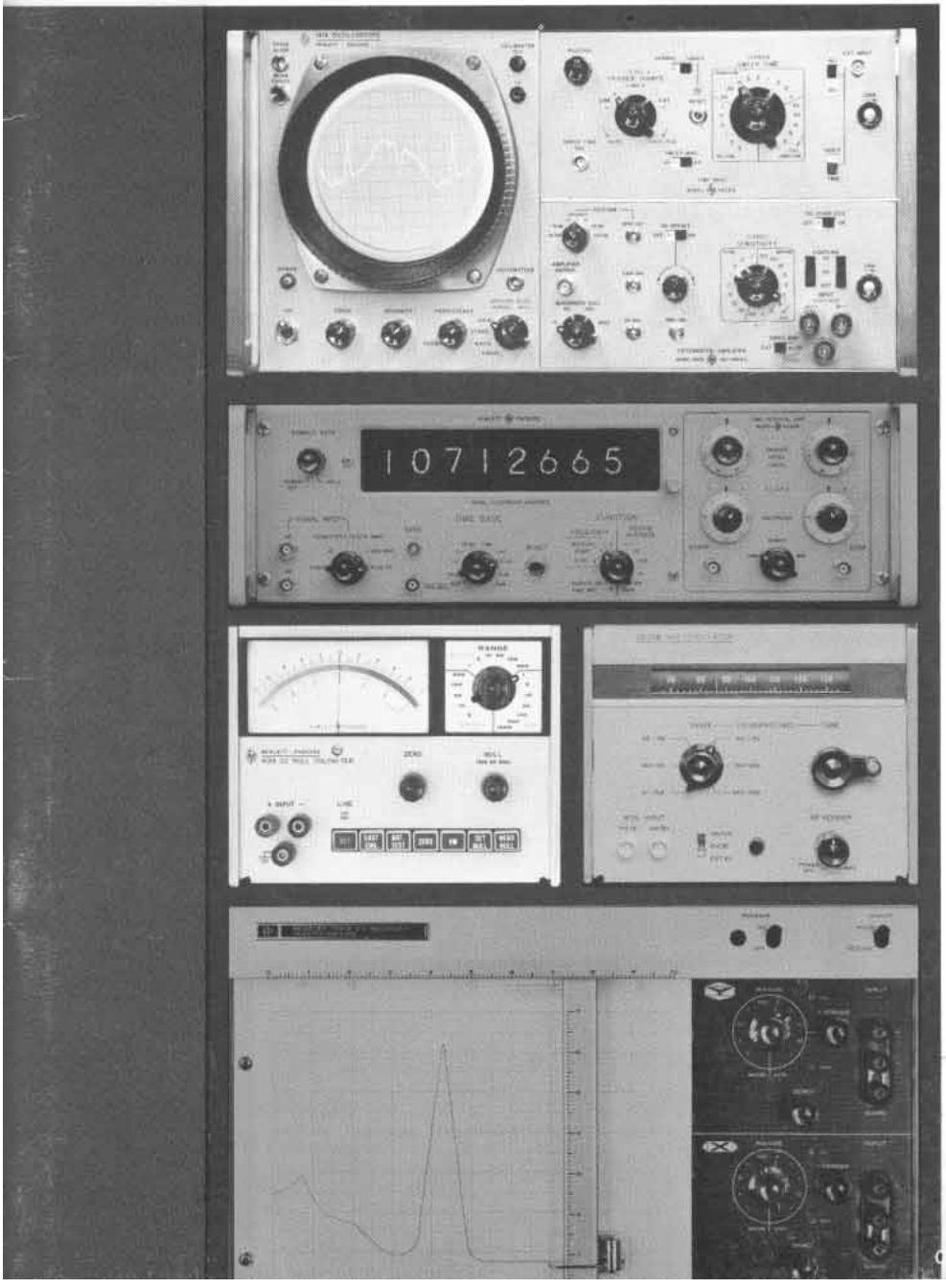
HEWLETT hp PACKARD



1966-1967 Index of ELECTRONIC MEASURING EQUIPMENT

HEWLETT hp PACKARD

TO USE THE INDEX OF ELECTRONIC MEASURING EQUIPMENT

Refer to the opposite page, find the classification of interest, and turn to the appropriate page. Equipment descriptions are necessarily concise, with some specifications stated only at their optimum point, etc. Complete technical information may be readily obtained from the Hewlett-Packard office nearest you (listed on inside back cover). The field engineer there will promptly send a data sheet, and will gladly discuss your specific application requirements.

TO FIND OUT ABOUT HEWLETT-PACKARD please lift this page.

ABOUT HEWLETT-PACKARD

From research-and-development laboratories and manufacturing facilities throughout the free world come Hewlett-Packard electronic measuring instruments...carefully designed and built to provide you with the greatest possible usefulness, accuracy, convenience, dependability and dollar value.

Now in its second quarter-century of growth, Hewlett-Packard is recognized as a major progressive source of instrumentation offering a standard of quality unmatched in the electronic test equipment field. Hewlett-Packard is also a leading supplier of medical diagnostic and patient monitoring equipment, as well as instruments for chemical and nuclear measurement.

To assure concentrated effort in developing true state-of-the-art measuring tools, plus specialized manufacturing experience and know-how that assures instrument quality and reliability, Hewlett-Packard is organized into the product-centered divisions and affiliates listed below.

And to provide complete applications assistance and after-sale back-up, Hewlett-Packard has more than 100 field engineering offices situated around the world. The inside back cover lists nearby offices serving your area; give the field engineers there a call next time you have a measurement need.

COLORADO SPRINGS DIVISION

Colorado Springs, Colorado—Oscilloscopes, pulse generators and related instruments.

DYMEC DIVISION

Palo Alto, California—Digital data acquisition and processing instruments and systems, plus specialized test equipment for other applications.

F & M SCIENTIFIC DIVISION

Avondale, Pennsylvania—Gas chromatographs, C-H-N analyzers, osmometers, viscometers and other equipment for chemical measurements.

FREQUENCY & TIME DIVISION

Palo Alto, California—Electronic counters, digital recorders, frequency and time standards, nuclear instrumentation.

HP ASSOCIATES

Palo Alto, California—Advanced solid-state components including hot carrier and step recovery diodes, microwave switches, photoconductors, optoelectronic devices.

HARRISON DIVISION

Berkeley Heights, New Jersey—Highly regulated dc power supplies and related equipment.

HEWLETT-PACKARD Ltd.

South Queensferry, Scotland—Communications test equipment for world-wide sales; also many of Hewlett-Packard's most widely used instruments for the British, EFTA and Commonwealth markets.

HEWLETT-PACKARD G.m.b.H.

Böblingen, West Germany—Pulse generators, industrial recorders for world-wide sales; also many of Hewlett-Packard's most widely used instruments for the European Common Market.

LOVELAND DIVISION

Loveland, Colorado—Voltmeters, oscillators, amplifiers, distortion analyzers, resistance and dc voltage standards, other general-purpose test equipment.

MICROWAVE DIVISION

Palo Alto, California—Sweep oscillators, signal generators, waveguide and coaxial test equipment, spectrum analyzers, specialized test equipment for use at microwave frequencies.

MOSELEY DIVISION

Pasadena, California—X-Y recorders, strip-chart recorders for laboratory and industrial applications, plus related accessory items.

ROCKAWAY DIVISION

Rockaway, New Jersey—Impedance measuring equipment, plus special-purpose signal generators and air navigation test sets.

SANBORN DIVISION

Waltham, Massachusetts—Recording systems and instruments for measuring and recording physical phenomena. Also medical diagnostic apparatus, including patient monitoring equipment.

YOKOGAWA-HEWLETT-PACKARD Ltd.

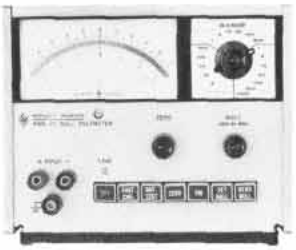
Tokyo, Japan—Impedance measuring instruments, oscillators, power supplies for world-wide sales; also many of Hewlett-Packard's most widely used instruments for the Japanese market.

CONTENTS

Data subject to change without notice. Prices f.o.b. factory.

VOLTAGE, CURRENT, RESISTANCE MEASUREMENTS

3420B DC Differential Voltmeter/Ratiometer



419A DC Null Voltmeter

735A DC Transfer Standard

DC voltage measurement, standards

Hewlett-Packard dc null voltmeters, dc differential voltmeters and dc standards... for unprecedented accuracy, stability, sensitivity and convenience on the production line or quality assurance bench, in the R&D or standards laboratory. Use the hp dc transfer standard and null voltmeter for making precise standard dc voltage measurements where they're needed.

