedure to test the ROM for faults. It also finds any inactive data bits (bits that always read high or low regardless of the ROM address selected).

Quick Looping Read or Write. The Quick Looping Read or Write function rapidly performs continuous Reads or Writes at a specified address. This feature lets you easily view bus signals on an oscilloscope synchronized to the TRIGGER OUTPUT pulse (located on the rear panel of the Troubleshooter). By increasing the repetition rate of the oscilloscope trace, this function makes the trace signal brighter and therefore easier to see.

Special Circuitry

Because the pod is intended to be used with defective micro-systems, Fluke designed it with special input protection circuitry. This circuitry provides overvoltage protection on each line to the unit under test — even if the pod is plugged in backwards. Other pod circuitry monitors and checks each read/write operation as it is performed. A self-test socket is included for verifying proper pod function.

Options and Accessories

9000A-910 Utility Tape

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 minicassette 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 minicassette that describes how to use each of these programs.



9010A Language Compiler

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 than ever before. The Compiler is available in several versions, offering compatibility with the following computer systems:

- IBM™ Personal Computer
- Kay Pro™ II
- Fluke 1720A and 1722A Instrument Controllers

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 File Inclusion features, 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.

9000A-006 Asynchronous Signature Probe Option

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.

9000 Series

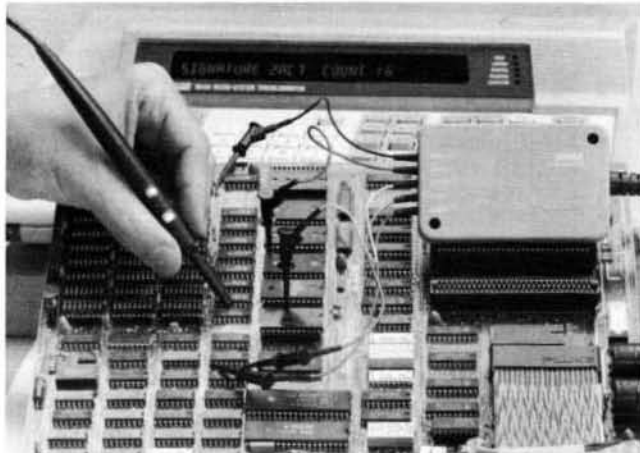
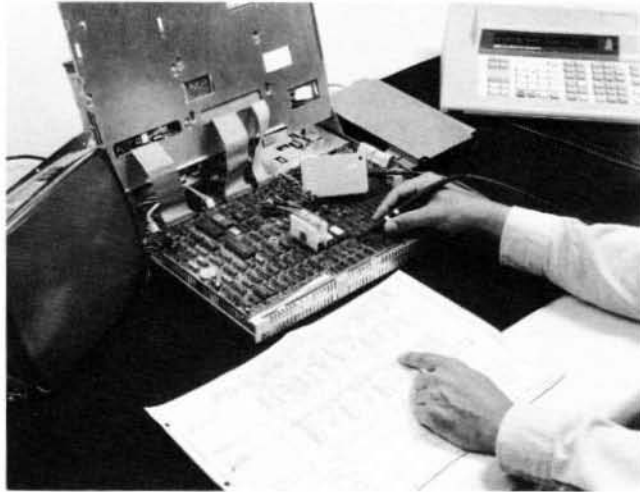
By adding the Asynchronous Signature Probe to your Fluke troubleshooter, you gain the ability to perform real-time measurement of such asynchronous circuits such as:

- 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 minicassette tape.



9020A-925 TestWriter

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 your own guided fault-isolation programs for digital circuit testing. In this configuration, the personal computer, communicating with the 9020A-001 through its RS-232-C interface, acts as both a system controller and a storage medium.

TestWriter is especially helpful for developing large-scale guided fault-isolation programs — both because of the large amount of memory in the personal computer and because of the time-saving features of the software. Using TestWriter, a test engineer can realize as much as a five hundred percent increase in programming efficiency.

To develop a TestWriter program, the test engineer begins by describing the board to be tested. TestWriter's built-in fault tree makes this simple, since it eliminates the time-consuming process of entering individual decision statements. The test engineer simply enters the type and interconnectivity information for the unit under test, and then creates a stimulus routine for the circuit; the fault tree does the rest.

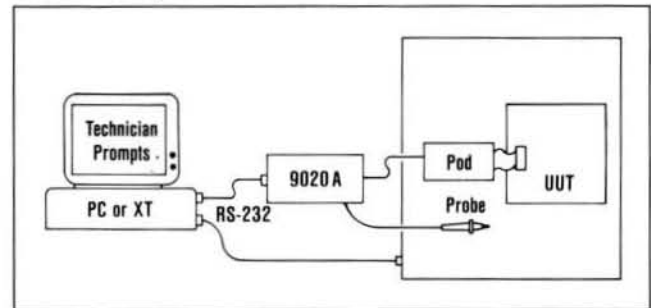
The next step is to gather reference data from a known-good unit. Using the 9020A and the appropriate interface pod, the test engineer stimulates each node of the reference unit's circuitry, with the personal computer recording and storing the response.

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.

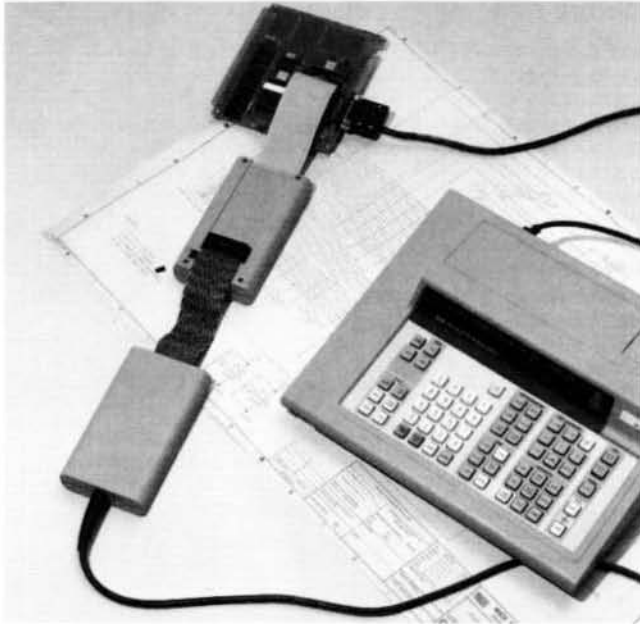
For cases where the operator is experienced in troubleshooting a particular board, TestWriter also allows unguided fault isolation, in which the operator decides the order in which nodes are to be tested.

Test Station Configuration



Pod Adapter Packaging Kit

Allows testing of many microprocessor systems not directly supported by a Fluke interface pod. 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.



Transit Cases

Lockable hard case holds 9000 Series pod, probe, accessories, four mini-cassette tapes, and user's manual. Foam-lined, sturdy construction.



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. Pod has 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). Minicassette 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 $\pm 30V$.

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 minicassette — or 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 and interface pods display an error message if they detect a bad clock signal.

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.
- **SYNC** — 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 minicassette); -40°C to +70°C non-operating temperature (+4°C to +50°C for minicassette)

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 (11 lb) mainframe; 0.7 kg (1.5 lb) per interface pod

Included: Probe, probe accessories, two minicassettes (none with 9020A), manuals, power cord

Models

9005A Micro-System Troubleshooter

9010A Micro-System Troubleshooter w/Program Functions

9020A-001 Micro-System Troubleshooter w/RS-232-C Interface

9020A-002 Micro-System Troubleshooter w/IEEE-488 Interface

Options

9010A-001* RS-232-C Interface for 9010A or 9005A

9000A-910 Utility Tape for 9010A or 9005A

9010A-920 Language Compiler compatible w/Fluke 1720A

& 1722A Instrument Controllers & 9010A or 9005A

9010A-922 Language Compiler for Kay Pro® II

& 9010A or 9005A

9010A-923 Language Compiler for IBM Personal Computer

& 9010A or 9005A

9000A-006* Asynchronous Signature Probe for 9005A,

9010A or 9020A

9020A-925 TestWriter Software for 9020A

**Service Center installable only. Other user-installable.*

Interface Pods

9000A-Z80

9000A-Z80/AA

9000A-Z8000**

9000A-1802**

9000A-6502

9000A-6800

9000A-6802**

9000A-6809**

9000A-8048**

9000A-8051**

9000A-8080

9000A-8085

9000A-8086

9000A-8088

9000A-9900

9000A-68000**

9000A-80186

9000A-80188

9000A-80286

***Each of these pods supports a family of microprocessors.*

Accessories

9000A-200 Pod Adapter Packaging Kit

9000A-900 Transit Case

Y8007 Ten-Pack of Minicassettes

Service & Support



RS-232



3200B

3200B Manufacturing Defects Analyzer

- High-speed testing of bare and loaded boards, backplanes, cables, and harnesses
- Industry leading measurement accuracy and ranges
- 65,536 possible test points
- Multisite testing for greater throughput
- Pin-verification testing
- Semiconductor junction testing
- Resistance measurements for resistor values and component-orientation testing
- Autolearn software for ease of use
- Smart assign/locate probe
- Verification program for system diagnostics
- Menu-driven software for easy file generation
- RS-232-C interface for up/down loading to CAD and other external computer systems
- Available fixturing gives complete systems
- Test Data Analysis — data logging software

In electronics manufacturing, the earlier you find a fault, the more time and money you save. Fluke's 3200B Manufacturing Defects Analyzer increases the efficiency of your production line by accurately identifying up to 80%* of all possible board defects at the earliest possible point in the manufacturing process (loaded board).

With the 3200B, you can screen out simple shorts and opens on bare boards, before they leave receiving inspection. On loaded boards, the 3200B lets you find and repair shorted, missing, incorrect, inverted, or dead components, as well as open or shorted traces, at speeds far exceeding those of functional and in-circuit test systems.

Our proprietary Ratiometric Measurement Technique and Dual Threshold Autolearn combine to give the 3200B resolution, fault coverage, and fault classification second to none.

With its high fault coverage, low cost, and rapid test speeds, the 3200B is ideally suited for testing boards early in the manufacturing process.

Easy and Versatile

Autolearn Software. The 3200B's Autolearn software gives new meaning to the term "user-friendly," making system operation so easy that most users can begin testing the first day. This software lets you create a test program automatically for any application by using a known-good unit as a reference.

*Industry average

10

Assign/Locate Probe. The 3200B comes with a smart probe that makes it easy to assign schematic designations or your own nomenclature to specific test points, so you don't need to refer to a cross-reference table to interpret fault reports. In locate mode, the probe is also a valuable tool for debugging programs or test fixtures.

High Pin Count. Fluke's proprietary scan chip lets the 3200B test more than 65,000 pins, far exceeding the test requirements of any board available today. This high-performance capability protects you against early obsolescence, as well as supporting multiple test sites and universal fixtures.

Pin Verification. Before loaded-board testing, the 3200B performs pin-verification checks to make sure that test fixture pins are actually in contact with the board being tested. This procedure ensures the validity of later test results.

Semiconductor Junction Testing. The 3200B verifies both the presence and the orientation of each junction element, checking to see that the component is correctly mounted and functioning properly. Components checked include diodes, transistors, and integrated circuits.

Measurement Commands. The 3200B also includes a set of resistance, capacitance, and inductance measurement commands to test for specific values between points where reactive or resistive components exist.

Multi-Site Testing. As your test demands increase, computer power already resident in the 3200B lets you add expansion cards to the system, tying a second, third, or fourth test site to the mainframe. This is a cost-effective way to expand your testing capabilities: you can add an extra station for a fraction of what you'd pay to add a new tester. With the flexibility of the 3200B, you can either use the same test program at multiple sites or have each site specialize in testing a different type of equipment — for example, testing bare boards at one site and loaded boards at another.

Remote Operator Console. Each test station is equipped with a Remote Operator Console. Operators enter the test program numbers, their own identification, and the date; prompts walk them through the remaining steps. A key lock on the Console prevents unauthorized modification of existing test programs.

Communications Interface. The system's RS-232C interface speeds test programming on new PCBs, letting you download test files from CAD equipment or transfer nomenclature lists from an external computer.

Off-Line Programming. The 3200B includes an off-line programming station, allowing you to develop and edit test programs at the same time as you are testing. The programming station consists of a video display, keyboard, and microcomputer with dual floppy disk drives.

System Self-Tests. You can also use the system's off-line diagnostics at any time to check the status of the test processor, measurement, and scan electronics.

Options. Options available with the 3200B include:

- A 132-column, high-speed impact printer to augment the system's built-in 35-column printer; useful for printing program listings and expanded fault reports.
- A foot switch for foot control over "Start" and "Continue" commands.
- Measure command software, to test for specific values between points where reactive or resistive components exist.
- Expansion cards for distributing test capabilities at multiple sites. You can test loaded boards at up to two sites, and perform any combination of bareboard or backplane testing at up to four sites.
- Bar code reader.
- Test Data Analysis software used with IBM Personal Computer and Lotus 1-2-3 (not included) for data logging.

3218 Test Fixturing System

- High point count
- Vacuum-actuated receiver
- Wireless connections between receiver test points and scan cards
- Linear motion bearings for reliable contact with UUT
- Efficient sealing system
- Precision-mated spring probes
- Easy to service and maintain
- Economical
- Test fixtures fully customized or in kit form

The 3218 Test Fixturing System, designed for use with the 3200B Manufacturing Defects Analyzer, offers an accurate, reliable, and economical solution for testing circuit boards. It consists of two parts: a receiver and a test fixture.

Vacuum Receiver Offers High Point Count

The 3218 receiver is designed for versatility, reliability, long life, and ease of maintenance. It offers a high point count, with the ability to handle wiring configurations of up to 4096 points. The connection between receiver test points and scan cards is wireless, with pin receptacles mated directly to the scan card connector. This design reduces stray capacitance and makes tests less susceptible to electrical noise interference. Linear motion bearings ensure precise alignment between the receiver and the test fixture, while the hinged construction of the unit allows easy access for maintenance.

Test Fixture Ensures Precise Alignment

Test fixturing is available in kit form or fully customized by Fluke.

The 3218 test fixture is a precision device, designed to give you consistent, accurate test results. Both the top plate and base plate use quad linear motion bearings, ensuring precise alignment and reliable contact with the unit under test every time vacuum is applied. The fixture's small vacuum evacuation area is equipped with a highly efficient sealing system, eliminating the risk of dust and dirt contamination between the unit under test and the test fixture pins.

The thermoplastic injection-molded construction of the test fixture makes it lightweight and easy to handle. Servicing the unit is also simple: you can assemble or disassemble it in minutes. All components are accessible, both for making engineering changes to accommodate design revisions and for debugging the unit under test — even when vacuum is being applied. And the fixture's snap-latch opening and hinged construction provide easy access to wiring, probes, receptacles, and the receiver/test fixture interface.

Precision-Mated Spring Probes

Fluke offers a full line of quality spring probes to use with your 3218 test fixture. These precision-mated parts result in smooth traveling probes at either extreme of operation. A roll-crimped probe receptacle provides a gas- and air-tight connection that holds up to production-testing demands. Probes are available in a variety of styles, in both 4-oz. and 8-oz. spring force.

Specifications

Test Points: Maximum of 65,536 for each 3200B system; individual switchboard has 128 points

Interface Cabling: Daisy-chained; one cable for each 2048 test-point array

Dual Continuity Thresholds: Loaded boards — short, 10 Ω -10 k Ω , programmable; open, 1 k Ω -10 k Ω , programmable. Bare boards, backplanes — short, 10 Ω -10 k Ω , programmable; open, 1 k Ω -100 k Ω , programmable

Test Stimulus Voltage for Continuity: Loaded boards, 300 mV; bare boards, backplanes, and cables, 8V

Junction Tests: Two-point programmable tests from 250 mV to 8V, with tolerance range, for diodes, transistors, and ICs

Test Statistics: Reports quantity of units tested, and quantity and percent that passed

Programming: Autolearn Software lets 3200B automatically learn continuity patterns from known-good unit; manual program entry available at off-line programming station; can download programs from CAD systems and other external computer systems

Program Storage: Dual 8-inch, double-sided, double-density disk drives; 1.25 MByte storage per drive

Assign/Locate Probe: Single-point probe for convenient assignment of user-defined nomenclature

RAM: 512K standard expandable to 1 megabyte

CRT Terminal: 14", 80 columns x 24 lines, upper/lower case ASCII characters, 7 x 9 character font

Test Sites: On one 3200B, up to two test sites for testing loaded boards; up to four for testing any combination of bare boards, backplanes, and harnesses

Remote Operator Console: One per test site. Includes:

Display: Four-digit LCD for numeric data entered from key pad

Controls: Learn, bare board, loaded board, backplane. Set dual HI/LO threshold limits, operator ID number, day/month, test/continue, job number, print first fail, print statistics, clear statistics, print program listing, enter data, save auto-learn data file on UUT, reset abort, paper advance

Indicators: Test, reset, halt, power on/off, pass/fail

Printer: 35-column impact printer, 60 cps, upper/lower case ASCII characters

Keylock: Protects test programs from unauthorized modification

I/O: External input connection for installing foot switch or assign/locate probe; external RS-232-C port

Communications Port: External RS-232-C port for up/down loading from CAD and other external computer systems. Maximum baud rate, 9600; asynchronous

132-Column printer (optional): Model 3058A Impact Printer; 160 cps

General Specifications

Temperature: +10°C to +38°C

Power: 500W

Size: 58 in H x 72 in W x 32 in D

Weight: 850 lb

Training

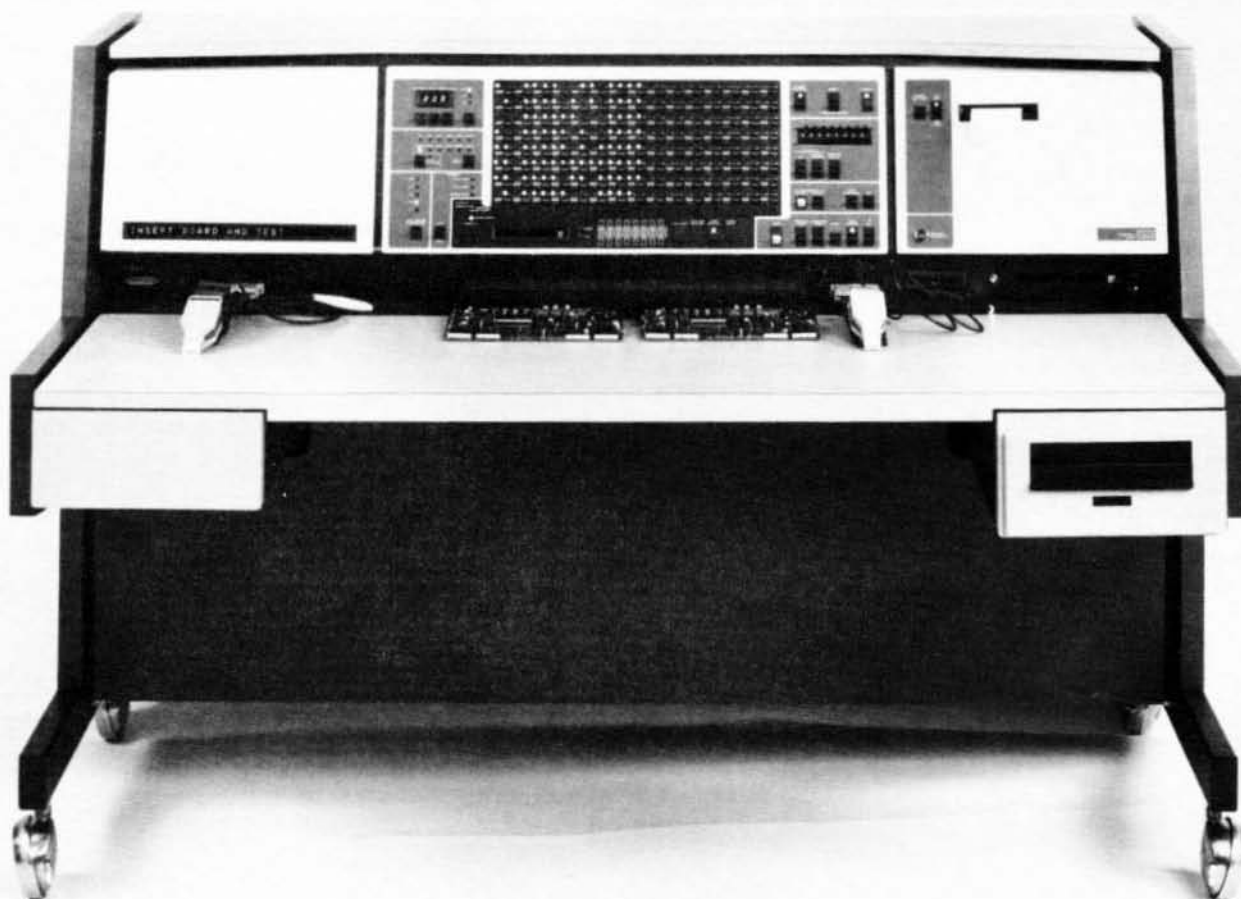
3200 Board Tester Maintenance

Prepared with an understanding of the System Component locations. Theory of Operation, Special Diagnostic utility programs. Alignment checks and Troubleshooting Tests, it is the intention and objective of this five-day course that you be able to maintain and repair the 3200B Manufacturing Defects Analyzer to the Subassembly, board, or module level. (See page 273 for more details.)