Instrument	Performance	Model	Price
DC standard and differential voltmeter for calibrating digital and differential VM's, use as high-voltage dc standard source, for dc standard transfer measurements, standard cell comparisons, as low-level null detector, for precision low-level measurements.	DC standard: ±0.002% accuracy, 1–1000 V full scale, floating, guarded input; high stability, regulation. DC differential voltmeter: ±0.005% accuracy, 1 μV to 1000 V null ranges, 1 ppm resolution at full scale, 6 digits. DC high Z VM: 1 μV to 1000 V end scale (±2% accuracy), $>10^{10}$ ohms input R on most ranges. Amplifier: gain to 60 db, ±0.001% linearity.	740B	$2350
AC and DC differential voltmeter, DC standard adds ac capability, 20 Hz-100 kHz, to dc standard and differential VM measurements. Useful also as dc standard, high Z ac or dc VM, voltage or power amplifier. Recorder output.	AC differential voltmeter: ±0.05% to ±0.2% accuracy 1–1000 V end scale, 1 MΩ/(<5 pf) input Z. DC differential VM: 0.02% accuracy, 1 to 1000 V end scale, input $Z>10^9$ ohms. DC standard: 0 to 1000 V, 6-digit resolution, ±0.02% accuracy; ±0.02% power amplifier, 0 to 1 kV.	741A	$1475
DC differential voltmeter/ratiometer for standard cell comparisons, precision low-level measurements. Fully floating input for attenuator and linearity tests. Resistance and voltage ratios. Recorder output. DC high Z voltmeter.	DC differential voltmeter: ±(0.002% of reading + 0.0001% of range) 1.1 to 1100 V full scale, 4 ranges, 0.2 ppm resolution at full scale, 6 voltage decade dials. Input R infinite 1 and 10 V ranges, 10 MΩ other ranges. Ratiometer: ±(0.002% of reading +0.0002% of range) RX1 to RX0.001, 4 ranges. DC high Z VM: 10 μV to 1000 V end scale (±3% of end scale), 9 ranges.	3420A 3420B (ac line and rechargeable batteries)	$1175 $1300
DC null voltmeter is portable and battery-operated. Useful as sensitive null detector for bridge measurements, floating VM measurements, thermocouples, general-purpose VM and/or null detector, dc amplifier.	Internal bucking voltage for measuring high-Z source voltages; 0.1 μV resolution, <0.5 μV drift/day; >80 db superimposed ac rejection, overload to 1200 V; ±3 μV to ±1 kV zero center scale VM, accuracy ±2% of end scale ±0.1 μV.	419A	$450
DC null voltmeter with high input impedance, stability; low noise, input isolated from ground. Useful as dc amplifier.	±1 mV to ±1000 V end-scale range, ±2% of end scale accuracy; high ac rejection; also, high-gain, low-noise amplifier.	413A	$350*
DC transfer standard is 1 V reference for volt boxes, potentiometers; standard cell comparator; stable microvolt source; portable, compact; simplifies dc standard work, direct-reading comparisons.	Outputs: 1.00000 V reference; 1.018+(Δ); 1.019 +(Δ); 0–1000 μV source with 1 μV resolution (Δ=3-digit direct-reading 0–1000 μV offset voltage); 2 ppm transfer accuracy between std. cells, 10 ppm/month stability, output floating and guarded.	735A	$375

*Add $5 for rack mount

Digital voltmeters

Select easy-to-use Hewlett-Packard digital voltmeters and get the right combination of performance, reliability and value for every application. Versatile DVM's with plug-in controls can be tailored to many measurements, while integrating and integrating/potentiometric DVM's accurately measure low-level signals in the presence of noise. For accessory equipment and systems using these DVM's, see page 38.

HO4-3460A High-resolution DVM

	Instrument	Range (full scale)	Accuracy	Speed	Model	Price
	DVM with plug-in versatility, choice of manual, automatic, remote ranging; extra-high sensitivity; ac and dc voltage, direct current, resistance measurements; 4-digit readout; 30 db ac rejection at 60 Hz; float input pair up to 500 V above chassis ground; ideal bench instrument.	0.100–1000 V	±0.05% of rdg ±1 digit	Fixed: 2–3/sec	3439A	$950*
	Add BCD output and remote programming to 3439A above: Solid-state instrument can be remotely programmed and provides a printer output; sample rate variable; ideal for low-cost systems (see page 44).	0.100–1000 V	±0.05% of rdg ±1 digit	Adjustable: 5/sec to 1/5 sec	3440A	$1160*
Plug-in units for 3439A and 3440A	**Manual range unit** for manual selection of dc voltage ranges.	10, 100, 1000 Vdc	±0.05% of rdg ±1 digit		3441A	$ 40
	Auto range unit for automatic, manual or remote selection of dc voltage ranges.	10, 100, 1000 Vdc	±0.05% of rdg ±1 digit		3442A	$ 135
	High gain/auto range unit for automatic, manual or remote selection of dc voltage ranges.	100, 1000 mV; 10, 100, 1000 Vdc	±0.05% of rdg ±1 digit		3443A	$ 450
	DC multifunction unit for manual selection of dc voltage, direct current, resistance ranges.	Voltage: same as 3443A Current: 100 μA–1000 mA Resistance: 1000 Ω –10 MΩ	E: ±0.05% of rdg ±1 digit I: ±0.2% of rdg ±1 digit R: ±0.3% of rdg ±1 digit		3444A	$ 575
	AC/DC range unit for automatic, manual or remote selection of ac and dc voltage ranges. Manual function selection.	DC: 10, 100, 1000 V AC: 10, 100, 1000 V 50 Hz–100 kHz	DC: ±0.05% of rdg ±1 digit AC: ±0.1% of rdg ±2 digits 50 Hz–20 kHz		3445A	$ 525
	AC/DC remote unit, same as 3445A except also has remote function selection.	Same as 3445A	Same as 3445A		3446A	$ 575

*Requires a plug-in unit for operation

Instrument	Range (full scale)	Accuracy	Speed	Model	Price
Integrating DVM measures accurately despite high common mode and superimposed noise; 140 db CMR all noise frequencies; 1 μv sensitivity; full programmability for systems (see pages 43,44).	0.1, 1, 10, 100, 1000 Vdc; 300% overrange, 6th digit	±0.01% of rdg ±0.005% of full scale ±1 digit at 25° C	1/sec for 5-digit resolution, 50/sec for 3-digit	2401C	$3950
Integrating/potentiometric DVM combines speed and high noise rejection, lab accuracy, 100 μv sensitivity, 5-digit readout, 150 db CMR, 120% of full scale superimposed noise rejection, pushbutton selection of manual or autoranging.	10, 100, 1000 Vdc; 20% overrange, 6th digit	±0.008% of rdg ±0.002% of full scale (20°–30°C) for 90 days	1.7/sec to 1/5 sec	3459A	$2850
Adds 1 V range, systems speed, BCD output, remote programming to 3459A above; sample rate to 15/sec, front and rear inputs (see systems use, page 44).	1, 10, 100, 1000 Vdc; 20% overrange, 6th digit	±0.004% of rdg ±0.002% of full scale (20°–30°C) for 90 days	15/sec to 1/5 sec; 15/sec at 5-digit resolution	3460A	$3600
Similar to 3460A above except resolution is 1 part in 1.2 x 10^6, sensitivity is 1 μV, and stability is 10 ppm/month.	1, 10, 100, 1000 Vdc; 20% overrange, 7th digit	±0.005% of rdg or ±0.005% of full scale	1/sec 6-digit resolution	HO4–3460A	$4250

continued on next page

VOLTAGE, CURRENT, RESISTANCE MEASUREMENTS

continued

AC voltage measurement

400E AC Voltmeter

3406A Broadband Sampling Voltmeter

Hewlett-Packard ac voltmeters offer measurements over a wide frequency range, 1 Hz to 1 GHz, at sensitivities from 0.001 V to 300 V, with high input resistances and low input capacitances. They include solid-state, vacuum-tube and battery-operated meters, a true rms voltmeter, and a differential voltmeter.

A unique incoherent sampling voltmeter (3406A) lets you accurately measure 1 mV to 3 V, from 10 kHz to 1 GHz...with the absolute average value of the input displayed on the meter. Outputs permit recording the ac measurement and plotting the input signal waveform with a pulse height analyzer.