3050B



RS-232



(NSN 6625-01-202-5309) **3050B**

3050B Digital/Analog Functional Test System

- Reference board testing for flexible, low-cost functional testing
- Single-board test using signature-based diagnostics
- Automatic Diagnostic Software
- Test Management System
- Automatic Fault Emulation
- Analog comparison for testing analog waveforms
- Analog test station with IEEE-488 port for comprehensive testing of analog boards
- Off-line programming station
- 1780A InfoTouch® Display
- Built-in 35-column printer

Locating functional board failures before they become system failures is the surest route to high production yields — but with price tags of half a million dollars or more, functional testers have typically been out of reach

of most production or repair operations. The Fluke 3050B Digital/Analog Functional Test System is the answer, offering comprehensive functional testing at confidence levels of 98% or higher, for an initial investment as low as \$114,500.00 (US list price).

The 3050B performs comprehensive functional testing, detecting difficult-to-locate dynamic faults. It can handle your toughest functional testing challenges, from hybrid circuitry to complex boards with surface-mounted devices — and its versatility makes it useful for rework and repair applications, as well. With the 3050B, you'll experience higher throughput, fewer defective boards at the system-test level, and a lower level of work-in-process.

Reference Board Test Procedures

The 3050B is much less expensive than most functional testers because its test procedures are based on a different technology. Instead of simulating the performance of the unit under test, which can require an enormous software library, the 3050B compares a known-good reference board to the unit under test. This approach not only costs less but offers far greater speed and accuracy. It also makes it much easier to keep your test procedures current as design changes are made in hardware and firmware: in many cases, you can accommodate these changes simply by changing the reference board.

Single Board Test

For applications that involve testing a wide variety of boards, the 3050B's Single Board Test capability eliminates the need to maintain a large inventory of reference boards.

Instead, a composite signature from a known-good unit, representing the total of all the board-edge pins, is stored on disk — as are group, subgroup, and node signatures. The 3050B then uses a signature-based diagnostic program to locate the fault by comparing signatures from the defective unit with those stored on disk.

In applying this technique, the operator first uses the 3050B to take a composite signature from all board-edge pins. The 3050B compares the results with the composite signature stored on disk. A faulty bit stream on any board edge pin results in a faulty signature, and therefore a failed test. Next, the 3050B prompts the operator through the process of testing first group signatures, then subgroup signatures, and finally node signatures, until the faulty node is located.

High-Speed Pass/Fail Testing

In your main production line, the 3050B provides you with high-speed pass/fail board testing, checking an entire board in ten seconds or less. The operator can execute simple commands (TEST, START, YES, etc.) at the touch of a front-panel switch — or with the convenient foot control. Prompts guide the operator through the test process, and pass/fail lights indicate the results. In addition, the 3050B will log all failures as they occur, giving you printed reports with detailed statistical information.

Automatic Diagnostic Software

The 3050B's Automatic Diagnostic Software package makes this versatile tester useful for rework and repair applications as well as for production-line functional testing. This software lets you quickly and accurately isolate faults — often in a matter of minutes.

The Automatic Diagnostic Software offers state-of-the-art, high-resolution board diagnostics, capable of handling anything from simple SSI logic to a multiplexed microprocessor bus. It provides completely automated troubleshooting of all digital circuitry — unidirectional, bidirectional, and loops — leapfrogging from the board edge for added speed. With the 3050B's Automatic Diagnostic Software, you can successfully troubleshoot such difficult problems as unstable symptoms, initialization failures, and speed-related faults. And, with the addition of the 3053B, the interface between this software and the 3050B's Test Management System lets you perform analog diagnostics, as well.

Custom Control of Testing

The 3050B's Test Management System gives you custom control of test and diagnostic routines. In addition to automatically setting up your tests and loading the necessary test programs, this software lets you dynamically alter both test program flow and test frequency, so you can develop custom procedures for special situations. The Test Management System controls analog testing, as well. And its data logging capabilities let you automatically record and print failure data.

The Test Management System language combines high-level language instructions (similar to those found in BASIC, FORTRAN, and Pascal) with instructions unique to the 3050B. These instructions interrogate and control the 3050B before, during, and after testing. The language structure is such that Test Management System programs can be incorporated into normal tester programs, such as Autotrack. The Test Management System also includes macro libraries, so test engineers can define macros for system use, as well as an adaptation of the ATLAS language for communicating with the 3053B Analog Instrumentation Module.

Analog Testing

With the analog option, you can use the 3050B to test analog waveforms as well as digital circuitry. In analog testing, the 3050B uses program-defined voltage tolerances to check for waveform differences between the reference board and the unit under test. It can detect errors relating to gain, phase, and shape. For additional analog test capability,

add the 3053B Analog Instrumentation Module. The 3053B comes with a rack of IEEE-488-compatible test instruments, including an ICS 4885 RS-232-C to IEEE-488 Converter/Controller, a Fluke 1953A Counter/Timer, a Fluke 8520A Digital Multimeter, two Lambda programmable dc power supplies, a Wavetek 275 Programmable Function Generator, and a Racal Dana 1200 Switch Matrix. All instruments are programmed with an adaptation of ATLAS, a powerful language that uses English-like statements. The ICS 4885 lets this test instrumentation communicate with the 3050B.

Using the 3053B, ATLAS, and the 3050B's Test Management System, you can create semi-automated analog diagnostics, measuring voltages of $\pm 50V$ and frequencies of up to 10 MHz. The combination of the 3050B and the 3053B gives you confidence levels of 98% or higher in testing hybrid boards, letting you isolate both digital and analog faults to the component level.

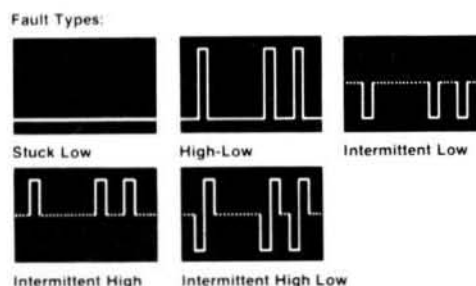
Powerful Processing

The multiple processors of the 3050B give it powerful processing capabilities. In addition to its 16-bit Control Microprocessor, providing overall system control, the 3050B includes an Auto Sequence Processor, for real-time generation of nine classes of automatic patterns, and a Stored Sequence Processor, for implementing user-defined test sequences.

Automatic Fault Emulation

The 3050B includes an Automatic Fault Emulator to give you complete control over the quality of your test programs. The Automatic Fault Emulator is both quicker and more accurate than hypothetically generated fault simulation: It can verify a test program for a 100 IC board in about four hours, as opposed to simulator-based systems, which can require nearly a week.

Using one of five different classes of faults (see Figure 2), the 3050B empirically tests the comprehensiveness of your test program. It emulates hard and soft failures, calculates both stimulus and fault coverage, and highlights the circuit areas needing test improvement. For a more complete analysis, it will even give you a hard-copy printout of the test results.



Off-Line Programming

For fast and efficient generation of test and diagnostic programs, add the 3051B Off-Line Programming Station. This system makes program development easy, with user-oriented software, macro commands, and prompts to guide the test engineer through the entry process.

The 3051B includes an RS-232C communications interface to let you transfer data to and from external computer systems, as well as to the 3050B. Dual, double-sided floppy disk drives provide abundant storage — or you can link the station to a host computer for centralized program management.

Touch Display

For greater operator convenience, add the 1780A Touch Display to your 3050B. With the Touch Display, the operator can make selections, perform test procedures, and enter data logging information (such as the serial number of the unit being tested) without a keyboard, simply by touching the display. (For more information on the Touch Display, see page 202.)

Board Testers & Troubleshooters

3040A-1

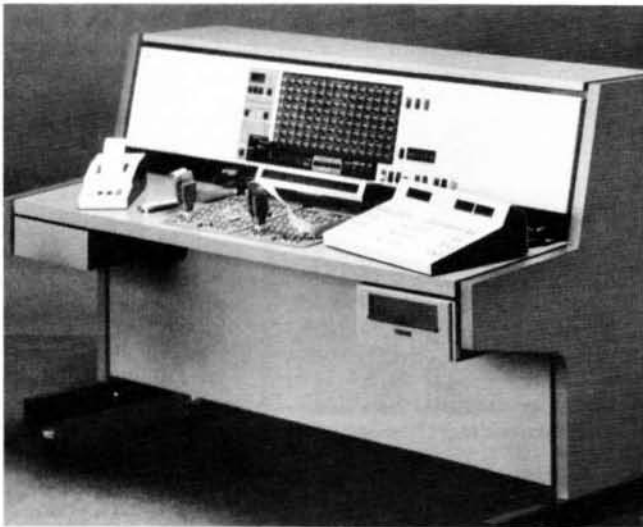


Printer
Fast RS-232-compatible printer for permanent program documentation

3051B
Offline Programming Station with two floppy disk drive units, keyboard, and terminal. System's prompting editors guide test engineer

3053B
Test station of analog stimulus and measurement instruments. RS-232 and IEEE-488 interfaces. Programming uses adapted ATLAS language

3050B (NSN 6625-01-202-5309)
Test console with clips and probes for both reference board and board under test. Reference board eliminates need for large memory, time-consuming IC modeling. A 35-column printer provides hard copy of test analysis



3040A-1 (Available on special order only.)

3040A-1

3040A-1 Digital/Analog Test System

- Reference board testing
- Single-board GO/NO GO tests
- Stored and automatic sequence programming
- Automatic fault emulator
- AUTOTRACK Multimode Diagnostics
- Analog testing
- Off-line programming station

The 3040A-1 Digital/Analog Test System minimizes the cost and time required for functional-test programming by using reference-board procedures. That is, it derives the correct response for each node of the unit under test from a known-good board instead of requiring the test engineer to input these values.

For GO/NO GO testing of single units, the 3040A-1 offers the option to generate a composite signature from all the board-edge pins. This signature is compared with the composite signature from a known-good board, stored on disk. A faulty bit stream on any board-edge pin results in a faulty signature — and therefore a failed test.

The 3040A-1 can also verify the comprehensiveness of user-generated test programs with its Automatic Fault Emulator. This software specifies the percentage of faults that a particular program can detect.

Stored and Automatic Sequence Programming

Stored sequences are user-defined patterns specifying output data or ranges of I/O channels. These give the 3040A-1 control over the functions of the unit under test. Automatic sequences are pseudo-random, gray-encoded automatic patterns of clocks, pulses, and data, used by the 3040A-1 to exercise the functions of the unit being tested. By using a combination of stored and automatic sequences, the 3040A-1 speeds the programming process while ensuring thorough testing of all board functions.

AUTOTRACK Multimode Diagnostics

The 3040A-1's optional clip and probe algorithms, with prompts to guide the operator, are useful for tracking defects and breaking loops — even under dynamic conditions. The system's printer lists the tracking sequence and diagnostic statements as well as identifying the defective node.

Analog Testing Option

The 3040A-1 may be configured with an analog option, Complex Waveform Conformance, providing up to 32 channels of analog testing capability. With this option, you can test analog and digital signals on the same board at the same time.

Off-Line Programming

The 3040A-1 off-line programming station lets you generate test programs without interrupting test activity. Prompts guide the test engineer through each step of the process. The programming station includes a full ASCII keyboard, CRT display, dual floppy disk drives, and an RS-232C printer interface for program documentation.



(NSN 6625-01-056-9777) **3010A**

3010A Logictester

- Portable benchtop tester
- Simplified programming
- High-speed testing
- Walk-back diagnostics

The 3010A Logictester is a self-contained portable unit useful for functional testing of moderately complex printed circuit boards. It simplifies programming by algorithmically generating a large array of stimulus patterns. As a result, you can develop test programs in hours instead of weeks, by simply selecting the appropriate stimulus algorithm for each input. The 3010A further simplifies programming by eliminating the need for assemblers, compilers, and tapes, letting you both program and edit on-line.

High-Speed Testing

With the 3010A, you can perform high-speed testing at rates up to 4 MHz, as well as one-shot and continuous pulse-width measurement. For one-pass, go/no go tests, the 3010A includes an output count integrator that logically combines the activity of all I/O pins into a single signature.

Rapid Fault Tracking

The 3010A allows quick isolation of faulty nodes. It checks the nodal signatures of 8-pin subgroups until it finds an incorrect count. The operator then backtracks through the nodal transition counts to the point where inputs to an IC are normal but outputs are incorrect. This is the defective node.

Training

3040/3050 Board Tester Maintenance Training

Prepared with an understanding of the System layout, service manual organization, theory of operation, self test diagnostic operation, servicing techniques, adjustment procedures, and mechanical assemblies, it is the intention of this five-day course that you be able to maintain and repair the 3050B to the major subassembly or board level. (See page 273 for more details.)

Glossary of Terms

Adjacent trace short — A short resulting from an inadvertent connection between two adjacent traces.

Assign/locate probe — A "smart" probe used with the 3200B. Lets users assign their own nomenclature to test points; also helpful in debugging programs and test fixtures.

ATE — Automated test equipment, including systems such as manufacturing defects analyzers, functional testers, and incircuit testers.

ATLAS — A powerful programming language for analog applications. Uses English-like statements.

Auto-learn — 3200B automatic self-learn operation that finds continuity and isolation patterns from a known-good board or backplane.

Backplane — Unit of electronic equipment in which various logic and control elements are interconnected. Often takes the form of a "rat's nest" of wires, interconnecting printed circuit cards in the rear of computer racks or cabinets.

Bare board — A printed circuit board with no components on it — just traces.

Bed-of-nails test fixture — A surface on which spring pins are strategically located so as to make electrical contact with a UUT.

CAD — Computer-aided design.

Card cage — A metal rack that provides housing and interconnection between printed circuit boards.

Confidence level — A statistical percentage indicating the likelihood of successfully isolating all faults.

Continuity — A resistance between two points that is less than the programmed low threshold; means the points are shorted together.

Cps — Characters per second; unit of measurement for printer speed.

Dynamic faults — Faults that appear only when the components on the board are interacting in sequence, at rated speed.

Functional test — A test for faults that only appear when the components on the board are interacting in sequence, at rated speed. (Also see Dynamic faults.)

Hybrid board — A printed circuit board including analog as well as digital components.

IC — An integrated circuit.

IEEE 488 — A high-speed communications interface, often used in analog test equipment.

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 — A resistance between two points that is greater than the programmed high threshold.

Junction test — Verifies the presence and orientation for a junction element, checking to see that the component is correctly mounted and properly functioning. Used to check diodes, transistors, and, in many cases, ICs.

Kernel — The central circuitry on a microprocessor-based board, including the microprocessor, bus, RAM, ROM, and I/O circuitry.

LEARN algorithm — See **Auto-learn**.

Loaded board — A printed circuit board with all components inserted.

Measure command software — A group of commands that tests for specific values between points where reactive or resistive components exist.

Minicassette — A storage medium used by Fluke board test equipment for storing test programs.

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.

Out-of-tolerance component — One which, when tested, is not within its specified tolerance rating.

PCB — A printed circuit board.

Peripheral circuitry — On a microprocessor-based board, circuitry located outside the kernel. (Also see **Kernel**.)

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 Vcc or ground.

Prompt — A displayed message that guides the operator to the next step.

RAM — Random access memory.

Resistive pin — A point that has an impedance value that is lower than the high threshold and higher than the low threshold.

Response — Electrical output produced by a node when it is stimulated. (Also see **Stimulus voltage**.)

Rework — Repair of defective boards that takes place as part of the production operation, allowing malfunctioning boards to be recycled instead of discarded.

ROM — Read-only memory.

RS-232C — A standard communications interface specifying various electrical and mechanical characteristics for a bit-serial interface between computers, terminals, and modems. It describes an interface consisting of 25 pins or leads, each of which is lettered and provides a function, such as timing control or the sending of data.

Semiconductor junction test — See **Junction test**.

Short — Continuity where isolation is expected.

Signature — Four bit hex number representing data stream at a node.

Stimulus voltage — A voltage applied to the UUT during a measurement. In shorts and opens testing, the stimulus voltage is fixed at 300 mV in loaded-board mode and 8V in bare-board, backplane, or cable testing. For measurement commands, it is programmable from 300 mV to 8V. For junction tests, it is fixed at 2V.

Test site — A workstation for testing boards, consisting of a remote operator console and a user-defined test fixture. This workstation provides the interface to the test station processor.

Troubleshooting — Locating and diagnosing faults or malfunctions in electronic equipment by means of systematic checking or analysis.

UUT — The unit under test.

To Put Fluke Board Testers and Troubleshooters to Work for You. . .