Instrument	Frequency range	Voltage range*	Accuracy**	Model	Price
High-accuracy ac voltmeter has dc output (±0.5%) for driving DVM's or recorders; useful as high-gain ac amplifier; input impedance 10 MΩ/8–21 pf.	10 Hz–10 MHz	1 mV–300 V (12 ranges)	±1% to ±4%	400E	$285
Similar to 400E above except has linear 12 db log scale uppermost.		−70 db to +52 db (12 ranges)	±1% to ±4%	400 EL	$295
Vacuum-tube voltmeter, also useful as ac amplifier; input impedance 10 MΩ/10–25 pf.	10 Hz–4 MHz	1 mV–300 V (12 ranges)	±2% to ±5%	400D	$250***
Similar to 400 D above except has 1% accuracy and larger meter.			±1% to ±5%	400H	$325***
Similar to 400 H above except has linear 12-db log scale uppermost.		−70 db to +52 db (12 ranges)	±2% to ±5%	400L	$325***
Battery-operated ac voltmeter, input impedance 2 MΩ/20–40 pf.	1 Hz–1 MHz	1 mV–300 V (12 ranges)	±3% to ±5%	403A	$275
Rechargeable battery ac voltmeter also operates from ac power line, input impedance 2 MΩ/25–50 pf.	5 Hz–2 MHz	1 mV–300 V (12 ranges)	±2% to ±5%	403B	$310
RMS voltmeter provides actual rms readings of complex ac signals; dc output for driving DVM's or recorders; input impedance 10 MΩ/15–40 pf.	10 Hz–10 MHz	1 mV–300 V (12 ranges)	±1% to ±5%	3400A	$525
RF millivoltmeter, input impedance depends on probe tip.	500 kHz–1 GHz	10 mV–10 V (7 ranges)	±3% to ±1 db	411A	$450***
Sampling RF voltmeter has hold button on probe to retain meter indication; output provides true rms measurements when used with 3400A; many accessories; input impedance depends on probe tip used.	<10 kHz to >1 GHz	1 mV–3 V (8 ranges)	±3% to ±8%	3406A	$650
AC differential voltmeter (see model 741A on page 2); input impedance is 1 MΩ/<5 pf.	20 Hz–100 kHz	1 V–1000 V end scale (4 ranges)	±0.05% to ±0.2% end scale	741A	$1475

*RMS full scale, except as noted **Full scale, except as noted ***Add $5 for rack-mount version of the cabinet instrument

Frequency-selective voltmeters

(See waveform analyzers on page 8.)

Multi-function meters

When it's important to make a variety of measurements with one instrument, select a versatile multi-function meter from Hewlett-Packard. There's the low-cost 427A solid-state, battery-operated meter for maximum value...while the 414A Autovoltmeter offers time-saving "touch and read" convenience, with range, polarity automatically selected in 300 msec.

427A Multi-function Meter

414A Autovoltmeter

Instrument	Voltage range* (accuracy)	Current range* (accuracy)	Resistance range (accuracy)	Model	Price
Autovoltmeter has automatic ranging and polarity; input impedance 10–100 MΩ. 12 dc voltage ranges 12 resistance ranges	DC: ±5 mV to ±1500 V (±0.5% f.s., ±0.5% rdg)		5Ω to 1.5 MΩ (±1% rdg, ±0.5% f.s.)	414A	$650
Battery-operated multi-function meter has 10 MΩdc input impedance and 10 MΩ/20 pf ac input impedance. 9 dc voltage ranges 10 ac voltage ranges 7 resistance ranges	DC: ±100 mV to ±1000V (±2%) AC: 10 mV–300 V 10 Hz-1 MHz (±2%)		10Ω to 10 MΩ midscale (±5%)	427A	$195**
Versatile voltmeter has 100 MΩdc input impedance and 10 MΩ/1.5 pf ac impedance. 7 dc, ac voltage ranges 11 dc voltage & current ranges 7 resistance ranges	DC: ±15 mV to ±1500V (±2%) AC: 0.5 V-300 V 20 Hz– >700 MHz (±3% at 400 Hz)	DC: ±1.5 μA to ±150 mA (±3%)	10Ω to 10 MΩ midscale (±5%)	410C	$425***
Vacuum-tube voltmeter has 122 MΩ dc input impedance and 10 MΩ/1.5 pf ac impedance. 6 dc, ac voltage ranges 7 resistance ranges	DC: ±1 V to ±1000 V (±3%) AC: 1–300 V 20 Hz–700 MHz (±3%)		0.2Ω to 500 MΩ (±5%)	410B	$245****
DC vacuum-tube voltmeter has 200 MΩ input impedance. 13 dc voltage ranges 13 direct current ranges 9 resistance ranges	DC: ±1 mV to ±1000 V (±1%)	DC: ±1 μA to ±1 A (±2%)	1Ω to 100 MΩ (±5% of reading)	412A	$400*****
DC microvolt-ammeter has 1 MΩ input impedance. 11 dc voltage ranges 18 direct current ranges	DC: ±10 μV to ±1 V (±3%)	DC: ±10 pA to ±3 mA (±3%)		425A	$500******

*Full scale, except as noted
**Add $35 for ac line and battery operation
***Includes 11036A ac voltage probe
****Add $20 for rack-mount version
*****Add $5 for rack-mount version

Current measurement

	Instrument	Current range	Accuracy	Frequency range	Model	Price
	DC milliammeter with clip-on probe eliminates direct connection, prevents circuit loading.	1 mA–10 A f.s. (9 ranges)	±3%	dc-400 Hz	428B	$600*
Probes for 428B	**Large aperture current probe** for measuring current in large conductors up to 2½" in diameter.	1 mA-10 A f.s.	±3%	dc-300 Hz	3528A	$450
Probes for 428B	**Magnetometer probe** for determining magnitude and direction of magnetic fields.	0.1 milligauss to 10 gauss	±3%		3529A	$ 75
	AC clip-on current probe for use with voltmeters and oscilloscopes; make measurements without breaking or loading circuit; input impedance is 50 milliohms in series with 0.05 μH.	1 mA-1 A rms (to 25 A with divider)	±2% to 3 db	60 Hz-4 MHz 25 Hz-20 MHz	456A	$190
	AC clip-on current probe for viewing fast rise waveforms on a wide-band oscilloscope.	1 mV/mA sensitivity	±3%	lower limit is 1700 Hz; upper limit 40 MHz with 30 pf load	1110A	$100
	Amplifier for 1110A probe above increases probe sensitivity, extends low frequency response.	(with scope) 1 mA/cm to 5 A/cm	±3%	50 Hz-20 MHz	1111A	$160

*Add $5 for rack-mount version

continued on next page

VOLTAGE, CURRENT, RESISTANCE MEASUREMENTS

continued

Meter calibration

Instrument	Voltage range (accuracy)	Frequency range	Model	Price
Voltmeter calibration system measures voltage accuracy and frequency response of voltmeters and oscilloscopes; consists of 3 instruments below (which may be purchased separately) in one enclosure.			K02-738BR	$1920
Voltmeter calibrator	300 μV-300 V, dc or ac, in 40 steps; (dc: 0.1%; ac: 0.2%)	400 Hz, rms and p-p; also dc	738BR	$850
Frequency response test set	>3 V into 50 Ω; (±0.5%)	300 kHz-10 MHz in 3 ranges; 5 Hz-10 MHz with 200 SR oscillator	739AR	$600
Oscillator extends lower frequency limit of 739AR above (also see page 31).			200SR	$225
AC/DC meter calibrator for voltmeters and ammeters; 1 μA-5A current output, dc or ac.	0.01–1000 V, dc or ac; (dc: 0.2%; ac: 0.4%)	58–62 Hz; also dc	6920B	$695

Meter accessories

For use with basic measuring instruments (voltmeters, multi-function meters, etc.) and oscilloscopes, Hewlett-Packard offers a wide selection of accessories including cables, voltage dividers, connectors, shunt resistors, line-matching transformers—each of which increases the versatility of the particular instrument.

Vector voltmeter

Phase and amplitude measurements from 1 MHz to 1 GHz are greatly simplified with the 8405A Vector Voltmeter, which measures the magnitude of each of two input signals and the phase difference between them. Easy to operate, this instrument permits component, network and amplifier characterization quickly and conveniently. Phase difference and magnitude are displayed on front-panel meters with recorder outputs also available. Input signals are applied through convenient probes. Phase range is ±180° with 0.1° resolution. Amplitude accuracy is ±0.5 db to 700 MHz, ±1 db to 1 GHz; voltage range is 1 mV to 10 V for the reference channel, 100 μV to 10 V full scale for the other channel. Residual noise is 10 μV. 8405A, $2500.