Any of the Fluke Sales Offices or Representatives listed on page 243-245 can help you determine which combination of equipment best meets your board testing and troubleshooting needs. Additional assistance in developing an analysis and justification for board testing and troubleshooting is available in the following ways.

• Attend a free Micro-System Troubleshooting Seminar. Topics will include:

- Use of built-in tests
- Use of mode keys
- Troubleshooting functions available
- Probe use
- Basic programming
- Auxiliary interface

Contact your Fluke Sales Office or Representative for seminar dates and locations.

• **Request a Return on Investment Analysis** for the 3200B Manufacturing Defects Analyzer, the 3050B Functional Tester, or the Emulative Testers (9000 and 9100 Series). Contact the Fluke Sales Office nearest you (see page 297). Based on the variables of board testing requirements as well as economic variables such as labor rates, productivity, depreciation, and tax factors, the sales staff can develop an analysis stated in terms of Payback Period, Rate of Return, Net Present Value, Profitability Index, or whatever method you need for your application and management methods.

Product Support & Services



As our customers demand new and more complete test and measurement solutions, Fluke is becoming more than a manufacturer of affordable, efficient products. At Fluke, we're dedicated to providing the best services possible to support our products in your specific application. To protect your product investment, Fluke 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 also offers applications and maintenance training, software and systems integration services, and product application consulting.

Extend the quality of your Fluke instruments with Fluke Customer Support Services. You can expect responsive service and support that's right for your specific needs.



Selection Guide

Support or Service	U.S.A.	Other Countries
Product Availability Product Specification Application Assistance Product Information Leasing Information	Your Sales Office (See page 297 or 306)	Your Fluke Representative (See page 298 or 300) WU Telex: 152385 TRT Telex: 185-103 Phone: (206) 356-5500
Consultation Software Development Site Evaluation Installation Application Training	Your Sales Office (See page 297 or 306)	Your Fluke Representative (See page 300)
Repair/Calibration Training Repair/Calibration Service Repair/Calibration Assistance Service Agreements Module Exchange	Your Technical Center (See page 300 or 306)	Your Service Representative (See page 300)
Replacement Parts Instruction Manuals	John Fluke Mfg. Co., Inc. P.O. Box C9090 Everett, WA 98206 Attention: Parts Dept. M/S 86 or call (800) 526-4731* or (206) 356-5774*	Your Service Representative (See page 300)

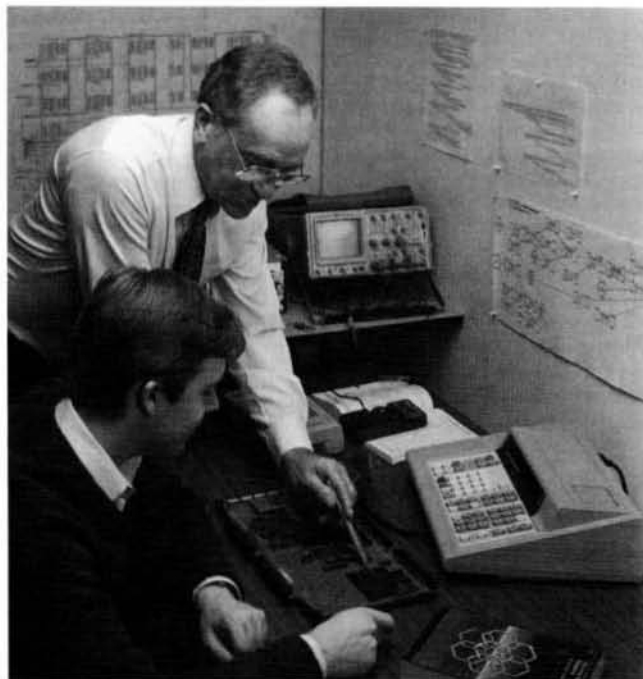
*Hours: 6 a.m. to 3 p.m. Pacific Time

Corporate Headquarters

John Fluke Mfg. Co., Inc.
P.O. Box C9090,
Everett, WA 98206
(206) 347-6100

European Headquarters

Fluke (Holland) B.V.
P.O. Box 2269
5600 CG Eindhoven
Netherlands
Tel: (40) 458045
TLX: (844) 51846



Fluke Applications Engineering Group

- Applications assistance and consulting
- Hardware assistance and consulting
- Software assistance and consulting
- Site evaluation and installation consulting
- Third-party support and consulting

When Fluke electronic test and measurement equipment is used in a systems application the system builder may wish to request additional support from Fluke. The Fluke Applications Engineering Group provides a wide range of services from telephone consulting 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 Applications Engineering Group can provide support tailored expressly for your application. Whether you need complete turn key software or additional manpower to augment your in-house programming staff, Fluke has the solution.

Fluke's Applications Engineering Group has a team of designers ready to assist you with your systems integration needs. When you take advantage of Fluke's expertise you can be confident that your system design will reflect the latest technology configured to match your application.

Our services are designed to support a wide variety of customers from first-time users of Fluke equipment to customers creating advanced systems on accelerated implementation schedules. When you plan to implement a Fluke instrument system, count on our Applications Engineering Group for help. No one knows test and measurement like Fluke.

Fluke Cooperative Services

- Independent specialists
- Specific industry expertise
- Systems solutions

Fluke's Cooperative Services program may be the answer to your test, measurement, or control application.

Today's projects require integration of hardware, software, training, and support to arrive at a total solution — on time and within budget. Today's projects call for teamwork. That's why we formed Fluke Cooperative Services (FCS).

The Fluke Cooperative Services team is a network of independent specialists who know hardware, who know software, and who know your industry.

With Fluke and FCS, there's no more shopping around and no more unclear accountability.

We carefully selected FCS members because of their expertise and because they are team players. We've already worked together, so we're ready to go to work for you on your project.

Teamwork and FCS — put them to work for you. You'll have one team to work with and one team that will stand behind its promises. We think that's better than passing the buck.

Repair and Calibration Services

- Variety of services to meet each customer's needs
- 90-day warranty of complete unit
- Installation of product improvements
- Full N.B.S. traceable calibration and/or alignment
- Documented quality assurance program
- Compliance with MIL-STD-45662 and nuclear industry standards
- Special calibration data available

Each Fluke Technical Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke products at peak performance. The procedures and documentation comply with MIL-STD-45662 and Nuclear Regulatory Commission requirements, assuring accuracy traceable to the National Bureau of Standards. Proper use of measurement standards is carefully and continually monitored through a corporate Controlled Audit Program.

Fluke's Customer Support Services is dedicated to only one 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 one unscheduled repair or a five-year extended warranty agreement that meets MIL-STD-45662.

Standard Price Service

- One-time repair or calibration at a fixed price.
- Added support for your own maintenance program.
- Take advantage of Fluke's expertise and resources on an as-needed basis.

These cost-effective services can be used to repair or calibrate your Fluke equipment on a one-time basis. For customers who routinely service

Repair & Calibration

their own Fluke instruments, this service offers an easy way to smooth out your peak workloads. For others, it's an easy and economical way to take advantage of Fluke's extensive service.

The Standard Price Service Program establishes a fixed charge for calibration and/or repair for each type of instrument. The price for calibration and/or repair includes all labor and material required.

These standard prices, which are based on historical averages for time and material, help you determine service costs in advance and avoid the potentially critical delay of quotation and approval procedures. Naturally, some units may have to be excluded from the program because of age or abuse. In such cases you will be advised and, if you approve, charged on the basis of the actual labor and parts required.

Standard Price Calibration

Routine calibration ensures your instrument is performing to published specification. Every instrument calibration follows the procedures specified in Fluke maintenance manuals. Instruments are then returned with a Fluke Certificate of Calibration, your proof of traceability to the National Bureau of Standards. In addition, we also include calibration labels to indicate the date of calibration and the date of next calibration, as well as tamper-proof seals to protect the integrity of the calibration performed.

Standard Price Repair Plus Calibration

This is a cost-effective way to service your Fluke product on a one-time basis. Using the industry's finest test equipment, our factory-trained technicians will test all functions and ranges while making the required repairs. We replace any defective parts with Fluke-specified and Fluke-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. Then, it is calibrated in the same manner as in the Standard Price Calibration service, complete with the same certification, labels and seals. Each unit is completely performance tested and returned with a service report.

Warranty

Standard Price repairs carry a complete instrument warranty for 90 days. This warranty covers the entire instrument, not just the portion that was repaired. You won't find a better warranty in the industry.

A Fluke Calibration Warranty guarantees your instrument's calibration for 90 days after it's returned to you. Even if the product fails, you pay only the repair charge and recalibration is provided at no charge. The warranty terms are given below.

Standard Price Repair Program Service Warranty

Fluke warrants products it services and parts it sells to be free from defects in material and workmanship for the period given below:

- (1) product repaired under Standard Price Program for 90 days from shipment of repaired product.
- (2) product repaired under Extended Warranty/Calibration Plan for the period of the extended warranty.
- (3) products repaired under Labor and Materials Services for 90 days from installation and
- (4) replacement parts for 90 days from date of shipment.

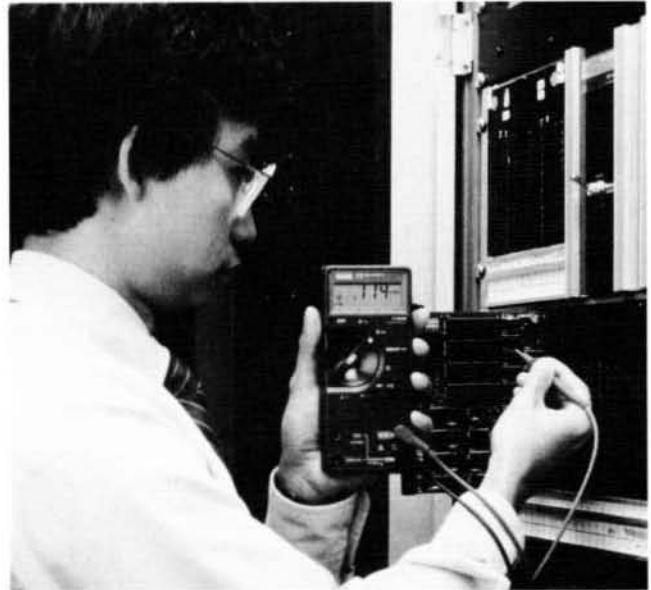
This warranty applies if you are the original purchaser. It does not apply to fuses, disposable batteries, or any product or part which has been misused, altered or damaged by accident or abnormal conditions of operation.

For warranty service, contact your nearest Fluke Technical Center for shipping instructions. If the product is returned to the Technical Center, it should be shipped freight prepaid.

Fluke will, at its option, repair your product or provide a module exchange free of charge. However, if Fluke determines that the failure was caused by misuse, alteration, accident or abnormal conditions of operation, you will be billed for the repair. After repair, we will return the product, freight prepaid.

THE WARRANTY STATED ABOVE IS YOUR SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS

OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.



Extended Warranty Service

- Fixed maintenance cost so you can budget accurately each year
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources

Fluke's Extended Warranty Plan provides your equipment the ultimate protection at one economical price. Comprehensive agreements provide routine calibration at regular intervals or repair service as needed. Or, you can combine these options for full service coverage.

Extended Warranty/Calibration Plan

Trust the scheduled calibration of your Fluke instruments to the world's leading manufacturer of calibration instrumentation and standards. Under this plan, we'll calibrate your instruments at the Fluke-recommended intervals. You'll automatically receive a 30-day advance notice that your instrument is due for calibration. If your instrument's application requires a different calibration interval than normally recommended, we can tailor a plan to meet your needs. Either way, you can expect 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.

Extended Warranty Repair Plan

This plan is an extension to your product's warranty. Whenever your product needs repair service, simply send it to the nearest Fluke Technical Center. There, it is 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 surface freight costs are included. As you might expect, a Fluke Service Report and Certificate of Calibration is enclosed with each repaired instrument. Contact the nearest Fluke Technical Center for 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 equipment than our full service plan. We've combined all the features of the Extended Warranty Calibration and Extended Warranty Repair into one full service plan. You pay a reasonable fee for each instrument, eliminating most additional service expenses.

Plan Ahead and Save

We offer a 15% discount on the listed price of the extended warranty plans when you purchase the agreement at the time of instrument purchase. Or, if you purchase this service prior to the expiration of the product warranty, we'll discount your plan by 7%.

You can also reduce your maintenance expenses with a Blanket Service Agreement. This agreement is based on the total dollar amount of your Extended Warranty or other service plans.

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. An inspection at a Fluke Technical Center is free or you can pay a minimal fee for an inspection at your site. If the condition of your instrument precludes coverage, we'll provide a Labor and Materials Service quote for the repairs necessary to qualify your instrument.

Labor and Materials Service

- Instruments that are out-of-production and no longer included on 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.
- For any special service requirements.

Sometimes you may want or need a firm price quotation of labor and material repair. Using this service, you'll know exactly the cost to get your instrument repaired. And, 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 product for its full life cycle. This means we'll service instruments manufactured more than 20 years ago or even those we discontinued. These repairs, however, are handled case-by-case 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 modified or special product, it may require 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 Technical Center.

Warranty

Instruments repaired under Labor and Materials Service are warranted to be free from defects in material and workmanship for 90 days. This applies to the entire instrument, not just the repaired portion. See the Standard Price Warranty for complete terms.

On-Site Service

- Minimize downtime.
- Guaranteed response time.
- Preventive maintenance.
- Custom agreements.

Most systems you buy from Fluke include a 90-day on-site warranty. Under this warranty coverage, we'll repair your system on-site in the event it fails. After this 90-day period, each instrument in the system continues to be covered by the Fluke standard warranty. The instrument service would then be performed at one of our Technical Centers.

If you would like to continue on-site service after the 90-day on-site warranty period, you can do so with a Supplemental On-Site Service Agreement. The instruments that are commonly used in systems can be covered by Supplemental On-Site Service. This eliminates the need to remove the instrument from the system and send it to a Fluke Technical Center for warranty service. The fee is nominal, just the extra expense of on-site service from the Fluke Technical Center to your facility.

After the warranty period and the Supplemental On-Site Service coverage, you can continue on-site service by using our Basic On-Site Service.

Special Services

- Calibration documentation.
- MIL-STD-45662 Calibration.
- 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 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 sales engineer. Once we know your needs, we can tailor a service plan that supports your business.

Emergency 48-Hour Service

When an instrument fails and downtime is costing you hundreds of thousands of dollars, use our emergency 48-hour service. From the time your instrument arrives at the Fluke Technical 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 a \$200 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 Technical Center for immediate help.

Blanket Service Agreements

Whether you choose Standard Price services or Extended Warranty services, you can reduce your costs substantially with Blanket Service Agreements. But you'll save more than money — you'll also save paperwork and administration time. A Blanket Agreement is based on the total cost of your yearly services.

Repair & Calibration

It's as easy as this. Contact your local Fluke Sales Engineer or your nearest Technical Center Manager and discuss your product mix and yearly requirements. We will develop a quotation for a Blanket Service Agreement for your review and consideration.

The dollar volume can include any mix of Fluke products on any service plan. You cannot, however, combine Extended Warranty discounts with Blanket Service Agreement discounts.

The manager of your nearest Technical Center will determine the mix of Fluke services that gives you the greatest discount. Call today and learn exactly how much you can save this year.

Service Reports

When your instrument is repaired by a Fluke Technical Center you automatically receive a Service Report for any work performed.

Calibration Certificates

For every product calibrated, Fluke includes a Certificate of Calibration. It's your guarantee that the instrument meets its specifications and is traceable to the National Bureau of Standards.

Calibration Labels

Any instrument calibrated by a Fluke Technical Center will be returned with a calibration label indicating the date of calibration and the date of next calibration. We'll also affix tamper-proof seals to your instrument.

Calibration Reports

If you need more detailed reports for MIL-STD-45662 or in-house quality assurance programs, we can provide comprehensive calibration reports. This includes the actual readings taken from each range and function of an instrument.

MIL-STD-45662 Calibrations

If you require calibration that meets MIL-STD-45662 we can provide this service and the documentation. Full compliance with 45662 includes the following items:

- Formal calibration procedures with recording of test results before and after any necessary adjustments.
- Records of calibration dates and identification of calibration standards and technicians.
- Records of accuracy of test standard's accuracy and controlled environmental conditions.
- System of notification and recalibration when test standards are found to be out-of-tolerance.

Replacement Parts

- Components that meet Fluke specifications standards
- Automatic notice of improved replacement types
- 90-day warranty
- Toll free parts order line (800) 526-4731*
- Recommended spare parts and 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 instrument to peak performance.

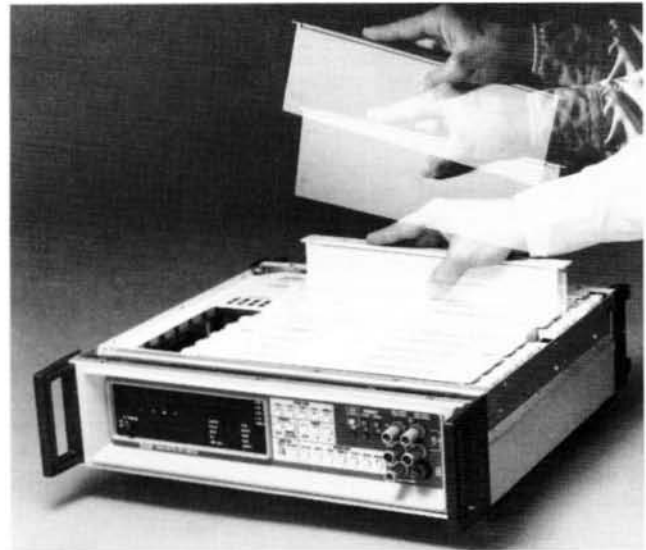
To support this service, an extensive inventory of repair parts is maintained by the Replacement Parts Center located in Everett, Washington. This computerized center stocks several hundred thousand components, subassemblies, and modules that are listed on a microfiche catalog available to customers. All Fluke replacement parts are warranted against defects in materials and workmanship for 90 days after shipment. (See the Standard Price Warranty for complete terms.) From most U.S. locations, you may place your orders directly to the Everett Replacement Parts Center by calling our toll-free number, (800) 526-4731. From Alaska, Hawaii, or Washington call (206) 356-5774. From locations

outside the U.S., place your parts order with your nearest International Representative, who will expedite processing or fill your order from local inventory.

When ordering, please identify parts by the 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 of the instrument 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 instrument after repair. Check the parts list and diagrams for footnotes containing special parts ordering instructions.

Recommended Spare Parts Lists and Spare Parts Kits, and instrument manuals are also available for most Fluke products.



Module Exchange Program

- Available for most modular products
- 24-hour delivery to most U.S. locations
- Minimum downtime for critical applications
- Reduced maintenance personnel training requirements
- Takes full advantage of product diagnostics
- 90-day warranty

Many Fluke instruments are modular in design and can be serviced most effectively by exchanging a defective module.