8405A Vector Voltmeter

IMPEDANCE MEASUREMENT

Vector impedance meter

The solid-state 4800A Vector Impedance Meter provides direct-reading impedance measurements 5 Hz-500 kHz. Impedance magnitude 1 ohm-10 megohms and phase angle 0 to ±90° are automatically displayed

on front-panel meters with no balancing or nulling adjustment. Also operates as direct-reading L-C meter 0.1 picofarads to 10,000 microfarads and 1 microhenry to 100,000 henries, measure Q employing "Q by Δ f" technique; oscillator monitor output for frequency counter; optional analog outputs for x-y recorder. Price $1490.

4800A Vector Impedance Meter

Universal impedance bridge

Fast, accurate measurements of C, R, L, D and Q are easy with the 4260A Universal Impedance Bridge. Digital readout, automatic decimal indication and simplified controls make it especially suitable for production testing and general measurement uses. A unique circuit electronically compensates for interaction between bridge controls in C and L measurements so balance is achieved with use of a single control. False or "sliding" nulls are eliminated, and direction indicators make range selection and C or L balance easy. Price, $550 (price f.o.b. Palo Alto, California; for price in other countries, contact local Hewlett-Packard sales office).

4260A Universal Impedance Bridge

Q meters

Two general-purpose impedance measuring devices specializing in measurement of low-loss components and circuits. Each is a self-contained system, including the rf source output indicator and reference standards. Model 260A covers 50 kHz-50 MHz, with a Q range of 10-625, C range 30-460 pf, L range 0.09 μh-130 mh; is priced at $990. Model 190A covers 20-260 MHz, Q range of 5-1200, C range 7.5-100 pf, L range 4 ph-8.5 μh; is priced at $1075.

RX meter and transistor tester

The 250A is a self-contained wide-range rf bridge system for use in measuring high-loss components and networks. Transistor measurements can be made with the 13510A Transistor Jig (see below). The 250A covers 500 kHz-250 MHz, resistance range 15 to 100,000 ohms, C range 0-20 pf (to 120 pf with auxiliary coils), inductance range 0.001 μh-100 mh (depends on freq.), measurement voltage level 0.05-0.75 V (depends on freq.). Price, $1795.

The 13510A is a test jig for use with 250A RX Meter. RF range 500 kHz-250 MHz, external bias range 50 mA, 30 V dc maximum. Price, $195.

Microwave impedance indicators*

415E SWR Meter

Instrument	Model	Price
Standing wave indicator tuned VM for swr measurement with slotted lines, detector mounts; direct-reading expanded scale for full-scale indication of 1.3 to 1.0; read in accurate upper portion of scale, using precise attenuator; 70 db calibrated range; 200 kΩ input impedance for use as null indicator; recorder output; tuned frequency 1000 cps $\pm$2%; max. sensitivity 0.1 μv.	415B	$250**
SWR meter low-noise tuned amplifier-voltmeter calibrated in db and swr; measures swr, attenuation, gain, other parameters based on difference between 2 signal levels; low noise figure (<4 db) increases measurement range; use with crystal or bolometer detectors; sensitivity 0.15 μv at max. bandwith; 70 db range; accuracy $\pm$0.05 db/10 db step; input freq. 1000 Hz, adjustable 7%; bandwith variable 15–130 Hz.	415E	$350
Ratio meter for reflectometer measurements using swept-frequency techniques to improve measurement coverage; continuous swept-frequency accuracy $\pm$3%; tuned frequency 1000 Hz $\pm$4%; eliminates amplitude variation errors with direct ratio display; four % reflection ranges 100–3% f.s.; two swr ranges 1.06–1.9; four db ranges 0–40 db.	416B	$590***

*Also see Coaxial and Waveguide Instruments (page 34) **For rack mount model add $5 ***For rack mount model, $15 less

continued on next page

IMPEDANCE MEASUREMENT

continued

Impedance, reflection coefficient bridges

Instrument	Frequency range	Model	Price
VHF bridge; direct reading 2–2000 Ω impedances, −90° to +90° phase angle; *easier, faster than using slotted lines.*	55–500 MHz	803A	$1250
VHF detector for use with 803A bridge; 5 μV sensitivity; fast, simple operation.	10–500 MHz	417A	$ 550
Reflection coefficient bridge; full range testing of coaxial devices.	8.2–12.4 GHz	X8440A	$1300

Slotted line, sections

Instrument	Frequency range	Model	Price
Coaxial slotted line for measuring swr; tunable probe, low residual swr, high accuracy, high stability.	500 MHz–4 GHz	805C	$525
Universal probe carriage for operation with 806B coaxial slotted section, 810B waveguide slotted sections, and probes below; high accuracy, stability; fast section inter-change; dial gauge for accuracy; easy to use.		809B	$175
Coaxial slotted section, 50 Ω impedance	3.0–12.0 GHz	806B	$200
Waveguide slotted sections, G- to P-Bands. (S-Band unit has carriage)	2.6–18 GHz	810A, B	$90–$450
Broadband probe, variable penetration in waveguide sections; connect to 440A for sensitive rf detector for slotted waveguide sections		442B	$ 50
Detector mount, use with 442B and slotted sections for detecting rf	2.4–12.4 GHz	440A	$ 85
Untuned probe, high sensitivity	2.6–18 GHz	444A	$ 55
Universal probe carriage for higher frequency K- and R-Band waveguide slotted sections and probe below.		814B	$225
Waveguide slotted sections for K- and R-Bands	18–26.5 GHz 26.5–40 GHz	K815B R815B	$265 $265
Untuned probe	18–40 GHz	446B	$145

WAVEFORM, DISTORTION ANALYZERS

Waveform analyzers

Two waveform analyzers separate input signals into individual frequency components so that fundamental, harmonics, and intermodulation products may be separately measured and evaluated. Both models have automatic frequency control for measuring drifting signals, and may be used as an oscillator-tuned voltmeter combination for transmission test of systems or devices. Accessory model 297A Sweep Drive lets you sweep through all or any part of the analyzer frequency range for easy semi-automatic plots of various waveform characteristics. Prices: 297A, $350; HO3-297A for 230 V 50 Hz operation, $375.

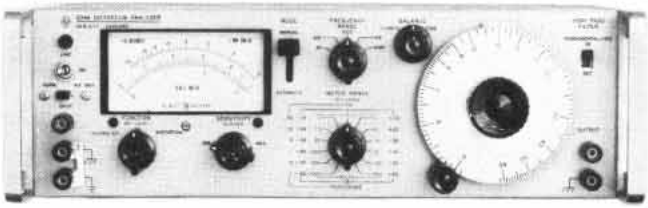
Instrument	Frequency range	Frequency accuracy	Voltage range	Voltage accuracy	Model	Price
Low-frequency analyzer, direct-reading, no calibration required.	20 Hz–50 kHz	±(1% +5 Hz)	30 μV–300 V full scale	±5% of full scale	302A	$1800*

Instrument	Frequency range	Frequency accuracy	Voltage range	Voltage accuracy	Model	Price
High-frequency analyzer, digital frequency readout, 3 bandwidths.	1 kHz–1.5 MHz	+(1% +300 Hz)	10 μV–100 V full scale	±6% of full scale	310A	$2200

*Rack mount $15 less

Distortion analyzers

Four solid-state distortion analyzers offer extended frequency range, greater set level sensitivity, improved selectivity, greater overall accuracy, and unprecedented ease of use. All measure total distortion down to 0.1% full scale. Two models feature automatic fundamental nulling (>80 db rejection): manually null to <10% of set level reference, flip a switch, and nulling is completed automatically; no more tedious tuning on the more sensitive ranges. Two models have a switchable high-pass filter to provide pure distortion measurements on signals >1 kHz by attenuating all frequencies below 400 Hz. Two models have an AM detector covering 550 kHz to >65 MHz at carrier levels as low as 1 V. Other features include common floating input terminals for either distortion or voltage measurements, with floating low-distortion output for oscilloscope or true rms monitoring.