The Module Exchange Program allows you to obtain an exchange module quickly and economically. When using this program, you need only identify the defective module, which simplifies your troubleshooting procedures and reduces your training and skill requirements for maintenance personnel. Self-diagnostics built into many Fluke instruments further simplify the process of identifying the faulty module.

Once a defective module is identified, your local Fluke Technical Center (see page 300 for locations) will place your order with the Module Exchange Center located in Everett, Washington. The replacement module will be sent directly to you via overnight air carrier. A similar program is offered to customers in countries outside the U.S.

Please contact your Technical Center or International Representative for a list of Fluke products which are supported by the Module Exchange Program, and detailed information on exchanging defective modules.



Customer Training

- Maintenance training
- Applications training
- Product training
- Technology seminars
- Special customer training packages

Training Pays Off In Productivity

Fluke Customer Support Services is dedicated to providing information, assistance, and training for people who use and maintain Fluke products. As a designer and manufacturer of sophisticated instrumentation, we recognize that well trained technical people are an asset which is essential to productivity.

To gain maximum performance and productivity from your Fluke 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 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 will teach you the technology behind the features and functions, and help you to effectively troubleshoot and maintain even the most complex systems.

Schedule

We have scheduled our courses throughout the United States for your convenience. Dates, fees and locations are shown in the following sections for each of our course offerings.

1722/1752 Applications	3200 Maintenance	8840 Maintenance
1722 Maintenance	5100 Maintenance	9010 Programming
2280 Introduction	5200 Maintenance	9010 Troubleshooting
2280 Maintenance	5205 Maintenance	FlexSys Software
2452 Applications	5440 Maintenance	DMMs Maintenance
2452 Maintenance	7400 Procedure Writing	Metrology for Technicians
3040/3050 Maintenance	8500 Maintenance	

You will also find detailed course descriptions, outlines and prerequisites. We recognize that our scheduled classes may not fit your needs or schedule. That's why we created On-Site and Unscheduled Training.

On-Site Training

If our scheduled courses are not convenient or you want to train a larger group of people, an on-site course is an easy, economical solution.

Unscheduled Training

Unscheduled training courses for up to ten of your people can also be given at one of the designated Fluke training facilities (Paramus, New Jersey; Chicago, Illinois; or Burbank, California).

For more information on unscheduled training and on-site training contact one of the Training Coordinators.

At Fluke we believe that our customers purchase more than just a piece of test equipment. We are committed to providing solutions that meet your requirements.

Training Coordinators

Burbank, CA (213) 849-7181
Chicago, IL (312) 705-0500
Paramus, NJ (201) 262-9550

Training Schedule — 1987

The following is a listing of the training courses, along with the scheduled date and location. The course listings are presented first, with the locations and dates to follow.

1722/1752 Instrument Controller

Software and Applications

Course Objectives: This Applications Training course will detail the 1722's approach to controlling system operations through skills gained in software programming and hardware configuration of the unit. With an understanding of the standard hardware components, available options, and the configurations of those options, you'll gain insights to your particular application needs. The software training includes complete coverage of FDOS (Fluke Disk Operating System), System Utility Programs, and Fluke Extended BASIC, all of which are available to the user. Graphic capabilities, Menu creation, and Touch Sensitive Overlay software commands are detailed and explored.

Course Outline: A formal course outline of this course is not available since each course is formatted to conform to the configuration of your particular 1722 or 1752 Instrument Controller. Because these courses are tailored to your needs and equipment, they are usually conducted at your location using your exact equipment. The instructor will contact you for configuration and installed option information prior to conducting the class. The course schedule on page 274 reflects regularly scheduled

Customer Training

classes which are held in the regional centers. Should you wish to attend one of them, please contact the closest regional training coordinator. A very general course outline would be as follows:

- Introduction
- FDOS Operating System
- File Structure
- Utility Program
- Graphics Capability
- Touch Sensitive Overlay (TSO)
- Developing Interface Menus

Prerequisites: You should be familiar with the BASIC programming language and the operation of measurement/sensor types of equipment (i.e., thermocouples, transducers, thermistors, RTDs). Knowing another programming language would be beneficial, but is not mandatory. A background in electronics would be helpful, but not necessary.

Who Should Attend: Operators, programmers, managers, and supervisors who have a need to operate, program, or interface the 1722/1752 Instrument Controller to their particular application.

Catalog No. 1722-TAF / 5 Days

Course Schedule:

Boston, MA	Chicago, IL	Irvine, CA	Orlando, FL
Sep 14-18	Apr 6-10	Jan 26-30	May 9-13
Paramus, NJ	Seattle, WA		
Jun 15-19	Oct 19-23		

1722 Instrument Controller

Maintenance

Course Objectives: These two separate one-day courses will give you not only an extensive amount of hands-on operating time in which to gain experience and confidence on the use of the equipment, but you'll also troubleshoot the instrument to the module level. The use of built-in diagnostic capabilities will be covered in addition to the troubleshooting procedures.

Course Outline:

- **1722A Operation**
System Start-up/Initialization Procedures
Basic System Software Operation
- **Theory of Operation**
Overall Functional Simplified Block Analysis
- **1722A Maintenance**
Assembly/Disassembly
"Dead Box" Troubleshooting
"Live Box" Troubleshooting
Board Isolation and Fault Analysis
Hands-on Troubleshooting to the Module Level
- **Ordering (Appendix -100)**
The Module Exchange Center
Ordering Parts From Fluke
- **1700 Series Review**

Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment used in measuring voltage, current, resistance, and waveforms.

Who Should Attend: Anyone who has a need to operate or repair their 1720 or 1722 Instrument Controller.

Catalog No. 1722-TMF / 2 Days

Course Schedule:

Burbank, CA	Orlando, FL	Paramus, NJ	Seattle, WA
Feb 18, 19	Apr 20, 21	Sep 10, 11	Aug 31, Sep 1
Jun 30, Jul 1			
Nov 12, 13			

2280 Data Logger

Product Introduction

Course Objectives: This one-day seminar is designed to give you the basic skills, knowledge, and confidence to use the 2280 Series Data Logger to its fullest potential. Both theory of operation and hands-on experience will be included.

Course Outline:

- **Introduction**
- **2280 Series Overview**
What is the Data Logger
Functions and Capabilities
- **Control Identification**
Front and Rear Panel
Power the 2280
- **Programming the 2280**
Concepts of Programming
Entering a Program
Running a Program
- **Hands-On Exercises**
Analog Inputs
Analog Inputs with Alarms
Analog Inputs with Status Outputs
Analog Inputs with Plot Program
- **Post Sales Support**
Other Fluke Services
- **Course Review**

Prerequisites: None

Who Should Attend: Anyone working with data logging/event recording type devices who needs to familiarize themselves to the operation, functions, and capabilities of the 2280 Series.

Catalog No. 2280-TAF / 1 Day

Course Schedule:

Burbank, CA	Detroit, MI	Paramus, NJ
May 11	Jun 22	Oct 30
	Oct 12	

2280 Data Logger

Maintenance Training

Course Objectives: This five-day maintenance training course will present to the student all the information needed to repair the unit to the module level. The practical aspects of maintenance and hands-on exercises are highly stressed. Given a defective 2280 Data Logger, a set of Manuals, tools and test equipment you will be able to repair the 2280 to the module level.

Course Outline:

- **Introduction**
A System Overview
Manual Usage: The 2280 Manual Set w/exercises
Instrument Configuration
- **Operation and Programming**
Operation, Operating Modes, etc. w/exercises
An Introduction to Programming
Hands-On Exercises
- **Theory of Operation**
Overall Functional Analysis
Block Diagram Analysis
Static Awareness
- **Maintenance**
Assembly/Disassembly w/exercises
Specifications
System Diagnostics
Instrument Verification
Calibration Procedures
Troubleshooting

- **Parts Ordering**

Ordering Parts from Fluke
Module Ordering

- **Options**

All 18 Options to be Covered
Special Programming Considerations
Theory of Operation to the Module Level
Installation/Installation Verification
Performance Verification
Calibration

- **Hands-On Troubleshooting Exercises**

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians and supervisors who are required to maintain, calibrate, and repair their equipment.

Catalog No. 2280-TMF / 5 Days

Course Schedule:

Burbank, CA	Detroit, MI
May 11-15	Jun 22-26
Oct 12-16	

2452 Measurement Control System

Software and Applications

The 2452 Measurement Control System is one which combines a 2400B Intelligent Front End Computer and either a 1722A or a 1752A Instrument Controller. When linked together and configured to the particular application, the 2452MCS is a powerful measurement, data acquisition, and control system.

Course Objectives: This intensive three-day course will cover the utilities, graphics, hardware configurations, program development, and various customer applications of this system as they relate to data acquisition and controlling tasks. During the first two days the utilities of the 1722A/1752A will be detailed. The remaining day will deal with the 2400B, its various configurations, and machine control language.

Course Outline:

- **1722A/1752A:**
 - Operating System
 - File Structure
 - Utility Program
 - Graphics Capability
 - Touch Sensitive Overlay (TSO)
 - Develop Interface Menus
- **2400B:**
 - Hardware Option Definitions
 - Physical Locations
 - Configurations
 - Data Acquisition
 - Machine Control Language (MCL)
 - ProLink™
 - Access 1722/1752
 - Program Development
 - Commands, Structure, Syntax
 - Customer Applications
 - MCL Program Combinations
 - 1722 Language

Prerequisites: You should be familiar with the BASIC programming language and the operation of measurement/sensor types of equipment (i.e., thermocouples, transducers, thermistors, RTDs. Knowing another programming language would be beneficial, but is not mandatory. A background in electronics would be helpful, but not necessary.

Catalog No. 2452-TAF / 5 Days

Course Schedule:

Boston, MA	Burbank, CA	Chicago, IL	Detroit, MI
Jul 20-24	Apr 20-24	Apr 20-24	Jul 27-31
Orlando, FL	Paramus, NJ	Seattle, WA	
Jan 26-30	May 11-15	Nov 2-6	

2452 Measurement Control System

Maintenance

Course Objectives: The three-day 2452MCS Maintenance Training course will include theory of operation, block diagram analysis, assembly/disassembly procedures, board isolation, and extensive hands-on troubleshooting time. All of which is designed for you to gain the best possible insight into the board level repair and maintenance of these items.

Course Outline:

- **1780A Maintenance**
 - Assembly/Disassembly
 - Hands-on Troubleshooting
- **1722A Operation**
 - System Start-up and Initialization
 - Basic System Software operation
 - Theory of Operation
 - Functional Block Diagram Analysis
- **1722A Maintenance**
 - Assembly/Disassembly
 - "Dead Box" Troubleshooting
 - "Live Box" Troubleshooting
 - Board Isolation and Fault Analysis
 - Hands-on Module Level Troubleshooting
- **2400B Operation**
 - Software Operation
 - Theory of Operation
 - Functional Block Diagram Analysis
- **2400B Maintenance**
 - Assembly/Disassembly
 - Board Isolation and Fault Analysis
 - Hands-on Module Level Troubleshooting
- **Parts Ordering**
 - Module Exchange Program
 - Parts Ordering from Fluke

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, waveforms, current, and resistance in a troubleshooting atmosphere.

Who Should Attend: Technicians and supervisors who are required to maintain, calibrate, and repair their equipment.

Catalog No. 2452-TMF / 3 Days

Course Schedule:

Orlando, FL
Aug 17-21

3040/3050 Board Tester

Maintenance

Course Objectives: Prepared with an understanding of the system layout, service manual organization, theory of operation, self test diagnostic operation, servicing techniques, adjustment procedures, and mechanical assemblies, it is the intention of this five day course that you be able to maintain and repair the 3050B to the major subassembly or board level.

Course Outline:

- **Introduction**
- **System Overview**
 - System Definition
 - 3040/3050 Differences

Customer Training

Subassembly Locations

- Card Cage Layout
- Wiring Layout

Service Manual Organization

- Part 1 General Information
- Part 2 Glossary of Terms
- Part 3 Electrical/Mechanical Drawings

● Theory of Operation

Four Basic Operations:

- Keyboard Program Entry
- Recording the Program to Disk
- Downloading Program (to Memory)
- Testing UUT Boards

Module Descriptions/PCB Functions

- PCB Jumper/Dip Switch Configurations
- CPU EProm (Firmware) Part Number List

Optional Modules/PCB Functions

● Preventive Maintenance

- Mechanical Items
- Electrical Items

● Maintenance Operation (Procedures)

Servicing Techniques

Self Test Program Definitions

- Auto I & II Stored Sequence
- Merged Sequence TMS
- ADS/Autotrack AFE
- Analog

Self Test Diagnostic Operations

● Adjustments

- Power Supplies
- Clip/Probe Stimulus Thresholds

● Mechanical Assembly/Disassembly

- Disk Drives
- Annunciator Panel
- Printer

● Troubleshooting

- Tools to Use
 - Check all Functions
- Diagnostics
- Hands-On

Prerequisites: A formal education in electronics, including digital and analog theory. Practical hands-on experience troubleshooting complex systems. A working knowledge of basic test equipment used to measure voltage, current, resistance, and waveforms is a must. Additionally, a working knowledge of 3050 operation and programming is strongly suggested.

Catalog No. 3040-TMF / 5 Days

Course Schedule:

Chicago, IL	Paramus, NJ	Seattle, WA
Aug 3-7	Jan 12-16	Jun 1-5
	Nov 16-20	

3200 Board Tester

Maintenance

Course Objectives: Prepared with an understanding of the System Component locations, Theory of Operation, Special Diagnostic utility programs, Alignment checks and Troubleshooting Tests, it is the intention and objective of this five day course that you be able to maintain and repair the 3200B Manufacturing Defects Analyzer to the Subassembly, board, or module level.

Course Outline:

- Introduction
- System Overview
 - 3200B System Definition
 - System Overview (Locations)
 - System Features

● Theory of Operation

Basic Measurements

- Test Point Determination
- Bare Board/Loaded Board
- Component Determination

Making a Measurement

- Modes
- TTMH Technique
- Autolearn
- Test
- Thresholds
- Enhanced Tests

System Interconnect

- Basic Operation Theory
- PCB Functions

Major Operational Cautions

● Operation

- Power Up/Download
- System Verification Program
- Ontel as a Diagnostic Terminal
 - Test Exerciser Program

● Alignments

- Power Supply Alignments
- PMU - Menu Driven

● Mechanical Disassembly

Disk Drives

- Remove/Reinstall
- Termination Resistor
- Switch #4 (Drive 0 & 1)
- Switch #6
- Frequency Conversion

Ontel Terminal

- ROC — Remote Operating Console
- Test Station Power Supplies

● Troubleshooting

Programming Station Diagnostics

- RAMH80 — Memory Test
- MPDCTST — Controller Test
- PDCIFL — Disk Control
- PARRAM
- RTCTST4
- WETTST15
- ALIGN
- KBDTSTK

Test Station Mainframe — Test Site

- Assign Probe
- Pin Verification
- Extended Print Mode
- System Verification
- Test Exerciser

Troubleshooting Session

- Test Station — Mainframe
- Test Site — Scancards
- Programming Station

Prerequisites: A formal education in electronics, including digital and analog theory. Practical hands-on experience troubleshooting complex systems. A working knowledge of basic test equipment used to measure voltage, current, resistance, and waveforms is a must. Additionally, a working knowledge of 3200 operation and programming is strongly suggested.

Catalog No. 3200-TMF / 5 Days

Course Schedule:

Paramus, NJ	Seattle, WA
Jul 20-24	Feb 2-6

5100 Meter Calibrator

Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5100 Series Meter Calibrator to the component level. The models covered in this course are the 5100B, 5101B, and 5102B.

Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5100 units. Intensive hands-on exercises will support the confidence level of each student.

Course Outline:

- **Introduction**
- **5100 Series Overview**
 - Operation and Capabilities
 - Specifications
 - Hands-On Exercise
 - Differences Between 5100 Series Models
- **Block Diagram Analysis**
- **Theory of Operation**
 - Component Level
 - Mainframe
 - Options
- **Assembly/Disassembly**
 - Hands-On Exercise
- **Basics of Calibration**
- **Remote Operation**
 - Using 1722A Controller
- **Signal Tracing of Operational Units**
 - Troubleshooting Theory
 - Hands-On Troubleshooting of Faulty Units

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5100 Series equipment.

Catalog No. 5100-TMF / 5 Days

Course Schedule:

Burbank, CA	Chicago, IL	Paramus, NJ
Apr 13-17	Aug 10-14	Feb 9-13
Nov 2-6		

5200A Programmable AC Calibrator

Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5200A AC Calibrator to the component level.

Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5200A units. Intensive hands-on exercises will support the confidence level of each student.

Course Outline:

- **Introduction**
- **5100 Series Overview**
 - Operation and Familiarization
 - Specifications
 - Hands-On Exercise
- **Block Diagram Analysis**
- **Theory of Operation**
 - Component Level
- **Assembly/Disassembly**
 - Hands-On Exercise

- **Remote Operation**
 - Using 1722A Controller
- **Signal Tracing of Operational Units**
 - Verification of Operational Unit
- **Troubleshooting Theory**
 - Hands-On Troubleshooting of Faulty Units
- **Calibration Theory**

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5200A equipment.

Catalog No. 5200-TMF / 5 Days

Course Schedule:

Burbank, CA	Chicago, IL	Paramus, NJ
Jan 19-23	Aug 31-Sep 4	Apr 27-May 1
Nov 16-20		

5205 Precision Power Amplifier

Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5205A or 5215A Precision Power Amplifiers to the component level.

Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5205A and 5215A units. Intensive hands-on exercises will support the confidence level of each student.

Course Outline:

- **Introduction**
- **5200 Series Overview**
 - Operation and Familiarization
 - Specifications
 - Hands-On Exercise
 - Differences Between 5205A and 5215A Models
- **Block Diagram Analysis**
- **Theory of Operation**
 - Component Level
- **Remote Operation**
- **Performance Check**
 - Operational Verification
- **Calibration Theory**
- **Troubleshooting Theory**
 - Hands-On Troubleshooting of Faulty Units

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5200 Series equipment.

Catalog No. 5205-TMF / 5 Days

Course Schedule: On demand.

Customer Training

5440 Direct Voltage Calibrator

Maintenance

This five-day maintenance course is provided for those who wish to troubleshoot and repair their 5440 DC Calibrator to the component level. The models included in the course are the 5440A and 5440B.

Course Objectives: A thorough block diagram analysis, theory of operation, and troubleshooting discussion will provide the confidence needed to accomplish the troubleshooting and repairing of malfunctioning 5440 units. Intensive hands-on exercises will support the confidence level of each student.

Course Outline:

- **Introduction**
- **5440 Series Overview**
 - Operation
 - Specifications
 - Hands-On Exercise
- **Block Diagram Analysis**
- **Theory of Operation**
 - Component Level
 - Mainframe
 - Options
- **Assembly/Disassembly**
 - Hands-On Exercise
- **Basics of Calibration**
- **Remote Operation**
 - Using 1722A Controller
- **Signal Tracing of Operational Units**
- **Troubleshooting Theory**
 - Hands-On Troubleshooting of Faulty Units

Prerequisites: You should have a formal education in electronics, including digital and analog theory. Hands-on, practical troubleshooting experience as well as a working knowledge of basic test equipment is a must. You should be familiar with measuring voltages, current, resistance, and waveforms in a troubleshooting atmosphere.

Who Should Attend: Technicians, supervisors, or anyone who is required to maintain and repair their 5440 Series equipment.

Catalog No. 5440-TMF / 5 Days

Course Schedule: On demand.

7400 Calibration Systems

Procedure Writing

Course Objectives: Referred to as the Calibration Software Package, you'll attend this five day course to learn to write Performance Test and Calibration procedures for 7411 based systems. To do this you'll need to learn the overall 7400 Series program scheme. You will also learn to manage Calibration Histories and to become familiar with the 1722A Instrument Controller operating system and utilities.

Course Outline:

- **1722A Familiarization**
 - 1722 System Software
- **7411 Instrument Calibration Software**
 - Use and Operation
- **7411 Procedure Generator and Editor Software**
 - Use and Operation
 - Function Select Codes
 - Instrument Oriented Evaluations
 - System Oriented Evaluation
 - Message Oriented Evaluation
 - Transparent Function Select Codes
- **Writing Procedures**
 - Calibration History Management

Prerequisites: You should have a basic understanding of calibration theory and application. Computer experience is not required. A working knowledge of MIL-STD-45662A, Calibration Control System, would be beneficial.

Who Should Attend: Programmers, production test engineers, assembly or calibration line supervisors/managers, or anyone involved in computer automated calibration lines and who is interested in maximum high efficiency throughput.

Catalog No. 7411-TAF / 5 Days

Course Schedule:

Burbank, CA	Chicago, IL	Orlando, FL	Paramus, NJ
Feb 9-13	May 11-15	Jan 13-16	May 19-22
Aug 3-7		Dec 8-11	Nov 10-13

8500 Digital Multimeter

Maintenance

This training course will include maintenance on the 8500 Series DMMs. The models included in the course are the 8500A, 8502A, and 8506A.

Course Objectives: This five-day maintenance course is designed to give you the confidence to successfully troubleshoot the 8500 Series Digital Multimeters. Depending on your entry level, this troubleshooting will be accomplished to either the component or the module level.

Course Outline:

- **Introduction**
- **8500 Series Overview**
 - Operation
 - Specifications
 - Hands-On Exercise
 - Differences Between 8500 Series Models
- **Options**
 - Applications for Each Option
- **Theory of Operation**
 - Component Level
- **Assembly/Disassembly**
 - Hands-On Exercise
 - Troubleshooting Theory**
 - Hands-On Troubleshooting of Faulty Units
- **Discussion of Calibration Procedure**
 - Discussion only (no calibration performed)

Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment.

Who Should Attend: Anyone desiring the information needed to repair their malfunctioning 8500 Series DMM.

Catalog No. 8500-TMF / 5 Days

Course Schedule:

Burbank, CA	Dallas, TX	Orlando, FL	Seattle, WA
Mar 16-20	Mar 2-6	Jan 20-24	Apr 20-24

8840A Digital Multimeter

Maintenance

Course Objectives: In this four-day course you will learn to operate, calibrate, and maintain the 8840A. Additionally, you will learn to troubleshoot the unit to the component level.

Course Outline:

- **Introduction**
 - Product/System Overview
 - Operation/Measurement Techniques w/exercises
 - IEEE-488 Control
 - Static Awareness
 - Case Disassembly
- **Theory of Operation**
 - Overall Functional Analysis
 - Component Level

- **Calibration**
Specifications
Performance Testing
Closed-Case Software Calibration
- **Maintenance**
Assembly/Disassembly
Initial Troubleshooting Procedures
Digital Troubleshooting Techniques
Analog Troubleshooting Techniques
Hands-On Troubleshooting Exercises
Discussion of Calibration Procedure
- **Parts Ordering**
Ordering Parts from Fluke
- **Review**

Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment used in measuring voltage, current, resistance, and waveforms.

Who Should Attend: Anyone who has a need to operate, calibrate, or repair their 8840 DMM.

Catalog No. 8840-TMF / 4 Days

Course Schedule:

Burbank, CA Oct 19-22	Chicago, IL May 26-29	Rockville, MD Mar 10-13
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9010 Board Tester

Programming

Course Objectives: This course will stress programming techniques that will make using the 9010A both easier and faster. You will participate in the development and testing of Utility Programs, which will be used as the building blocks toward a full functional test. Included in the course will be a review of troubleshooting operations, hands-on circuit experience, and actual applications aimed at testing and troubleshooting I/O devices.

Course Outline:

- **Introduction**
- **Review Basic Operations**
Inputting "Known-good" Information
Built-In Tests
Troubleshooting Functions
Probe Operations
Registers
Arithmetic Functions
Programming
- **Utility Programs**
The Probe and the Program
Identifying Unknown Devices on the UUT
Display and Print Messages
Probe Placement Detector
- **Actual Circuit Applications**
Working with I/O devices
Basic Approach
Application Examples

Who Should Attend: Design engineers, manufacturing test engineers, service engineers.

Catalog No. T9001-TAF / 2 Days

Course Schedule: Programming

Atlanta, GA Jan 29, 30 Apr 30, May 1 Jul 16, 17 Oct 29, 30 Dec 17, 18	Austin, TX Aug 20, 21	Boston, MA Feb 26, 27 Apr 15, 16 Sep 17, 18 Dec 17, 18	Burbank, CA Jan 8, 9 Mar 12, 13 Apr 30, May 1 Aug 20, 21 Oct 15, 16
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Charlotte, NC May 14, 15 Nov 19, 20	Chicago, IL Mar 12, 13 Jun 11, 12 Sep 10, 11 Nov 19, 20	Cleveland, OH Mar 5, 6 Aug 27, 28	Denver, CO Feb 5, 6 Apr 16, 17 Jun 11, 12 Jul 30, 31 Sep 17, 18 Nov 19, 20
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Detroit, MI Feb 5, 6 May 7, 8 Aug 13, 14	Durham, NC Mar 12, 13 Jul 23, 24	Edmonton Sep 17, 18	Houston, TX Jul 23, 24
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Indianapolis, IN Apr 23, 24	Irvine, CA Jan 15, 16 Mar 19, 20 May 14, 15 Jul 9, 10 Aug 27, 28 Dec 17, 18	Kansas City Feb 19, 20 Sep 17, 18 Oct 22, 23	Milwaukee, WI Jan 15, 16 Oct 22, 23
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Minneapolis, MN Apr 9, 10 Sep 24, 25 Oct 8, 9	Oklahoma City, OK Sep 29, 30	Orlando, FL Feb 12, 13 Jun 11, 12	Ottawa Apr 9, 10
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Paramus, NJ Jan 22, 23 May 7, 8 Aug 6, 7 Oct 22, 23 Dec 10, 11	Phoenix, AZ Jan 29, 30 Apr 9, 10 Jun 4, 5 Jul 23, 24 Sep 10, 11 Nov 5, 6	Rockville, MD Mar 26, 27 May 21, 22 Sep 24, 25 Nov 12, 13	Santa Clara, CA Jan 22, 23 Mar 26, 27 May 21, 22 Jul 16, 17 Sep 3, 4 Oct 22, 23
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Seattle, WA Feb 26, 27 Jun 25, 26 Aug 6, 7 Oct 1, 2 Dec 10, 11	St. Louis, MO Jul 16, 17 Nov 5, 6	Toronto Jan 15, 16 Sep 10, 11	Vancouver, BC Apr 2, 3
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9010 Board Tester

Troubleshooting

This course was designed to provide your personnel with the problem solving methodology needed to stay current in today's micro-computer technology. Whether you're doing service repair, assembly line pre-testing, or debugging newly designed circuits still on the breadboard, you'll find this course extremely useful when dealing with complex microcomputer circuits. By being able to quickly and methodically troubleshoot to the component level you'll see confidence and productivity rise and costs fall.

Course Objectives: In this two day course you will learn to use the 9010A to troubleshoot to the component level using actual micro-computer boards. Using the built in tests and error messages, you will apply the 9000 Series Troubleshooting Strategy to isolate actual hardware problems in a hands-on environment. Testing of I/O LSI devices and the use of the Asynchronous Signature Probe option are heavily emphasized.

Course Outline:

- Preparing the 9010A for Testing
- Micro-System Troubleshooter Strategy
- Entering the Memory Map
- Using the BUS TEST
- Using the RAM SHORT TEST
- More about RAM Testing
- The ROM TEST
- Troubleshooting I/O
- Forcing Lines
- Signature Gathering Using the Probe
- Peripheral Interface Adaptors (PIAs)
- Asynchronous Signature Probe Option
- More Hands-on Training

Customer Training

Who Should Attend: Design engineers, manufacturing test engineers, test/repair technicians, service engineers and anyone responsible for troubleshooting and/or repairing microcomputer circuits.

Catalog No. T9000-TAF / 2 Days

Course Schedule: Troubleshooting

Atlanta, GA Jan 27, 28 Apr 28, 29 Jul 14, 15 Oct 27, 28 Dec 15, 16	Austin, TX Aug 18, 19	Boston, MA Feb 24, 25 Apr 13, 14 Sep 15, 16 Dec 15, 16	Burbank, CA Jan 6, 7 Mar 10, 11 Apr 28, 29 Aug 18, 19 Oct 13, 14
Charlotte, NC May 12, 13 Nov 17, 18	Chicago, IL Mar 10, 11 Jun 9, 10 Sep 8, 9 Nov 17, 18	Cleveland, OH Mar 3, 4 Aug 25, 26	Dallas, TX Jun 2, 3 Sep 1, 2 Dec 8, 9
Denver, CO Feb 3, 4 Apr 14, 15 Jun 9, 10 Jul 28, 29 Sep 15, 16 Nov 17, 18	Detroit, MI Feb 3, 4 May 5, 6 Aug 11, 12	Durham, NC Mar 10, 11 Jul 21, 22	Edmonton Sep 15, 16
Houston, TX Jan 20, 21 Jul 21, 22	Indianapolis, IN Apr 21, 22	Irvine, CA Jan 13, 14 Mar 17, 18 May 12, 13 Jul 7, 8 Aug 25, 26 Dec 15, 16	Kansas City Feb 17, 18 Sep 15, 16 Oct 20, 21
Milwaukee, WI Jan 13, 14 Oct 20, 21	Minneapolis, MN Apr 7, 8 Sep 22, 23 Oct 6, 7	Orlando, FL Feb 10, 11 Jun 9, 10	Ottawa Apr 7, 8
Paramus, NJ Jan 20, 21 Mar 11, 12 May 5, 6 Aug 4, 5 Oct 20, 21 Dec 8, 9	Phoenix, AZ Jan 27, 28 Apr 7, 8 Jun 2, 3 Jul 21, 22 Sep 8, 9 Nov 3, 4	Rockville, MD Mar 24, 25 May 19, 20 Jul 29, 30 Sep 22, 23 Nov 10, 11	Santa Clara, CA Jan 20, 21 Mar 24, 25 May 19, 20 Jul 14, 15 Sep 1, 2 Oct 20, 21
Seattle, WA Feb 24, 25 Jun 23, 24 Aug 4, 5 Sep 29, 30 Dec 8, 9	St. Louis, MO Feb 10, 11 Jul 14, 15 Nov 3, 4	Toronto Jan 13, 14 Sep 8, 9	Vancouver, BC Mar 31, Apr 1

FlexSys Software

This ten-day course studies the advantages of the FlexSys environment over the present ATLAS development systems by learning the components of the FlexSys system and the functions of the FlexSys utility package. The course discusses the software development environments and the execution of ATLAS/FlexSys procedures on a working ATE system. Emphasis is placed on hands-on program development and will cover the structure and syntax of:

- ATLAS/FlexSys language.
- Resource Description language and formation of the RD library.
- Assignment Files
- Configuration of the ATE system.
- Linking of non-ATLAS procedures to the ATLAS procedures.
- Summary files.

Course Outline:

- **Introduction**
ATLAS history and introduction to IEEE std 716 and 771
Advantages of the FlexSys system
- **Introduction to the FlexSys Menu System**
FlexSys development tools and their functions
Menu selection for development of source code
ATLAS
Resource Descriptions
Non-ATLAS Modules
Assign Files
- **Introduction to the Common Editor Functions**
- **Walk Through of ATLAS Program Execution**
- **General ATLAS Program Structure with Emphasis on the following**
Line numbering fields
Statement terminator
"BEGIN ATLAS" statement
Program preamble
Main ATLAS procedure
Terminate ATLAS statement
- **Structure and use of BNF diagrams as they apply to ATLAS/FlexSys programming**
- **Details of the ATLAS program preamble including**
Preamble statement order
Differences of Signal and Non-signal statements in the ATLAS language
The "REQUIRE" statement(s)
The "DECLARE" statement(s)
The "FILL" statement(s)
The "DEFINE" statement(s)
- **ATLAS Main Procedure**
"COMMENCE, MAIN PROCEDURE" statement
Main procedural statements INPUT/OUTPUT
Main procedural statements SIGNAL
SINGLE ACTION VERBS:
MULTI ACTION VERBS:
- **Main Procedural Statements, logical control**
The "IF-THEN-ELSE" capability:
The "WHILE-THEN" capability:
The "FOR-THEN" capability:
The "GOTO" statement
- **Block Structure of ATLAS Procedures, Discussion and Implementation**
Unavailability in true C/ATLAS 716
Syntax structure:
- **Describe the function of the following statements:**
"PERFORM" statement
"FINISH" statement
- **The RD BNF Chart**
- **Review the structure of BNF diagrams for resource description**
- **The FlexSys resource description structure**
Use of the five sections of the RD

- **The Begin Statement**
Case sensitivity of the RD language
Case convention in the RDs
Reserved words in the RD language
- **Device identification section of resource descriptions**
- **Global control section of the RD**
In IEEE-488 controlled equipment
Status Byte
Testing for particular status byte information
- **Control section of the resource description**
- **System integrator resource descriptions path control**
- **Assign files**
Configuring the ATE for the specific instrument population
Development of an Assignment File
Assigning the ATE system

Prerequisites: The course is very programming intensive. Approximately 40% of the class time is used for procedure writing and programming tasks. Because of this the student should have knowledge or experience with programming. Additionally, the student must have a working knowledge of Automated Test Equipment and how to design an ATE procedure using a program language. The student must also have a working knowledge of standard computer utilities such as file transfer, display editors, file management, compilation routines, and I/O device management. Although it is not necessary, the student would be more comfortable if they had a working knowledge of the ATLAS language, since FlexSys is an implementation of Common ATLAS. It would also be beneficial if the student had experience in the remote programming of digital multimeters, instrument controllers, power supplies, and analog system integrators.

Who Should Attend: The FlexSys course is useful to senior test and programming engineers who are familiar with IEEE remote controlled test instrumentation configurations and who have a need to develop ATLAS compatible procedures for government submission.

Catalog No. 1790-TGF / 10 Days

Course Schedule:

Seattle, WA
Feb 9-20
May 11-22
Sept 10-21
Nov 9-20

DMMs (handheld and benchtops)

Maintenance

This training course will include maintenance on all of the 8000 series DMMs. Students are required to bring a faulty DMM which they will troubleshoot in class. The models covered in this course are as grouped: 8000A/8030A, 8010A/8012A, 8020A/8021B/8022A & B/8024A/8026AA & B, 8040A/8050A, and the 8060A/8062A.

Course Objectives: This three-day maintenance course is designed to give you the confidence to successfully troubleshoot any and all of the 8000 Series Portable Digital Multimeters.

Course Outline:

- **Introduction**
Various Model Types
Definitions
- **8000 Series Overview**
Operation of each series
Specifications of each series
Verify proper operating functions
- **Theory of Operation**
DMM Basic Circuitry
Each Model
- **Troubleshooting Procedures**
Each Model
- **Hands-on Exercises**
Verify proper operation
Troubleshooting of faulty DMMs

Prerequisites: A formal education in digital and analog electronics theory. You should possess practical troubleshooting experience and a good working knowledge of basic test equipment. A basic understanding of meter calibration sources would be a plus. Experience in a calibration laboratory would be helpful but not necessary.

Who Should Attend: Anyone desiring the information needed to repair their malfunctioning DMM.

Catalog No. T8000-TMF / 3 Days

Course Schedule:

Burbank, CA	Chicago, IL	Orlando, FL	Paramus, NJ
Apr 7-9	Sep 28-30	Oct 28-30	Feb 2-4
Dec 8-10			

Metrology for Technicians

General Technology

Metrology for Technicians is a one-week course covering electrical/electronic measurements and calibration for technicians so that they will become more productive in calibrating test instrumentation. The course includes practical tips and exercises to illustrate:

- Loading Errors
- Lead Impedance
- Using Voltage Dividers
- Low Level Measurements
- Thermal EMFs
- Grounding and Guarding
- Measurement System Uncertainties

The student will also be introduced to "Creative Metrology." Creative Metrology is an innovative way of approaching the task of measurement from different points of view and extending the range of NBS traceability. The kind of thinking and techniques required to extend measurement parameters are dealt with in detail. The student will begin to see and use creative techniques for their measurement and calibration requirement.

Course Outline:

- **Traceability**
- **The Standards Laboratory**
- **Understanding Specifications**
Definitions
Ratios of Accuracy
Total Uncertainty of Measurement
Instrument Specifications
- **Measurement, Errors and Statistical Analysis**
Characteristic of Precision
Measurement Errors
Statistical Analysis
- **Null Detectors**
- **Standard Resistors and Dividers**
Resistor Requirements
How Resistors are Used
- **The Kelvin-Varley Divider**
A Ratio Divider
Construction of Kelvin-Varley
Specifications
- **Cables and Connectors**
DC and Low Frequency Applications
Advantages of Using Copper
The Effects of Metal Plating
The Effects of Soldered Connectors
AC Applications
General Maintenance
- **Direct Voltage Sources**
History of Cells
Standard Cells
Solid State Voltage References
Maintaining the Volt

Customer Training

- **Direct Current**
 - Measurement of Current
 - Calibration of Shunts
 - Establishing Current Sources
 - Current Source Calibration
- **Alternating Voltage and Current**
 - Sinusoid Waveforms
 - AC Referenced to DC
 - A Replacement for the Thermocouple
 - The Transfer Standard
 - Alternating Current
 - Inductive Voltage Dividers
- **AC Bridges**
 - AC Bridge Configuration
 - Bridge Errors
 - Inductors as Bridge Elements
 - Impedance Matching
 - Bridge Calibration
- **DC and AC Power**
 - The Power Formula
 - Power Relationships
 - Measuring Power
 - Errors in Single Phase Measurements
 - Calibration of Power Measuring Equipment

Who Should Attend: Engineers and technicians with an electronics background whose work involves measurements and calibration.