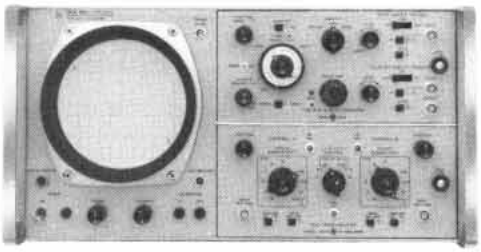


334A Distortion Analyzer

Frequency range	Voltmeter range	Automatic fundamental nulling	High-pass filter	AM detector	Model	Price
Fundamentals 5 Hz–600 kHz, harmonic indications to 3 MHz, in 7 ranges.	300 μV–300 V in 13 ranges, with flat response 5 Hz–3 MHz				331A	$590
				X	332A	$620
Maximum input sensitivity at 0.1% distortion setting corresponds to 300 μV rms for measuring low-level residuals.		X	X		333A	$760
		X	X	X	334A	$790

OSCILLOSCOPES

140A, 141A Dual-plug-in Oscilloscopes...to 20 MHz



140A Oscilloscope, with 20 MHz dual-trace amplifier and sweep delay plug-ins

The 140A Oscilloscope, with a choice of two plug-ins (amplifier and time base) or one double-size special-purpose plug-in, offers bandwidths to 20 MHz, sensitivities to 10 μV/cm, sweep speeds to 20 nsec/cm; features an extra-bright, post-accelerator 7.5 kV crt, 10 x 10 cm internal graticule, beam finder, 1 and 10 V ±1% calibrator. Modular cabinet for rack or bench use. Price without plug-ins, $575.

141A Oscilloscope is identical to 140A except for addition of variable persistence and storage modes

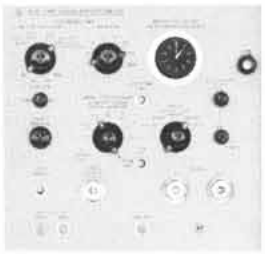
The 141A Oscilloscope combines plug-in and main frame characteristics of the 140A with variable persistence and trace storage. Allows easy viewing of slowly moving or low rep rate waveforms without flicker, especially useful when measurements must be made at very slow sweep speeds to insure high resolution. Permits display of several sweeps at once when events are separated in time: integrates automatically

continued on next page

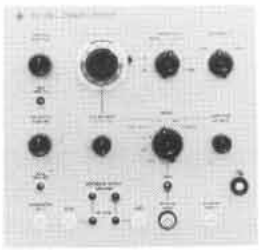
OSCILLOSCOPES

continued

by superimposing sweeps. High writing rate captures and stores fast single-shot for careful study; variable persistence from 0.2 sec to 1 min; normal writing rate to 20 cm/msec, high writing rate position >1 cm/ μsec; storage >1 hour (for days when turned off). Price without plug-ins, $1275.



1415A Time Domain Reflectometer Plug-in



1416A Swept Frequency Indicator Plug-in

Amplifier plug-ins for 140A, 141A	Bandwidth (rise-time)	Calibrated sensitivity	Model	Price
Dual-channel amplifier plug-in offers convenient triggering on channel A or composite; algebraic addition of inputs; has signal delay for viewing leading edges of pulses.	dc–20 MHz (17.5 nsec)	5 mV/cm–10 V/cm	1402A	$550
Dual-channel amplifier plug-in offering differential input, broad bandwidth at low price.	dc–5 MHz (70 nsec)	5 mV/cm–10 V/cm	1405A	$325
Dual-channel amplifier plug-in offering differential input, 40 db CMR; convenient triggering from channel A or composite.	dc–450 kHz (7.8 μsec)	1 mV/cm–10 V/cm	1401A	$325
Single-channel amplifier plug-in with differential input, 40 db CMR, selectable bandwidth.	dc–400 kHz (8.7 μsec)	100 μV/cm–20 V/cm	1400A	$210
Single-channel amplifier plug-in high sensitivity with guarded differential input, 106 db CMR, selectable bandwidth.	0.1 Hz–400 kHz (8.7 μsec)	10 μV/cm–100 mV/cm	1403A	$475

Time base plug-ins for 140A, 141A	Sweep ranges	Triggering	Model	Price
Time base plug-in offering automatic triggering, single sweep, external input.	0.5 μsec/cm–5 sec/cm, ±3%; X10 magnifier extends fastest sweep to 50 nsec/cm	Automatic to 500 kHz, level select to >20 MHz; trigger from internal, external or line	1420A	$325
Time base plug-in with built-in delay generator, calibrated; mixed sweep for slow and fast signal display; external input.	0.2 μsec/cm–1 sec/cm ±3%; X10 magnifier extends fastest sweep to 20 nsec/cm	Automatic and level select; internal or external to >20 MHz; calibrated delay variable 0.2 μsec–10 sec; delay accuracy ±1%, linearity ±0.2%	1421A	$625

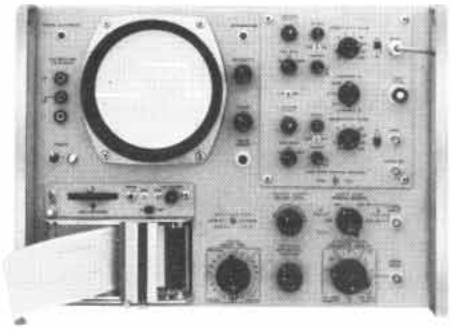
Special-purpose plug-ins for 140A, 141A	Features	Model	Price
Time domain reflectometer tests cables, connectors, strip lines, other broadband devices; step voltage is fed into device under test and reflections from discontinuities are displayed on crt. Indicates both nature (resistive, capacitive, inductive) and precise location of discontinuities. See TDR calibrator below.	150 psec system rise time resolves reflections only 1 inch apart; calibrated in ρ/cm, allowing reflection coefficients as small as 0.001 to be measured, time scale also calibrated directly in distance for air or polyethylene cable; tests polyethylene cable to 600 ft.; x-y recorder outputs.	1415A	$1050*
Swept frequency indicator speeds, simplifies swept frequency measurements; high resolution, direct db readout; output for x-y recorder; easily determine insertion and return loss of attenuators, filters, isolators, loads (see sweep oscillators on page 29.)	Sensitivity 10 db/cm to 0.5 db/cm; db offset control permits increased resolution; linear mode 50 μV/cm to 10 mV/cm, accuracy ±3%; vertical amplifier has both linear and log response.	1416A	$ 675

*Option 14 extends testing in polyethylene cable to 3000 ft.; $100 extra.

Time domain reflectometer calibrator (coaxial susceptance standard); uses a 50-ohm precision air line with adjustable, calibrated capacitance to serve as a TDR resistance and susceptance standard. Model 874A, $250

175A Dual-plug-in Oscilloscope...to 50 MHz

The 175A Oscilloscope offers a 6 x 10 cm display on a 12 kV post-accelerator crt with internal graticule. Beam finder locates trace. 24 calibrated sweeps from 0.1 μsec/cm to 5 sec/cm, ±3%; X10 magnifier extends fastest sweep to 10 nsec/cm. Triggering to >50 MHz. Includes 1% internal calibrator. 14 amplifier and time base plug-ins to choose from, including pushbutton trace recorder. Price without plug-ins, $1325. (An extra fast writing rate model is available for photographing high-speed transients; ask your Hewlett-Packard field engineer for complete information about the H30-175A.)



175A Oscilloscope, with 1755A Dual-trace 50 MHz Amplifier and 1784A Recorder Plug-ins

Vertical Plug-ins for 175A	Bandwidth (rise-time)	Sensitivity	Model	Price
Dual-channel amplifier plug-in, high sensitivity; algebraic addition of inputs; sync amplifier for triggering on channel B; X1 and X5 sensitivity modes.	dc–50 MHz (8.5 nsec)	10 mV/cm–5 V/cm	1755A	$575
	dc–40 MHz (9 nsec)	5 mV/cm (X1)		
	dc–20 MHz (17 nsec)	1 mV/cm (X5)		
Dual-channel amplifier plug-in, algebraic addition of inputs; sync amplifier for triggering on channel B.	dc–50 MHz (8 nsec)	50 mV/cm–20 V/cm	1750B	$325
Four-channel amplifier plug-in sync amplifier, triggering on any channel; trace identifier.	dc–40 MHz (9 nsec)	50 mV/cm–20 V/cm	1754A	$595
High-gain differential amplifier plug-in, differential input 5 mV/cm to 50 mV/cm, with 40 db CMR.	dc–18 MHz (20 nsec)	5 mV/cm–20 mV/cm	1752A	$225
	dc–22 MHz (16 nsec)	50 mV/cm–20 V/cm		
High-gain, wideband differential amplifier plug-in, differential input with 30 db CMR; two attenuators for mixing different signals; X1 and X10 sensitivity modes.	dc–40 MHz (9 nsec)	50 mV/cm–20 V/cm (X1)	1752B	$285
	dc–30 MHz (12 nsec)	5 mV/cm (X10)		
Single-channel amplifier plug-in, 9 calibrated sensitivity ranges.	dc–50 MHz (7 nsec)	50 mV/cm–20 V/cm	1751A	$160
Single-channel amplifier and scanner plug-in, provides output for voltmeter, recorder; waveform amplitudes can be digitized and recorded with 1% accuracy; automatic and manual scan.	dc–50 MHz (7 nsec)	50 mV/cm–20 V/cm	H05–1751A	$525

Special K01–1759A and K02–1759A Amplifier Plug-ins with 2.5 nsec rise time are available.