Catalog No. T1000-TGF / 5 Days

Course Schedule

Burbank, CA Feb 23-27 May 4-8 Oct 5-9	Butler, PA May 4-8 May 11-15	Chicago, IL Feb 16-20 Jul 20-24	Dallas, TX Apr 6-10 Oct 12-16
Denver, CO Jul 20-24 Oct 26-30	Detroit, MI May 11-15 Sept 14-18	Fairfield, CT Jun 22-26	Irvine, CA May 18-22
Minneapolis, MN Mar 23-27 Jun 8-12 Dec 7-11	Orlando, FL Feb 23-27 Mar 3-6 Jul 27-31 Aug 3-7 Nov 16-20	Ottawa, Ontario Mar 16-20	Paramus, NJ Jun 8-12 Sept 21-25
Phoenix, AZ Mar 9-13 Sept 14-18	Rockville, MD Oct 5-9	Santa Clara, CA Mar 30-Apr 3 Dec 14-18	Seattle, WA Aug 24-28
Springfield, MA Mar 30-Apr 3 Apr 6-10			

Ordering & Other Information



Ordering Fluke products is as easy and convenient as picking up the phone. Fluke Sales Offices, Representatives and authorized Industrial Distributors are located

worldwide to provide you with immediate sales assistance, on your local level. For U.S. Government purchases, we also have strategically located sales specialists ready to assist your needs. For details on pricing, delivery and terms, to technical information regarding the suitability of a particular product for a specific application, Fluke can help. Give us a call.

This section of the catalog also includes specifications and information on limited-demand products as well as miscellaneous accessories used for a variety of Fluke products. Also, don't overlook our complete listing of all technical and sales literature available. For more information, simply fill in the postage-paid reply card included at the end of this section and send it to us.



Also see page 63 for other DMM accessories and page 178 for thermometer accessories.



Y9109 **Y9108** **Y9113**

BNC-Banana Adapters

BNC-to-banana adapters permit interconnection between equipment having BNC plugs or jacks and equipment with double banana plugs or jacks.*

*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.

Y9109* BNC Plug to Binding Posts

Y9108* BNC Jack to Double Banana Plugs

Y9113* BNC Plug to Double Banana Plugs



Y9115

Y9114

Phone Adapters

Adapters permit interconnection between equipment with phone plugs and equipment with BNC or double banana plug connectors.*

*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.

Y9115* BNC Plug to Phone Jack

Y9114* BNC Jack to Phone Plug



Y9117

Y9116

Phono Adapters

Adapters allow interconnection between equipment having phono connectors and BNC connectors.*

*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.

Y9117* Phono Jack to BNC Plug

Y9116* BNC Jack to Phono Plug



M00-100-714

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

M03-230-700 Dust Cover



Y9100

Y9101

Y9102

Y9103

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* 50-ohm feedthrough termination

Y9301 Min-Loss Pad, 50Ω to 75Ω

Y9317 50Ω Termination, N



Y9107

Y9110

Y9106

BNC Connectors

Y9107* BNC "T"

Y9110* BNC Jack for printed circuit boards

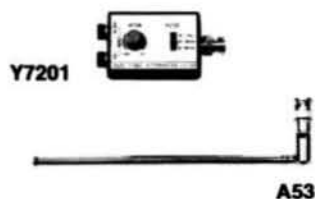
Y9106* BNC "T"

Y9307 Adapter, N to BNC, 75Ω

Y9308 Adapter, N to BNC, 50Ω

Y9316 Cap, Non-Shorting, BNC

*Available through Distributors (see page 302)



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 k Ω

Attenuation Range: $\div 5$ to $\div 100$, continuously adjustable

Low Pass Filter: 1 kHz, 20 kHz, or 100 kHz switch-selectable

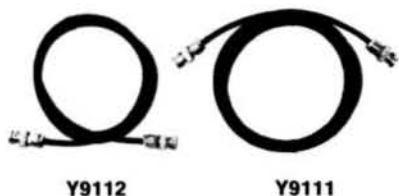
Maximum Input: 30V

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



50 Ω BNC Coaxial Cables

RG-58 C/U coaxial cables with BNC connectors (plugs) on each end are available in two lengths:

Y9111** 0.93m (3 ft) 50 Ω Cable, BNC

Y9112** 1.85m (6 ft) 50 Ω Cable, BNC

Y9315 Coaxial Cable, N Mate



IEEE-488-Compatible Cables

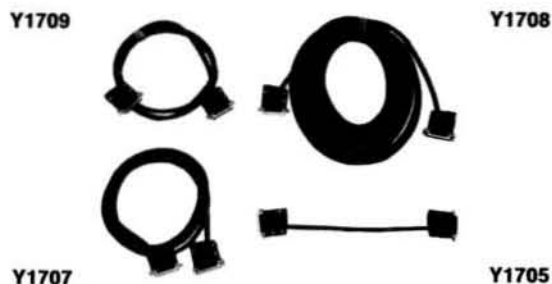
A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.

Y8021 Shielded Cable, 1m (39.4 in)

Y8022 Shielded Cable, 2m (78.8 in)

Y8023 Shielded Cable, 4m (13 ft)

** 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.



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 2m (6.56 ft) Null Modem Cable

Y1703 4m (13 ft) Null Modem Cable

Y1705 30m (1 ft) Null Modem Cable

Y1707 2m (6.56 ft) Interface Cable

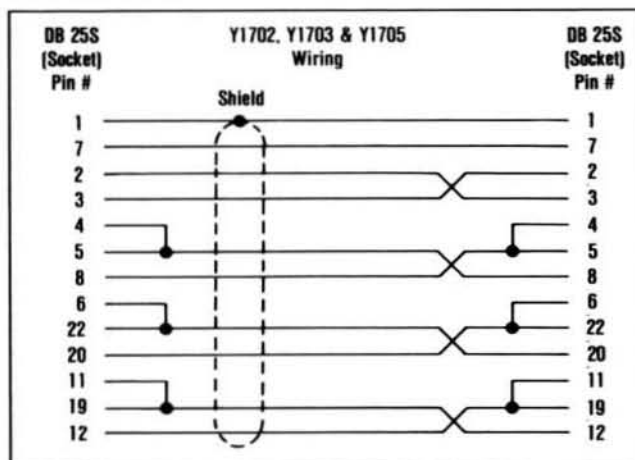
Y1708 10m (32.8 ft) Interface Cable

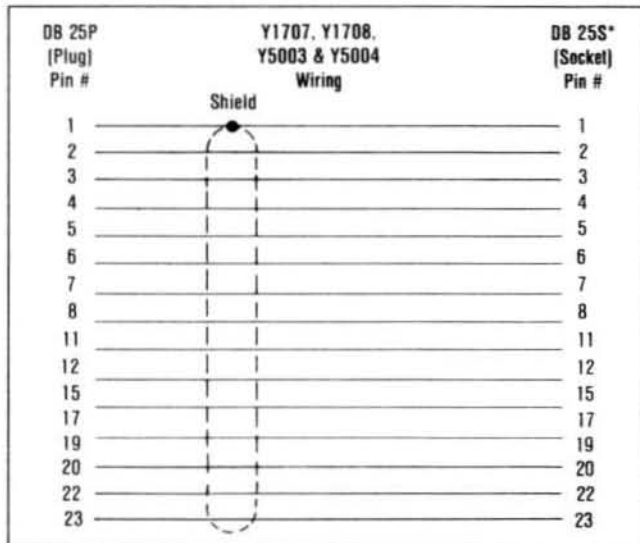
Y1709 1m (3.28 ft) Printer Cable

Y5003 1.52m (5 ft) Interface Cable

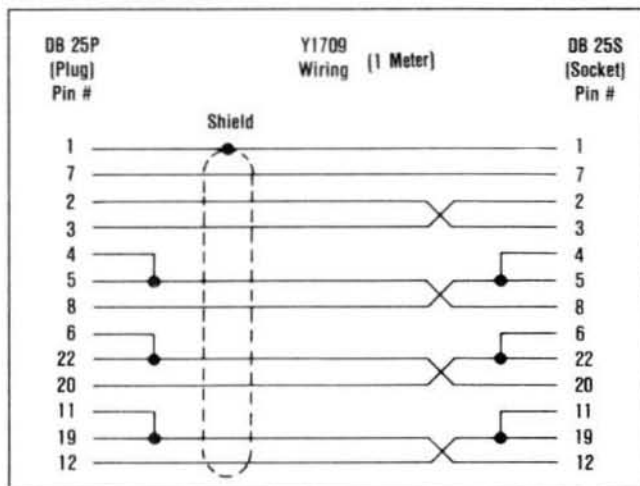
Y5004 3.05m (10 ft) Interface Cable

RS-232 Cable Wiring





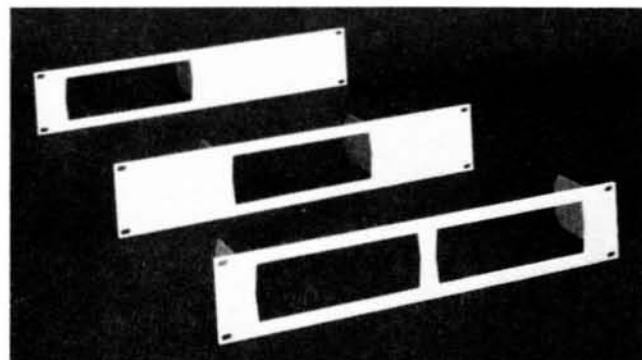
*DB 25P for Y5003 and Y5004



Rack-Width Rack Adapters

Fluke bench/systems instruments are designed to be easily mounted in a standard 19-inch rack cabinet. Some have rack-mount panels and some need rack adapters. When adapters are required they are listed with the instrument — among its recommended accessories.

Portable Instrument Rack Adapters



Multimeter Rack Adapters, 3 1/2" High

8010A: M00-200-611, M00-200-612, and M00-200-613
8000A, 8012A, 8050A, 8600A: Same as for 8010A
8840A, 8842A, 8840A/AF: Y8834, Y8835 and Y8836

Y8834 Single Rack Mount Kit, 8840A, 8842A
Y8835 Dual Rack Mount Kit, 8840A, 8842A
Y8836 Center Rack Mount Kit, 8840A, 8842A

Counter Rack Adapters, 3 1/2" High

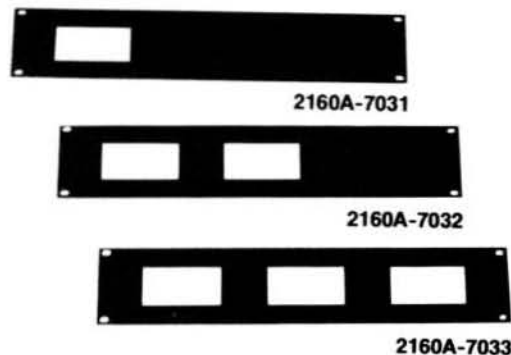
1900A: M00-200-611, M00-200-612, and M00-200-613
1910A, 1911A, 1912A: Same as for 1900A

Thermometer Rack Adapters, 3 1/2" High

2165A: M00-200-611, M00-200-612, and M00-200-613
2166A, 2168A, 2175A, 2176A: Same as for 2165A

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

Panel-Mount Thermometer Adapters



Either the 2160A or the 2170A Thermometer may be mounted in these rack-width panels that are 3 1/2 inches high. Also, the 2161A Multipoint Selector and 2162A Digital Comparator will fit the panel openings.

2160A-7031 3 1/2" Rack Mount Panel Kit, Single
2160A-7032 3 1/2" Rack Mount Panel Kit, Double
2160A-7033 3 1/2" Rack Mount Panel Kit, Triple

*Available through Distributors (see page 302).

PTI-Style Instrument Adapters

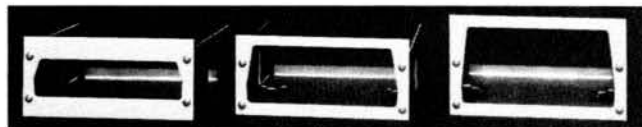
Rack adapters for the 2180- and 2190-Series Thermometers, 7200 Series Counters, 8920 Series DVMs, and other Fluke products in PTI cases look like those shown in the picture except for the size of the opening or height of the panel.



PTI Case Style	Panel Opening		Rack Panel Size	
	Single	Double	Height	Width
Style A	Y2010	Y2011	3½ in (89 mm)	19 in (483 mm)
Style B	Y2012	Y2013	5¼ in (133 mm)	
Style C	Y2014	Y2015	5¼ in (133 mm)	
Style D	Y2016	Y2017	7 in (177.8 mm)	
Style A + C	—	Y2027	5¼ 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	Adapter Number	Panel-Mount Adapters			
		Panel Cutout		Bezel Size	
		Height	Width	Height	Width
Style A	Y2018	92 mm (3.62 in)	186 mm (7.32 in)	97 mm (3.82 in)	214 mm (8.43 in)
Style B	Y2019	92 mm (3.62 in)		97 mm (3.82 in)	
Style C	Y2020	*		122 mm (4.80 in)	
Style D	Y2021	138 mm (5.43 in)		145 mm (5.70 in)	

* Any dimension from 96mm to 116mm. 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.

PTI-Style Instruments

PTI Instruments & Accessories	PTI Case Style			
	A	B	C	D
1120A			•	
2020A, 2030A, 2300A				•
2180A, 2189A, 2190A Y2000, Y2001 Y2002 Y2003, Y2009	•		•	
7220A, 7250A, 7260A, 7261A		•	•	
8860A 8920A, 8921A, 8922A			•	•
Y5020				•
Y2023			•	

Y2024 3-Module Power Cord



Three 3-wire receptacles for powering two or three PTI-style instruments from one power outlet.

PTI Case Dimensions

Style	Height	Width	Depth
A	57 mm (2.25 in)	205 mm (8.05 in)	326 mm (12.85 in)
B	82 mm (3.23 in)		
C	105 mm (4.13 in)		
D	128 mm (5.03 in)		

Models

Y2010 3½" Rack Mount Kit PTI, Single
Y2011 3½" Rack Mount Kit PTI, Double
Y2012 5¼" Rack Mount Kit PTI, Single
Y2013 5¼" Rack Mount Kit PTI, Double
Y2014 5¼" Rack Mount Kit PTI, Single
Y2015 5¼" Rack Mount Kit PTI, Double
Y2016 7" Rack Mount Kit PTI, Single
Y2017 7" Rack Mount Kit PTI, Double
Y2018 3.05" DIN Panel Mount Kit PTI
Y2019 3.81" DIN Panel Mount Kit PTI
Y2020 4.80" DIN Panel Mount Kit PTI
Y2021 5.70" DIN Panel Mount Kit PTI
Y2024 3-Module Power Cord
Y2027 5¼" Rack Mount Kit PTI, Dual

Meaning of Limited Demand

The instruments described on these pages represent a desirable choice in a few specialized cases. Recommended substitutes are usually given with the description.

Differential Voltmeters



887AB

(NSN 6625-00-451-9287)

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.

Because analog meters are used on the front panel of differential voltmeters to indicate a null condition, they also provide a good visual monitor of small voltage changes and trends.

Differential Voltmeter Selection Guide

Model	DC Resolution	AC Sensing	Infinite Impedance
893A	10 μ V	Average	To 1100V
895A	1 μ V	N/A	To 1100V
887AB	1 μ V	Average	To 11V
931B-01	N/A	True RMS	N/A

893A Differential Voltmeter

895A Differential Voltmeter

887AB Differential Voltmeter

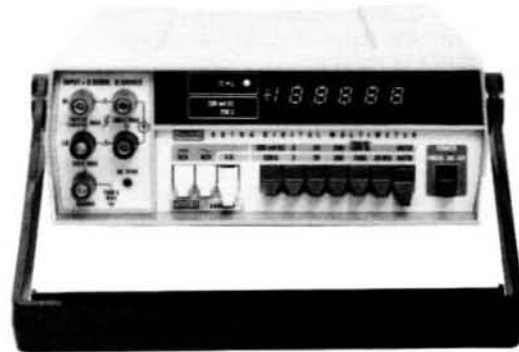
931B-01 Differential Voltmeter

382A Voltage/Current Calibrator

The 382A combines a $\pm 0.01\%$ voltage calibrator and a $\pm 0.02\%$ current calibrator. Current mode offers 0 to 2A in four ranges. Voltage outputs are available in two ranges; 0 to 50V dc and 0 to 5V dc. Resolution is 10 μ V for voltage and 0.1 μ A for current with a stability of 0.005%/mo. Voltage and current limiting are adjustable. The 382A is short-circuit proof.

382A DC Voltage/Current Calibrator

8810A Digital Multimeter



8810A

The 8810A is a low cost, high precision, 5½-digit, autoranging digital multimeter that may be bought with or without built-in options. The choice of options not only lets you satisfy specific immediate applications in the most economical way but lets you add capabilities to match changing requirements later.

The 8840A Digital Multimeter is the recommended replacement for the 8810A.

8810A Digital Multimeter

Options*

8810A-02 BCD Data Output

8810A-07 Resistance

8810A-07K Field Installable Resistance

8810A-08 Average Responding AC Volts

8810A-08K Field Installable Average Responding AC Volts

8810A-09 True-RMS AC Volts

8810A-09K Field Installable True-RMS AC Volts

C89 Carrying Case

* Option -08 cannot be used with -09.

Digital Multimeter 8125A and 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.

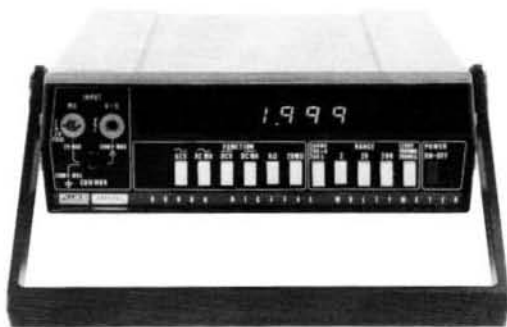
The functions, ranges, and performance of the 8425A are identical to those of the discontinued 8400A. Prices on request.

80F-15 Precision High Voltage Probe

The 80F-15 probe precisely divides inputs by 1000:1 to allow measurement of voltages to 15 kV dc. Accuracy is $\pm 0.05\%$ of input into $10\text{ M}\Omega \pm 0.1\%$ voltmeter input, 1 year, $23^\circ\text{C} \pm 1^\circ\text{C}$.

- 80F-15 High Voltage probe (10 M Ω cal)
- 80F-15-01 High Voltage probe (11 M Ω cal)
- 80F-15-02 High Voltage probe (10¹⁰ M Ω cal)

8000A Digital Multimeter



(NSN 6625-00-322-8715) **8000A**

A classic 3½-digit DMM with LED readout. The 8010A, 8012A, or 8050A with LCD readout are recommended replacements.

- 8000A DMM
- 8000A-01 DMM w/Rechargeable Batteries
- 8000A/MAS for x-ray testing

High Voltage Power Supplies



(NSN 4931-00-115-0567) **410B**

The 410B and 415B are extremely stable dc sources that cover the range of 0 to 10,000V with 5 mV resolution and 0.25% calibration accuracy. The 410B provides 0 to $\pm 10,000\text{V}$ at 10 mA maximum output current. The 415B covers from 0 to $\pm 3100\text{V}$ at 30 mA maximum. Both models include adjustable over-current protection.

- 410B High Voltage Power Supply
- 415B High Voltage Power Supply

A-90 Current Shunt



(NSN 6625-00-506-0533) **A-90**

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 $\pm 0.15\%$ for dc, $\pm 0.3\%$ for ac.

A-90 Current Shunt

80E-10 High Voltage Divider



(NSN 6625-00-459-3219) **80E-10**

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 $\pm 0.01\%$. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

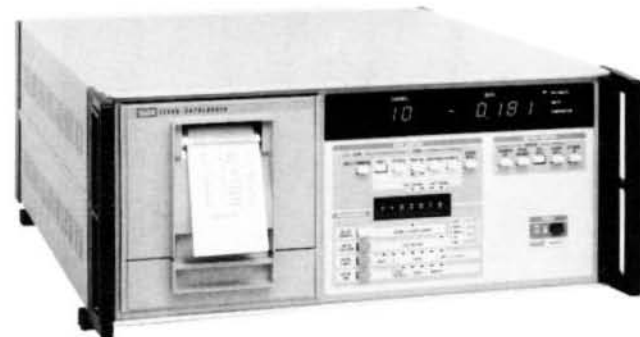
80E-10 High Voltage Divider

2240C Data Logger



The 2240C sells for a mid-range price yet it handles most data logging requirements. A large variety of options makes it possible to configure each system to closely match the size and unique character of individual requirements. Programming is accomplished from the front panel or from a remote computer via an RS-232-C or IEEE-488 interface. You can scan and record all data, record data only when an out-of-limit transition occurs, or record data periodically at preselected intervals. Data is displayed on the front LED panel, and can be written to the built-in printer or to an external device.

2200B Data Logger



The 2200B is recommended for comparatively simple data logging operations. It will scan up to 60 input channels as a stand-alone instrument and up to 100 channels if connected to an Extender Chassis. Included in the price of each 2200B is a scanner card option (-06) and a mating connector option (-08) that will handle up to 10 DC voltage or thermocouple inputs. Also included is an A-to-D converter circuit card and the capability to linearize up to four different combinations of thermocouples, RTDs, and/or current transmitter inputs (from a list of 15). Data can be retrieved from the LED display panel, from the internal printer or from an external device.

- 2240C Data Logger
- 2200B Data Logger, w/-06 and -08
- 2201A Scanner Extender Chassis
- 2202A Remote Scanner Chassis
- 2203A RTD Scanner Chassis

2240C & 2200B Options

- 2200A-03 RTD Connector
- 2200A-04 RTD Scanner
- 2200A-05 General Purpose Scanner
- 2200A-06 Low Level Scanner
- 2200A-07 Solder Pin Connector
- 2200A-08 Isothermal Block Connector
- 2200A-12B Interface for ASR33
- 2200A-12M Interface to RS-232-C Modems
- 2200A-14G Interface for Kennedy 1600/360, 1610/360
- 2200A-16 Digital Input (BCD)
- 2240A-23 Alarm Set Point Outputs
- 2240A-28 Connector for 1 to 5 mA Transmitters
- 2240A-29 Connector for 4 to 20 mA Transmitters
- 2240A-30 Connector for 10 to 50 mA Transmitters
- 2240A-33 Interchangeable RTD Scanner
- 2240A-33/AL AC Voltage Scanner

2240C (only) Options

- 2240B-15 IEEE Interface
- 2240B-17A Remote Control, RS-232-C, Modem
- 2240B-17B Remote Control, RS-232-C, Terminal
- 2240B-17C Remote Control, 20 mA Loop, TTY
- 2240B-32* Dual Interval Scan
- 2240C-40* mx+b Scaling
- 2240C-41* Alarm Set Point
- 2240C-42* Time and Group Average
- 2240C-43* Temperature Scaling Group I
- 2240C-44* Temperature Scaling Group II
- 2240C-45* Temperature Scaling Group III

*Factory or Service Center installation only. Others user-installable

2200B (only) Options

- 2240B-26* Multiple Scaling
- 2240B-27* Engineering Units Notation
- 2200B-34* 40 Alarm Limit Set Points
- 2240B-37* IEEE Interface

*Factory or Service Center installation only. Others user-installable



7405A Multimeter Calibration Workstation

The 7405A is a fully automated, precision calibration workstation. It can rapidly and accurately calibrate a wide range of meters including DMMs, DVMs, VTVMs, and VOMs as well as voltage and current sources, power supplies, amplifiers, and passive devices.

A basic 7405A is comprised of a fully integrated group of Fluke measurement and calibration instruments — the 5100B Multifunction Calibrator, the 8505A Digital Multimeter, and the 1722A Instrument Controller — built into a console having a single unique Test Interface Panel. Switching circuitry in the test panel provides functional self tests. Innovative software combined with the test panel enhances the 7405A accuracy (e.g., 20 ppm for dV, 0.025% for aV) making 7405A specifications exceed those of the stand-alone instruments.

The software package offers clear advantages over other automated calibration systems. Experienced programmers are not needed; calibration procedures can be written without learning any computer language. The 7405A accepts instructions using calibration terminology that calibration people know. Automated test procedures which formerly took specialists several days to write can now be produced in less than an hour.

When you purchase a 7405A you also get the 7411B Calibration-at-a-Keystroke Software, a software package you can depend on. 7411B includes calibration procedures for meters manufactured by most major vendors today. Remember that 7411B calibration procedures you wrote or that are supplied by Fluke are onward compatible with future offerings from Fluke.

7405A Automated Calibration Workstation

Options

- 7405A-100 Precision Power Amplifier (requires both -150 and -500 Options)
- 7405A-120 Transconductance Amplifier (requires both -150 and -500 Options)
- 7405A-150 5100-Series Interface
- 7405A-200 Frequency Counter/Timer
- 7405A-500 Rack with Cabinet
- 7405A-501 Same as -500, but 230V version
- 7400A-520 Controller Workstation

Application Information

Ask your Fluke Sales Office or Representative for a free copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Micro-System Troubleshooters: 9000 Series

9010A Avoiding Potential Problems When Getting Started	B0127
IEEE-488 Production Test	B0146
Remote Operation	B0147
Guide to 8085 Microprocessor-Based System Testing	B0151
31 Most Often Asked Questions About the Fluke 9010A	B0155
9000A Series User Designed Interface Pod Adapters	B0156
Troubleshooting 8086/8088 Interrupt Circuitry with the Fluke 9000 Series Troubleshooters	B0157
The Probe and the Program	B0163
Using the Fluke 9000 Series Micro-System Troubleshooter to Test and Troubleshoot Video Controllers	B0168
Portable Tester Learn Boards to Simplify Service (Electronics, 6/81) ..	F0016
Designing Microprocessor-Based Systems for Testability (Electronic Test, 10/83)	F0032
Testing and Repairing Microprocessor-Based Metering Equipment (Transmission & Distribution magazine, 1/86)	F0051
KCST-TV 9010A Field Report (Broadcast Engineering, 10/85)	F0055
Introductory Training Manual Micro-System Troubleshooters (9000A Series)	J0178
Fluke Troubleshooter - A Collection of Articles for Micro-System Troubleshooter Users (Replaces all earlier newsletters):	
For all of 1983 issues	P0003
For all of 1984 issues	P0009
For all of 1985 issues	P0014

PC Board Testers: 3000 Series/3200 Series

Manufacturing Defects Analyzers Catch Flaws Before In-Circuit and Functional Test (Electronics Test 10/84)	F0041
PCB-ATE Low Cost Defect Delection (Test & Measurement World Magazine, 2/85)	F0049
Offloading Functional Testers	G0089
Third Party Programming Folder	J0163
March Pattern Memory Test (3040A)	L0003
Testing 8080-Based Boards on the 3040A	L0004
Interfacing 8085 Boards to the 3040A	L0005
Unconnected Output Errors	L0006
Using Autotrack in a Loop (3040A/3050A)	L0007
External Input Bus (EIB) (3040A/3050A)	L0009
Counter Initialization Functional Testing (3000 Series)	L0010
Expanding 2-Way Bus Capability (3010A/3020A)	L0011
Oversized PCB Mounting (3000 Series)	L0012
Testing Static Memories (3000 Series)	L0014
Program Debug (3020A/3040A/3050A)	L0015
Pin Electronics for the 3050A	L0016
Testing Reactive Components with the 3200A	L0017
Expanding Models 3040A/3050A to Test PCBs With More Than 240 Pins	L0018

Digital Multimeters and Voltmeters

Systems Use of 8500A/8502A (Applicable to 8505A/8506A) ..	B0001/AB-25
Using the 8520A DMM's Math Programs	B0075
Measuring High Resistance Using the 8860A	B0095
Zener Diode Testing Using the 8860A	B0096
Measuring Power Supply Regulation Using the 8860A	B0103
Decibel Measurements Using the 8860A	B0106
8520A Burst Measurements	B0107
Analog Bar Graph Applications Using Fluke 70 Series Multimeter	B0158
Automotive Applications for Fluke Multimeters	B0164
Is It a Fluke (8050A) (Hi-Fi for Pleasure, Angus McKenzie Facilities, Ltd., 8/80)	F0015
8060A Custom Chip Adds Frequency to Handheld Meter (Electronics 5/82)	F0019
Small Instruments with Big Testing Capabilities (8060A) (Telephony magazine, 5/17/82)	F0020
The On-Site Fluke Story (Model 77) (Vector, May 1984)	F0036

Digital Multimeter Packaging Tackles Harsh Environments (Electronic Packaging & Production, 10/84)	F0045
Fault Protection for Digital Multimeters (Electrical Construction & Maintenance magazine, 2/87)	F0066
Reliability of Handheld DMMs (Quality magazine, 12/86)	F0067
Selecting True RMS & Averaging DMMs	G0098
Multimeter Safety	G0101

Calibrators and Standards

Cost Optimized Calibration 5100B Series (Was AB-43)	B0055
Additional 7105A Calibration Techniques	B0141
Questions & Answers on the 5440A Direct Voltage Calibrator	B0152
Understanding the 5440 Series	B0170
Calibration — Philosophy in Practice	E0010
Calibrator Brings Record Accuracy Event to Production & Repair (5440A) (Electronics 9/82)	F0021
Voltmeters and Calibrators - A History and Review of Their Parallel Development (Measurements & Control magazine, 12/85)	F0057
International Standards - It is a Small World After All (Quality magazine, 8/86)	F0061
Is There a Need for a Calibration Lab? (Quality magazine, 10/86)	F0062
The Changing of the Guard: Buying the Right Calibration Instrument (Electronic Test, 12/86)	F0068
Fluke Traceability to NBS Direct Voltage Chart	J0246
Technology Keeps Fluke #1 in Calibration	J0251
Closed-Loop Calibration Flow Chart	J0274
Accuracy Enhancement Chart	J0275

Computer-Aided Calibration: 7400 Series/A123 Series

Questions & Answers on the 7410A Automated Calibration System ...	B0137
High Precision DMM and Oscilloscope Calibrator in One Attractive Package	L0019
Precision Direct Voltage and Ratio Calibration System with Standards Room Accuracy	L0020
Automated Calibration System	L0021
Mobile Automated Calibration System	L0022

Instrument/System Controllers: 1720A/1722A/1752A

Floppy Disk	B0076
Startup, Self Test, FDOS and COMMON	B0077
File Utility Program Fundamentals	B0078
Communication over the IEEE-488 Bus	B0079
System Command File	B0097
Disk Initialization	B0098
Modification of Files	B0099
E-Disk	B0123
BASIC Main Memory Arrays	B0142
An Introduction to Virtual Arrays	B0143
Programming with Virtual Arrays	B0144
Relocating Object Files	B0154
Plotter Routine Library	B0162
Interfacing with an Epson FX-Series Printer	B0166
ATLAS: Programming for ATE (Avionics Magazine, 1986)	F0060

Data Acquisition Data Loggers: 2280 SERIES/2200B/2240C

Road Testing With a Battery Powered 2280A Data Logger ...	AL-1041/D0027
Using the 2280A to Test a Fluidized Coal Pilot Plant	AL-1044/D0030
Using the 2280A to Test Digital Audio Disks	AL-1045/D0031
Using the 2280A Data Logger to Test Power Supplies	AL-1046/D0032
Using the 2280A Data Logger to Test Helicopter Air Speed Sensors	AL-1047/D0033
Data Logger Expands to 1500 Point/Data Acquisition and Control System (Control Engineering 9/82)	F0025
Temperature and Sterilization: Accurate Temperature Measurement Increases Productivity of Autoclave Sterilization (Medical Electronics Magazine 9/83)	F0029
Data Loggers in Test Measurement (Test & Measurement World 9/83) ..	F0033
Trunk-Mounted Data Logger Road Tests Chrysler Cars (Industrial and Process Control magazine, 7/84)	F0043
Data Logger Helps Reduce Cost in Brewery (Industrial and Process Control magazine, 6/85)	F0052
2280A Data Logger Operator's Notebook	J0222

Data Acquisition/Computer Front Ends/Process Control: 2400B/2452MCS

Intelligent Computer Front End — Software Dialog	A0202
For Fire Testing	AL-1032/D0018
To Monitor Remote TV Transmitting Stations	AL-1033/D0020
To Test Steam Turbines	AL-1034/D0019
To Control Hot Runner Temperatures in a Plastic Injection Molding Process	AL-1035/D0021
For Wire Harness Testing	AL-1036/D0022
To Monitor a Gas Pipeline Main Compressor Station	AL-1037/D0023
To Monitor a Steel Mill's Basic Oxygen Furnaces	AL-1038/D0024
To Control Stress and Rupture Testing Furnaces	AL-1039/D0025
Using the 2400A for Environmental Testing of Electronic Components	AL-1040/D0026
Using the 2400A to Monitor and Control Petrochemical Pilot Plants	AL-1042/D0028
Using the 2452MCS with Stepper Motor Controller Option to Run a Factory Pick-and-Place Machine	AL-1043/D0029
Using the 2400A Series for Gas Flow Metering & Control	AL-1049/D0035
Furnace Control and Monitoring	AL-1050/D0036
Using the 2452MCS as an Automatic Weather Station	D0037/AL-1051
2400B-001 Serial Interface	B0159
Runnerless Tooling: A Fast and Reliable Way to Mold Any Material (Modern Plastics 10/83)	F0030
Flexible Test Systems Cut Costs and Hike Production-Line Turnarounds (Electronics 5/84)	F0037
Efficiency of Chemical Process Development Increased by Computerized Control System (Chemical Processing 10/84)	F0047
Programming Control Algorithms (Chemical Engineering magazine, 3/18/85) (incorrectly labeled as F005)	F0050

Touch-Control Equipment: 1020 Series/1780A

Touch Control Screens - A New Trend in Operator Control Interfaces for Test Equipment (Evaluation Engineering magazine, 6/86)	F0063
Touch Panels Make Their Mark on Production Test (Electronic Packaging & Production magazine, 8/86)	F0064
Interfacing 1020 Series Touch Control Screens to Programmable Logic Controllers	L0023
Adding Touch Control Screens to Allen-Bradley Programmable Logic Control Systems	L0024
Fluke Touch Control Screens Provide Versatile New Operator Controls for Stamping Presses	L0025
Adding Touch Control to Texas Instruments Series 500 Controllers	L0026
Adding Touch Control Screens to Square D Programmable Controllers	L0027

Digital Thermometers

Total Instrument Accuracy for Digital Thermometers (Was AB-29)	B0005
Test or Calibrate Thermocouple or Millivolt Indicators (2190 + Y2003) (Was AB-47)	B0059
2300A Temperature Scanner: Typical PTI Applications (Was AB-51)	B0074
Case Studies in Temperature Measurement	AL-1048/D0034
Thermocouples, RTDs Can Boost Temperature Measurement Accuracy (Industrial Research & Development 11/83)	F0031

Printers

"Computing" Printer Solution — Some Typical Instrumentation Applications (2030A) (Was AB-50)	B0068
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Signal Sources

Systems Use of the 6010A Synthesized Signal Generator	AB-21/B0047
Systems Use of the 6011A Synthesized Signal Generator	AB-22/B0048
Signal Generator Primer	B0121
Filter Testing Using the 6070A and 6071A Synthesized Signal Generators	B0124
Understanding Precision Crystal Time Bases (Electronics 8/78)	F0007
Delay Lines Give RF Generator Spectral Purity, Programmability (Electronics 8/80)	F0013

Frequency Counters

Understanding Precision Crystal Time Bases (Electronics 8/78)	F0007
Compact Low-Cost Counters Carry Lab to Field (7200 Series) (Electronics 7/79)	F0008

General

IEEE Standard 488-197 Digital Interface for Programmable Instrumentation	AB-36/B0053
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Service Information

Ask your local Fluke Technical Center for a free copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Digital Multimeters and Voltmeters

Auto-Zero Circuit 8300A, Inverting Amplifier	C0045
Digital Voltmeter Guard Terminal Connection	C0048
Installation of Fuse Holder in the 8300A MV/Ohm	C0055
Troubleshooting Feedback Amplifiers	TB-2
Troubleshooting the True RMS Converter (8200A, 8400A)	TB-6
Troubleshooting the 8500A Utilizing Its Modular Structure	TB-10
Use of Millivolt/Ohm Option for 8300A DVM on 50 Hertz	C0047
80F-5/15 Improved Shock Protection	C0066
8000A Troubleshooting	TB-12
8000A Digital IC Replacement	C0062
8000A/mAS High Voltage Protection	C0065
802XB AC Reading During Overloads	C0092
8100A Battery Pack Recharge Cycles	C0053
8100A Battery Pack Repair and Replacement	C0049
8100A In-Circuit FET Leakage Tests	C0044
8100A, 8110A, 8120A, 8125A AC Linearity Tests	C0050
8100A, 8110A & 8120A 1000 Range Hi-Pot Failure	C0054
8030/8040 Battery Fuse Protection	C0069
8500A Calibration Memory Battery Replacement	C0070
8500A Controller Replacement for 8500 Series DMMs	C0098
8600A AC Converter Part Change	C0075
8800A Ohms Converter Replacement	C0068
931A Digit Switch Installation Instructions	C0042

Calibrators and Standards

Improving Reliability in Systems Use of 3330B	C0082
332B/D; 335A/D Calibration Access Warning Decal	C0072
332D & 335A Replacement of Lamps with LEDs	C0063
330B Power Line Wiring Modification	C0060
3330B Reliability Improvements	C0088
341A/343A LED Replacement	C0084
5100 Series Plug-In Relay Replacement	C0073
5100 Troubleshooting Information	B0086
5100/5101 Power Supply Fuse Installation	C0087
515A Battery Pack Mounting	C0086
5200A Oscillator Assembly Component Selection	C0085
5205 Troubleshooting Notes & Procedures	C0083
5205A/5215A LED Loop Bandwidth Calibration	C0067
5205A/5215A Operating, Cleaning & Servicing Notes	C0080
5205A/5215A Reliability Enhancement	C0097
720A Linearity Drift with Time	C0058
760A Switch Maintenance and Replacement	C0043
7405A Automated Calibration System Preparation	C0094
7410A Automated Calibration System Preparation	C0089