Horizontal plug-ins for 175A	Performance features	Model	Price
Auxiliary plug-in	Allows 175A to perform all standard functions; single sweep included.	1780A	$ 25
Sweep delay generator plug-in provides calibrated delay times; mixed sweep for slow and fast signal display.	Delay times 0.5 μsec–10 sec with 1% accuracy to 1 sec, 3% to 10 sec; linearity 0.2%; time jitter less than 1 part in 50,000.	1781B	$325
Display scanner plug-in permits permanent recordings of crt display with x-y or strip-chart recorders.	30 MHz bandwidth; automatic, manual or external scanning.	1782A	$425
Time mark generator plug-in provides synchronized 0.5% accuracy intensity modulated time markers on crt trace.	Markers selectable at 10, 1 or 0.1 μsec intervals; also available for external use.	1783A	$130
Recorder plug-in provides accurate permanent records of any displayed repetitive signal with pushbutton ease.	Duplicates crt display within 3% ±1 mm, 30 MHz bandwidth. Make 20 recordings for the price of one photograph.	1784A	$775

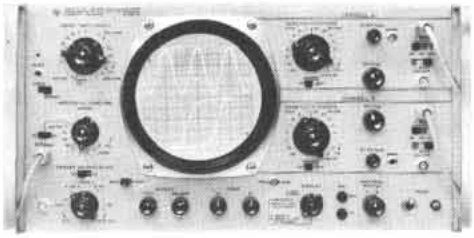
continued on next page

OSCILLOSCOPES

continued

DC to 500 kHz Oscilloscopes

Four versatile oscilloscopes offer bandwidths to 500 kHz and sensitivities to 100 μV/cm. Single- and dual-channel and dual-beam models are available. All have automatic triggering, calibrated sweeps and an internal graticule no-parallax, no-glare 10 x 10 cm cathode-ray tube for easy, accurate viewing.

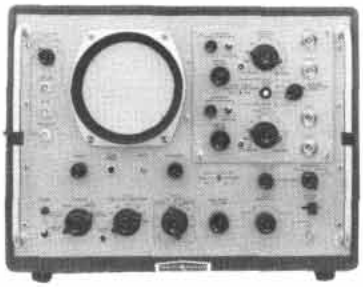


132A Dual-Beam Oscilloscope

Instrument	Bandwidth	Sensitivity	Sweep range	Model	Price
Single-channel scope: 4 calibrated vertical ranges, 15 calibrated sweeps, plus X5 magnifier; phase shift between vertical and horizontal amplifiers <2° to 100 kHz; beam finder.	dc–450 kHz	10 mV/cm–10 V/cm	1 μsec/cm–200 msec/cm	120B	$475
Single-channel scope: identical X and Y amplifiers, each with 16 calibrated sensitivity ranges, differential input, 21 calibrated sweeps, plus magnifier to X50; phase shift between amplifiers <1° to 100 kHz; beam finder.	dc–500 kHz	200 μV/cm–20 V/cm	0.2 μsec/cm–5 sec/cm	130C	$695
Dual-channel scope: separate traces presented on chopped or alternate sweeps, single trace when desired; each channel has 4 calibrated sensitivity ranges, differential input; 15 calibrated sweeps, plus X5 magnifier.	dc–200 kHz	10 mV/cm–10 V/cm	1 μsec/cm–200 msec/cm	122A	$695
Dual-beam scope: two completely independent beams for simultaneous display of Y vs. time and X vs. Y; 17 calibrated sensitivity ranges, differential input; 21 calibrated sweeps, plus magnifier to X50; beam finder.	dc–500 kHz	100 μV/cm–20 V/cm	0.5 μsec/cm–5 sec/cm	132A	$1275

Sampling Oscilloscope... bandwidths to 4 GHz

This versatile sampling scope permits microsecond, nanosecond and picosecond measurements. Ten calibrated sweep ranges 10 nsec/cm to 10 μsec/cm ±5%; X1 to X100 magnifier increases maximum sweep to 0.1 nsec/cm. Delay control permits any portion of the unmagnified trace to be viewed when using a magnified sweep. Triggers to over 1000 MHz; sensitivity, 15 mV in the sensitive position, 200 mV at 50 to 1000 MHz in the high-frequency position; 1.5 V sync output pulse for triggering external equipment



185B Sampling Oscilloscope, with 188A Dual-trace 4 GHz Plug-in

Has output for x-y recorder, no-parallax internal graticule cathode-ray tube, beam finder. Three plug-ins for increased versatility. Price, 185B Sampling Oscilloscope, $2000.

Sampling scope plug-ins	Rise time (bandwidth)	Sensitivity	Model	Price
Dual-channel 1000 MHz vertical amplifier, input through high-impedance probes (100 KΩ shunted by 2 pf); differential input; accessories included.	350 psec (1 GHz)	1 mV/cm to 200 mV/cm	187C	$1250

Sampling scope plug-ins	Rise time (bandwidth)	Sensitivity	Model	Price
Dual-channel 4 GHz vertical amplifier, feed-through sampler in 50-ohm line lets signals be monitored without terminating unless desired; differential input.	90 psec (4 GHz)	1 mV/cm to 200 mV/cm	188A	$1500
Switching time tester, includes 1 nsec rise time 20 V pulse generator, vertical amplifier, 2 bias supplies; circuit test boards for transistors, diodes, included.*	0.5 nsec (700 MHz)	4 mV/cm to 10 V/cm	186A	$1700

Sampling oscilloscope accessories	Features	Model	Price
Delay line enables signals to be viewed whenever suitable triggers are not available separately, by providing a delay between the trigger input and the vertical input of the scope.**	Input impedance 50 ohms, rise time approx. 0.25 nsec; includes delay line, sync takeoff and load.	1100A**	$300
Trigger countdown permits stable triggering to 10 GHz.	With 185B, cw signals as low as 5 mV can be displayed with <30 psec of jitter.	1103A	$265
Accessory kit for convenient probing when delay line is used with 187B/C; also for 188A, 186A.	Includes dividers, blocking capacitors.	1102B	$190

*Also see transistor test jig, page 7. **For 187B; for 187C order 1100A Option 01.

Militarized oscilloscope

Here is a plug-in oscilloscope militarized for rugged dependability under a wide range of environmental conditions: 170B, $2350. Plug-ins available include the following: 22 MHz dual-channel vertical amplifier, 20 mV/cm to 20 V/cm, 162C, $420; horizontal sweep delay provides delays from 1 μsec to 10 sec, mixed sweeps, 166E, $435; horizontal auxiliary allows normal or single sweeps, 166F, $35.

Oscilloscope cameras

197A Oscilloscope Camera

Instrument	Photographic characteristics	Model	Price
Scope camera with electronic shutter, all controls outside camera and color coded; interchangeable rotatable back; Polaroid® Land Film Pack Back standard; 11 detented positions of back for multiple exposures; remote shutter input and external sync output provided.	Shutter speeds 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, 4 sec, plus time and bulb; adjustable focus, f/1.9 lens standard, f/1.4 optional; object-to-image ratio adjustable 1:1 to 1:0.7; automatic ultraviolet light for optimum photo contrast.	197A	$475*
Scope camera offering sharp definition and easy-to-use Polaroid® Land Film Pack Back**; prefocused for convenient operation; detented moving lens for multiple exposures.	High resolution f/1.9 lens, internal ultraviolet light; shutter speeds 1/100, 1/50, 1/25, 1/10, 1/5, 1/2, 1 sec, plus time and bulb.	196B	$445
Scope camera with same features as 196B above, but without internal ultraviolet light.		196A	$395

*Available without ultraviolet light as Option 01, $425 **Roll film back also available ®Polaroid by Polaroid Corp.

Testmobiles

Three Hewlett-Packard Testmobile models provide easy mobility for Hewlett-Packard oscilloscopes and other types of instrumentation. They incorporate storage capability for plug-ins and accessories, and they offer conveniently adjustable viewing angle for easy instrument viewing. The three models differ in their storage capacity and flexibility. Model 1115A, $115; 1116A, $85; 1117A, $155.

Oscilloscope accessories

Hewlett-Packard offers a complete line of oscilloscope accessories, including probes, adapters, terminations, cables, viewing hoods and service aids. These accessories are described in the Hewlett-Packard general catalog and on data sheets available from your Hewlett-Packard field engineer.

POWER SUPPLIES

A complete selection of ac input-dc output highly regulated power supplies is available from Hewlett-Packard. These supplies include more than 100 models, each ideal for a specific requirement. Specifications differ in output current and voltage, in load and line regulation and in ripple/noise characteristics, a standard of performance relative to the amount of ac that can be tolerated on the dc output. Output requirements, in these specific terms, plus economy, should be considered in the selection of a power supply. Other characteristics to be considered are remote programming, remote sensing and possible requirements for constant current output or constant voltage output, or a need for automatic crossover between constant current and constant voltage.

Hewlett-Packard offers several basic selections of power supplies which are designated by the following three-letter classifications:

CCB Series —constant current bench supplies
LAB Series —general-purpose bench supplies, latest generation, adaptable to rack-mount use
STB Series —high-stability bench supplies, high performance, easily rack mounted
MPB Series —medium-power bench supplies, latest generation, adaptable to rack mounting
HVB Series —high-voltage bench supplies
DPR Series —dual-power rack supplies, 2 supplies in one "package"
LVR Series —low-voltage rack mount supplies
MVR Series —medium-voltage rack mount supplies
HVR Series —high-voltage rack mount supplies
SCR-1 Series —silicon-controlled rectifier supplies for efficient high-current delivery with high regulation
SCR-1P Series—compact versions of SCR supplies
SCR-3 Series —SCR supplies with 3 kw output
SCR-10 Series—SCR supplies with 10 kw output
MOD Series —modular plug-in regulated supplies

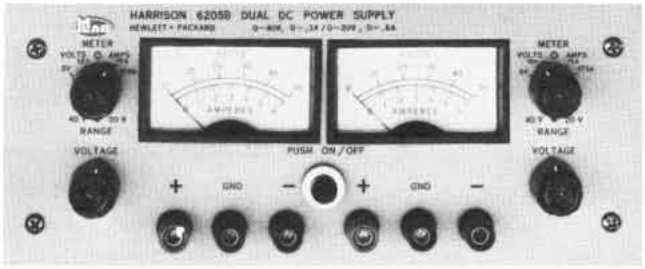
Special devices include high-speed programming supplies, power supply/power amplifier, integrated circuit supply, klystron supplies and others.

The following tables list the principal specifications of these supplies; complete data is available from your Hewlett-Packard field engineer.

CCB Series constant current bench supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Supplies capable of producing very low DC currents with low ripple, high output impedance (10,000 Ω), and high common mode rejection. Constant current and remotely programmable. Meter for voltage or current monitoring.	0–50	0–0.75	<0.0015%	<0.001%	<0.075 mA rms	6177A	$425
	0–100	0–0.3	<0.0015%	<0.001%	<0.03 mA rms	6181A	$425
	0–300	0–0.1	<0.0015%	<0.001%	<0.01 mA rms	6186A	$425

LAB Series general-purpose bench supplies

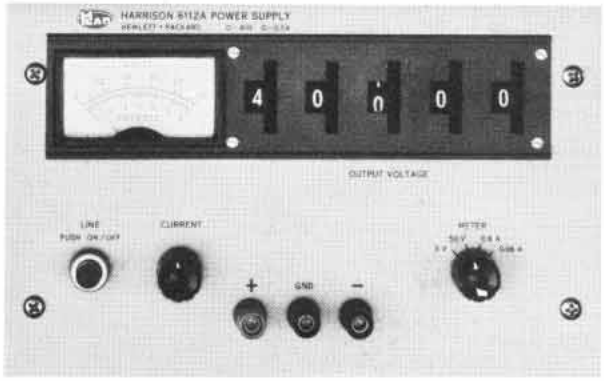


6205B, representative of the LAB Series, offers nine output combinations: 0-20V at 0-600 mA or 0-40 V at 0-300 mA. The 6205B consists of two independent supplies, and the 9 combinations are available by taking advantage of the Auto-Series and Auto-Parallel operation of the two. X10 meter sensitivity switch is also featured.

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Constant voltage/constant current; bench or 3½" half rack, Auto-Series, Auto-Parallel, adjustable voltage and current level; switchable range selection, X10 voltage and current meter switch.	0–20 0–40	0–1.5 0–0.75	0.01%+4 mV	0.01%+4 mV	200 μV rms	6200B	$189
	0–20	0–1.5	0.01%+4 mV	0.01%+4 mV	200 μV rms	6201B	$169
	0–40	0–0.75	0.01%+4 mV	0.01%+4 mV	200 μV rms	6202B	$169
	0–7.5	0–3	5 mV	3 mV	200 μV rms	6203B	$169
Bench mount or 3½" rack; Auto-Series, Auto-Parallel, adjustable voltage and current limit; switchable range selection; X10 voltage and current meter switch. The 6205B has two separate outputs, each rated as shown. Model 6205B only, with Option 15, has the X10 meter sensitivity deleted and is priced at $195.	0–20 0–40	0–0.6 0–0.3	0.01%+4 mV	0.01%+4 mV	200 μV rms	6204B	$144
	0–20 0–40	0–600 mA 0–300 mA	0.01%+4 mV	0.01%+4 mV	200 μV rms	6205B	$235
	0–30 0–60	0–1 0–0.5	0.01%+4 mV	0.01%+4 mV	200 μV rms	6206B	$169
Except for output, same as 6202B, above.	0–160	0–0.2	0.02%+2 mV	0.02%+2 mV	500 μV rms	6207A	$194
	0–320	0–0.1	0.02%+2 mV	0.02%+2 mV	1 mV rms	6209A	$194

Note: All above models offer remote programming

STB Series high-stability bench supplies*



6112A STB Supply

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Supplies with 0.01% stability, 6112A and 6116A with digital programmer*; all-silicon circuitry, remote programming.	0–40	0–500 mA	0.001%+350 μV	0.001%	40 μV rms	6102A	$265
						6112A	$375
	0–100	0–200 mA	0.001%+200 μV	0.001%	40 μV rms	6106A	$265
						6116A	$375
	0–3000	0–5 mA	0.001%+100 μV	0.001%	0.5 mV rms	6110A	$495

*Separate digital programmer, 6931A, $129, available for use with 6102A, 6106A

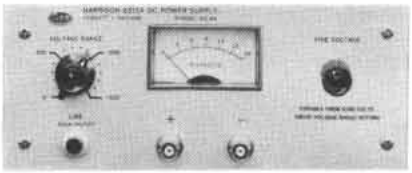
continued on next page

POWER SUPPLIES
continued

MPB Series medium-power bench supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Highly regulated supplies offering constant voltage/ constant current operation with automatic crossover, all-silicon circuitry, remote programming and sensing, "crowbar" overload protection as an option; all are half-rack width, easily rack mounted; they differ in output and in height of cabinet. All feature a switch to select the mode of meter operation; as a voltmeter with X1 or X10 sensitivity, or an ammeter with X1 or X10 sensitivity.	0–7.5	0–5	5 mV	0.01%+2 mV	200 μV rms	6281A	$210
	0–10	0–10	0.01%+5 mV	0.01%+1 mV	500 μV rms	6282A	$350
	0–20	0–3	0.01%+4 mV	0.01%+2 mV	200 μV rms	6284A	$210
	0–20	0–5	0.01%+5 mV	0.01%+1 mV	500 μV rms	6285A	$350
	0–20	0–10	0.01%+5 mV	0.01%+1 mV	500 μV rms	6286A	$395
	0–40	0–1.5	0.01%+2 mV	0.01%+2 mV	200 μV rms	6289A	$210
	0–40	0–3	0.01%+4 mV	0.01%+1 mV	500 μV rms	6290A	$350
	0–40	0–5	0.01%+5 mV	0.01%+1 mV	500 μV rms	6291A	$395
	0–60	0–1	0.01%+2 mV	0.01%+2 mV	200 μV rms	6294A	$210
	0–60	0–3	0.01%+4 mV	0.01%+1 mV	500 μV rms	6296A	$395
	0–100	0–750 ma	0.01%+2 mV	0.01%+2 mV	200 μV rms	6299A	$225