Data Loggers

2200B & 2240B Data Logger Memory Loss	C0076
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Counters

1910A/1911A Counter Measurement Techniques	C0075
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High Voltage Power Supplies

Safety Check of Line Fuseholder Wiring (410B)	C0079
415B Over Current Modification	C0052

General

Component Replacement Techniques	C0071
Fluke Instrument Switches	C0064
Ni-Cad Battery Shelf Life	C0056
Preventing Electrostatic Damage During Service	C0081
Troubleshooting Into IEEE-488	C0076
Troubleshooting AC Converters	C0090
Preventive Maintenance for Internal Ni-Cad Batteries	C0093

Customer Support Services Data Sheets

Digital Multimeter Repair and Calibration	A0221
Fluke Module Exchange Program	E0031
Repair and Calibration Services	E0225
FCS — A Commitment to Systems Solutions	G0137
1722A Product Update	M0007
1722A to 1752A Product Update	M0009
2280A to 2280B Product Update	M0006
2400A to 2400B Product Update	M0008
5440A to 5440B Product Update	M0005

Applications Training Data Sheets

1722/1752 Instrument Controller Software & Applications Training	E0238
2452 Measurement Control System Software & Applications Training	E0241
7400 Series Calibration Systems Procedure Writing	E0229
2280A/B Data Logger Product Introduction	E0228

9010 Board Tester Troubleshooting Training	E0242
9010 Board Tester Programming Training	E0243
FlexSys Software Training	E0239
Metrology for Technicians	A0260

Maintenance Training Data Sheets

1722A Instrument Controller Maintenance	E0234
2280A/B Data Logger Maintenance	E0235
2452 Measurement Control System Maintenance	E0240
3040A/3050B Board Tester Maintenance	E0236
3200B Board Tester Maintenance	E0230
5100 Series Meter Calibrator Maintenance	E0231
5200 Programmable AC Calibrator Maintenance	E0227
8500 Series Digital Multimeter Maintenance	E0232
8840 Digital Multimeter Maintenance	E0233
8000 Series DMM Maintenance	E0237

Specials

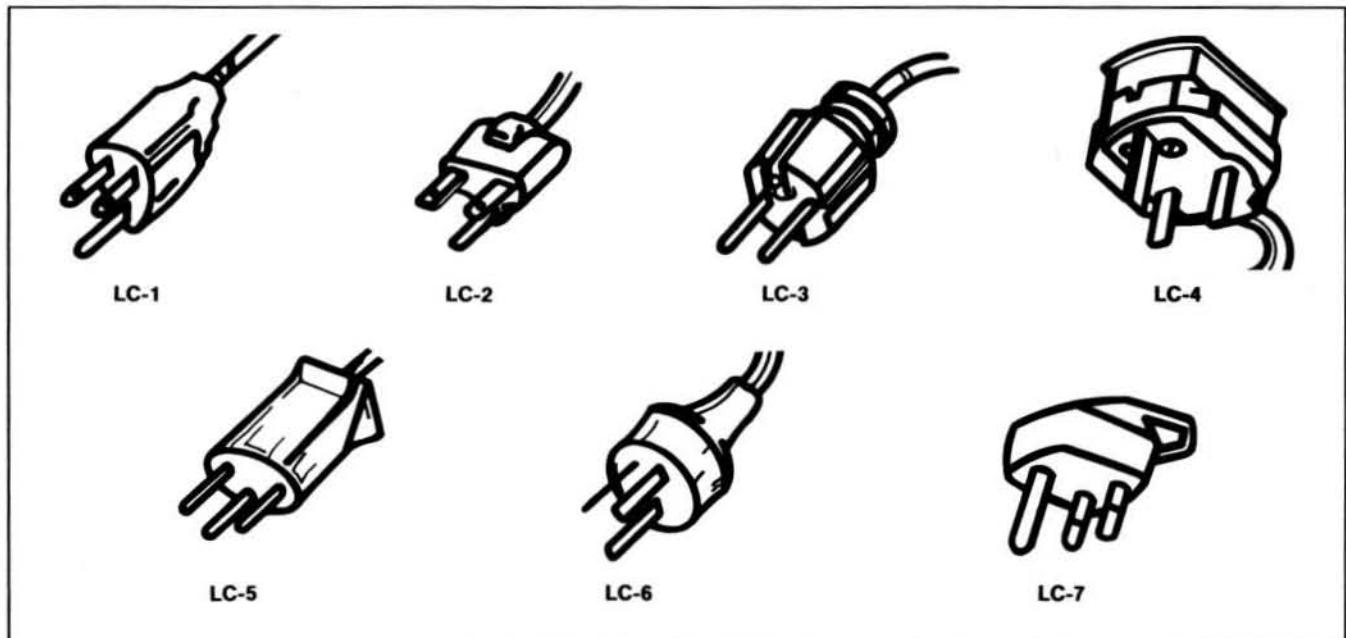
Fluke Customer Training Brochure (multi-page)	E0224
Fluke 1987 Course Planner (poster)	00016

Power Cord and Plug Options

Fluke instruments requiring line voltage 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 most commonly used in the country where the instrument will be delivered.

If you require a power cord and plug other than the one listed for the country where the instrument will be delivered, specify that power cord and plug when you order.

North American	120V/15A	Option LC-1
North American	240V/15A	Option LC-2
Universal Euro	220V/16A	Option LC-3
United Kingdom	240V/13A	Option LC-4
Switzerland	220V/10A	Option LC-5
Australian	240V/10A	Option LC-6
South African	240V/5A	Option LC-7



The Fluke Warranty

Fluke warrants each product it manufactures to be free from defects in material and workmanship under normal use and service anywhere in the world for the warranty period listed below.

1-Year Warranty — Most Fluke products are warranted for 1 year.

2-Year Warranty — Fluke 25, 27, Models 8020B, 8021B, 8024B, 8025A, 8026B, 8842A.

3-Year Warranty — Fluke 21, Fluke 23, Fluke 73, Fluke 75, Fluke 77.

90-Day Warranty — 1765A/AB, Replacement Parts, Module Exchange, Standard Price Repairs.

90-Day On-Site — 3010A, 3040A, 3050B, 3051B, 3053A.

90-Day On-Site System Warranty Plus 9-Month Service Center Warranty on Instruments — 7405A, 7410A, 2452MCS, 3200B.

Software — Most software is warranted for 90 days.

Warranty Terms and Conditions

Fluke warrants each product it manufactures to be free from defects in material and workmanship under normal use and service. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke products; it is not warranted to be error free. This warranty extends only to the original purchaser and does not apply to fuses, computer media, batteries or any product which, in Fluke's sole opinion, has been subject to misuse, alteration or abnormal conditions of operation or handling. The warranty period is controlled by the warranty document furnished with each product and begins on the date of shipment.

For warranty service, contact a Fluke Service Center or send the product, with a description of the difficulty, postage prepaid, to the nearest Fluke Service Center. Fluke assumes no risk for damage in transit. Fluke will, at its option, repair or replace the product free of charge. However, if Fluke determines that the failure was caused by misuse, alteration or abnormal condition of operation or handling, you will be billed for the repair. The repaired instrument will be returned to you, transportation prepaid.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE. FLUKE WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Calibration & Specifications

A Certificate of Calibration comes with every Fluke serialized measurement or calibration product except those indicated as "Available through Distributors." The Certificate of Calibration includes the Model and Serial number and states that the unit delivered was calibrated with standards traceable to the National Bureau of Standards. Traceability records are maintained according to MIL-STD-45662.

Products marked Available through Distributors include a Statement of Calibration Practice.

Special calibration reports that include numerical values pertaining to the calibration are available for a modest fee. Contact your Fluke Sales Office or Representative.

Specifications in this catalog are those that apply at the time of printing. Fluke reserves the right to change specifications without notice.

Special Instruments and Systems

Many Fluke instruments can be supplied with non-standard paint, altered specification ranges, special connectors, or other special features. Some automated systems may be assembled and customized to your requirements, also. Contact the Fluke Representative or Sales Office in your area.

Prices & Terms

Prices are F.O.B. origin unless otherwise specified, apply only when the final destination is within the U.S.A., are in U.S. funds, and are subject to change without notice.

Upon request, quotations, or pro forma invoices will be furnished to you by Fluke or Fluke Sales Representatives.

U.S. terms are 30 days net. Unless credit has already been established, shipments will be made C.O.D. or on receipt of cash in advance. Terms for orders from other countries are either an irrevocable letter of credit or cash in advance, unless other terms have been previously arranged.

Government Operations Group

Fluke sales offices (see page 297) and the Government Operations offices listed here have the latest information on provisioning, nomenclature, and National Stock Numbers.

Army Accounts Manager

4920 Corporate Drive, Suite J
Huntsville, AL 35805-6202
(205) 837-0581

5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Navy Accounts Manager

5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

16969 Von Karman, Suite 100
Irvine, CA 92714
(714) 863-9031

Air Force Accounts Manager

10417 Gulfdale
San Antonio, TX 78216
(512) 340-2621

5450 Far Hills Ave., Suite #111
Kettering, OH 45429
(513) 436-2224

USMC Accounts Manager

5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Security Accounts Manager

5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Dept. of Transportation

5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

U.S. General Services Administration

Most of the instruments in this catalog are available on the following General Services Administration Contracts in FSC Group 66, Part II, Sections "H" and "J", Class 6625:

Contract	Period	Category
GS00F78460 (Section H)	September 4, 1985 to July 31, 1988	Electrical/ Electronic Components & Test Equipment
GS00F70562 (Section J)	August 3, 1984 to May 31, 1987	Instruments: Measuring and Testing

Special Products, Systems, and Services

Listed below are examples of products, systems, and services that specifically support Government applications.

Products

Model 6060A/AN Synthesized Signal Generator. (NSN 6625-01-222-5007). A low-cost efficient signal generator and FM deviation meter with a frequency range of 10 kHz to 520 MHz. (See page 142.)

Model 8520A/AS-1 System Multimeter (NSN 6625-01-141-8057). Certified by the Air Force as the first module to complete all requirements imposed by the Modular Automated Test Equipment (MATE) Program. (See page 21.)

Model 8025A Multimeter (NSN 6625-01-147-6182). A handheld instrument designed to the ruggedized requirements of MIL-T-28800 Type II, Class 2, Style A. A "B" model performs to -40°C. (See page 50.)

Model 8050A-01 Multimeter (AN/USM-486/U NSN 6625-01-145-2430). A 4½-digit multimeter with 85 RF Probe selected by the Army as the preferred benchtop multimeter for multi-service maintenance and repair testing. (See page 30.)

Model 8840A/AF Digital Multimeter (NSN 6625-01-196-0014). A low-cost, high-accuracy 5½-digit multimeter for bench and system applications. (See page 3.)

Model 77/AN Digital Multimeter (NSN 6625-01-213-9354). A very low-cost 3½-digit handheld multimeter with 0.3% dc accuracy and special features including "Touch Hold." (See page 47.)

Systems

MECCA (Modularly Equipped and Configured Calibrators and Analyzers). Provides the Navy with automatic calibration capability on-site under rigorous conditions by integrating the Fluke 1722A/AP Instrument Controller, 5102B Meter Calibrator and 8506A/AN Digital Multimeter.

Model A123 Automated Calibration System. A high accuracy mobile calibration system, configured to calibrate 5½- and 6½-digit DMMs automatically.

Software

FlexSys (ATLAS Test Software). FlexSys is a complete ATLAS software system which runs on Fluke's powerful IEEE-488 Controller, the 1722A. With FlexSys and the use of resource descriptions, TPS integration is rapid and easy. ATE system reconfiguration can be accomplished without recompiling or modifying ATLAS test procedures. (See page 228.)

Services

Direct Voltage Maintenance Program. (See page 103.)

Application Training. Some of the courses presently available, including several which are complimentary with a system purchase, are identified below. Contact your local Fluke sales office or Government Operations field office for the most current information on course/seminar content and attendance considerations. (See page 273.)

1722/1752 Data Acquisition Training Course
2280 Data Loggers Training Course
2450MCS Measurement and Control System Training Course
3040A-1 Digital/Analog Board Test System Training Course
3050B Digital/Analog Board Test System Training Course
3200A Manufacturing Defect Analyzer Training Course
6070A/6071A Signal Generator RF Seminar
7405A/7410A-100 Automated Calibration System Intermediate Training
9000A Micro-System Troubleshooter Introductory Training
(Basic and Advanced courses)
9100A Troubleshooting Course
Metrology Technology

Maintenance Training. Fluke understands the needs of certain customers to possess their own maintenance capability. Maintenance training courses currently scheduled for presentation in 1987 at various Technical Service Centers include: (See page 273.)

1722 Instrument Controller
2280 Data Logger
2452 Intelligent Computer Front End
3050 Functional PCB Tester
3200 Manufacturing Defects Tester
4200 Programmable Power Source
5100/5101/5102 Calibrator
5200 Programmable AC Calibrator
5205 Precision Power Amplifier
5215 Calibrator Power Amplifier
5440 Direct Voltage Calibrator
8500/8502/8505/8506 DMM Portable Digital Multimeters
4200 Series DACs

Logistics Data Book

The Fluke Logistics Data Book is available from your local sales office. This document provides comprehensive information including National Stock Numbers, military nomenclature and replacement model numbers as well as products, systems, and services which offer benefits tailored to special government/military requirements. Detailed listings of available application and maintenance training plus technical literature are also included.

Alabama

Huntsville

4920 Corporate Drive
Suite J
Huntsville, AL 35805-6202
(205) 837-0581

Arizona

Tempe

2211 S. 48th Street
Suite B
Tempe, AZ 85282
(602) 438-8314

Tucson

(602) 790-9881

California

Southern

P.O. Box 19676
Irvine, CA 92713
16969 Von Karman
Suite 100
Irvine, CA 92714
(714) 863-9031

Burbank

2020 N. Lincoln Street
Burbank, CA 91504
(213) 849-7181

Northern

2300 Walsh Ave., Bldg. K
Santa Clara, CA 95051
(408) 727-0513

Colorado

Denver

14180 E. Evans Ave.
Aurora, CO 80014
(303) 695-1000

Connecticut

Hartford

Glen Lochen East
41-C New London Turnpike
Glastonbury, CT 06033
(203) 659-3541

Florida

Clearwater

(813) 799-0087

Miami

(305) 462-1380

Orlando

940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

Tampa

(813) 251-9211

Georgia

Atlanta

2700 Delk Road
Suite 150
Marietta, GA 30067
(404) 953-4747

Illinois

Chicago

1150 W. Euclid Avenue
Palatine, IL 60067
(312) 705-0500

Indiana

Indianapolis

8777 Purdue Road
Suite 101
Indianapolis, IN 46268
(317) 875-7870

Iowa

Iowa City

(319) 354-2811

Kansas

Kansas City

(913) 492-1010

Louisiana

Baton Rouge

(504) 924-1203

New Orleans

(504) 455-0814

Massachusetts

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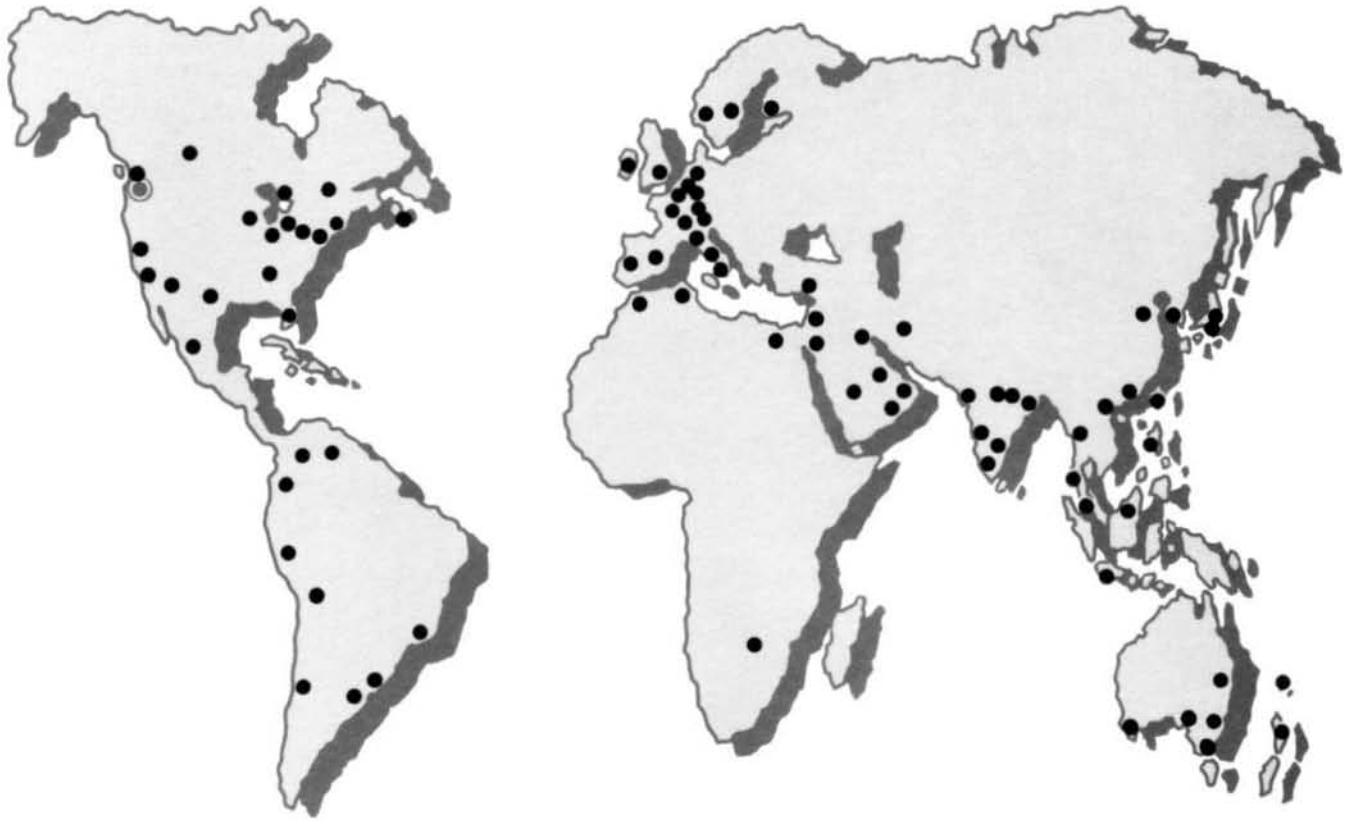
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