6515A Power Supply



HVB Series high-voltage bench supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Regulated dc supplies with all-silicon circuitry, 6515A half rack, 6516A half rack.	0–1600	0–5 mA	0.01% or 16 mV*	0.01% or 16 mV*	2 mV rms	6515A	$235
	0–3000	0–6 mA	0.01% or 16 mV*	0.01% or 16 mV*	4 mV rms	6516A	$295

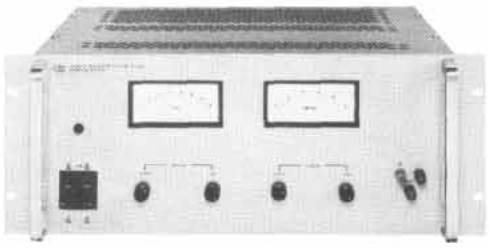
*Whichever is greater

6255A Power Supply

DPR Series dual-power rack supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Two highly regulated supplies in one package, constant voltage/constant current, automatic crossover; all-silicon, remote programming, sensing; option "crowbar" over-voltage protection. Meter selector switch to monitor voltage with X1 or X10 sensitivity, or current with X1 or X10 sensitivity.	0–7.5	0–5	5 mV	0.01%+2 mV	200 μV rms	6251A	$445
	0–20	0–3	0.01%+4 mV	0.01%+2 mV	200 μV rms	6253A	$445
	0–40	0–1.5	0.01%+2 mV	0.01%+2 mV	200 μV rms	6255A	$445
	0–60	0–1	0.01%+2 mV	0.01%+2 mV	200 μV rms	6257A	$445
	0–100	0–750 mA	0.01%+2 mV	0.01%+2 mV	200 μV rms	6258A	$445

LVR Series low-voltage rack supplies



6269A Supply, typical of LVR Series

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Lab versions (6200 Series) constant voltage/constant current with automatic crossover, meters, coarse and fine controls, silicon differential amplifier; systems versions (6300 Series) constant voltage/current limiting, rear-panel voltage control, no meters; all models Auto-Series, Auto-parallel; optional "crowbar" overload protection.	0–10	0–100	0.01%+200 μV	0.01%+200 μV	1 mV	6260A	$775
	0–18	0–10	0.01%+200 μV	0.01%+200 μV	500 μV rms	6263A	$435
						6363A	$359
	0–18	0–20	0.01%+200 μV	0.01%+200 μV	500 μV rms	6264A	$525
						6364A	$450
	0–36	0–3	0.01%+200 μV	0.01%+200 μV	500 μV rms	6265A	$350
						6365A	$279
	0–36	0–5	0.01%+200 μV	0.01%+200 μV	500 μV rms	6266A	$435
						6366A	$359
	0–36	0–10	0.01%+200 μV	0.01%+200 μV	500 μV rms	6267A	$525
						6367A	$450
	0–40	0–30	0.01%+200 μV	0.01%+200 μV	1 mV rms	6268A	$695
	0–40	0–50	0.01%+200 μV	0.01%+200 μV	500 μV rms	6269A	$875
	0–60	0–3	0.01%+200 μV	0.01%+200 μV	500 μV rms	6271A	$435
						6371A	$359
	0–60	0–15	0.01%+200 μV	0.01%±200 μV	500 μV rms	6274A	$695

MVR Series medium-voltage rack supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
All semiconductor circuitry; voltage continuously variable; convection cooling, fully protected against overloads.	0–320	0–600 mA	0.007% or 0.01 V*	0.007% or 0.01 V*	1 mV rms	890A	$445
	0–320	0–1.5	0.007% or 0.01 V*	0.007% or 0.01 V*	1 mV rms	895A	$625

*Whichever is greater

HVR Series high-voltage rack supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Constant voltage/constant current with automatic crossover; all solid-state circuitry; 3-decade switching with vernier control, short circuit proof.	0–1000	0–200 mA	0.005% or 20 mV*	0.005% or 20 mV*	1 mV rms	6521A	$750
	0–2000	0–100 mA	0.005% or 20 mV*	0.005% or 20 mV*	1 mV rms	6522A	$750
	0–4000	0–50 mA	0.005% or 20 mV*	0.005% or 20 mV*	1 mV rms	6525A	$750

*Whichever is greater

SCR-1 Series SCR regulated supplies

Instrument	Output V	Output A	Combined line and load regulation	Ripple/noise	Model	Price
Silicon-controlled rectifier supplies for high efficiency; constant voltage/constant current; remote programming, remote sensing.	0–72	0–5	0.5%	1% rms	505A	$435
	0–36	0–10	0.5%	1% rms	510A	$410
	0–36	0–25	0.5%	1% rms	520A	$575

continued on next page

POWER SUPPLIES

continued

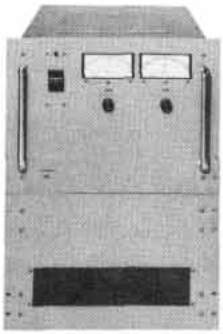
SCR-1P Series compact SCR supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Compact versions of the SCR supplies described above; 3½" or 5¼" high, 19" wide; constant voltage/ constant current, automatic crossover.	0–20	0–15	20 mV	10 mV	40 mV	6427B	$380
	0–20	0–45	36 mV	20 mV	40 mV	6428B	$550
	0–36	0–10	36 mV	18 mV	36 mV	6433B	$370
	0–60	0–5	60 mV	30 mV	120 mV	6438B	$360
	0–60	0–15	120 mV	60 mV	60 mV	6439B	$550
	0–120	0–2.5	120 mV	60 mV	240 mV	6443B	$360
	1–600	0–1.5	1.2 V	600 mV	1.2 V	6448B	$550

SCR-3 Series SCR supplies with 3 kw output

Instrument	Output V	Output A	Combined line and load regulation	Ripple/noise	Model	Price
Constant voltage/constant current supplies with automatic crossover; remote sensing. 3-phase, 460 V input. Also available 208 V or 230 V input at $40 less.	0–8	0–300	25 mV	1%	6450A	$1590
	0–15	0–200	0.2%+10 mV	1%	6453A	$1590
	0–36	0–100	0.2%+10 mV	0.5%	6456B	$1490
	0–64	0–50	0.2%+10 mV	0.25%	6459A	$1490

SCR-10 Series SCR supplies with 10 kw output



6469A Power Supply

Instrument	Output V	Output A	Combined line and load regulation	Ripple/noise	Model	Price
Constant voltage/constant current, automatic cross-over; all-silicon circuitry, moderate regulation, remote programming and sensing; short circuit proof, Auto-Series, Auto-Parallel operation. Cabinet construction with casters. Also available for rack mounting for $85 less.	0–4	0–2000	50 mV	7%	6463A	$3585
	0–8	0–1000	25 mV	1%	6464A	$3385
	0–16 or 0–18	0–600 or 0–500	0.2%+10 mV	1%	6466A	$3185
	0–36	0–300	0.2%+10 mV	0.5%	6469A	$2985
	0–64	0–150	0.2%+10 mV	0.25%	6472A	$2985
	0–110	0–100	0.2%+10 mV	0.2%	6475A	$2985
	0–220	0–50	0.2%+10 mV	0.15%	6477A	$2985
	0–300	0–35	0.2%+10 mV	0.1%	6479A	$2985
	0–500	0–20	0.2%+10 mV	0.1%	6483A	$2985

MOD Series plug-in modular regulated supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
All input, output connectors via 11-pin plug; other pins to permit remote programming of output control; Auto-Series, Auto-Parallel, remote sensing; plug directly into any chassis with 11-pin socket (two 8-pin sockets for the 6358A); efficient grouping of like or mixed rack mount supplies.	0–18	0–300 mA	3 mV or 0.03%*	3 mV or 0.03%*	1 mV rms	6343A	$120
	0–18	0–1	3 mV or 0.03%*	3 mV or 0.03%*	1 mV rms	6344A	$165
	0–18	0–2.5	3 mV or 0.03%*	3 mV or 0.03%*	1 mV rms	6345A	$225
	0–36	0–150 mA	3 mV or 0.02%*	3 mV or 0.02%*	1 mV rms	6346A	$120
	0–36	0–500 mA	3 mV or 0.02%*	3 mV or 0.02%*	1 mV rms	6347A	$165
	0–36	0–1.5	3 mV or 0.02%*	3 mV or 0.02%*	1 mV rms	6348A	$225
	0–160	0–400 mA	0.005%+2 mV	0.005%+1 mV	1 mV rms	6354A**	$259
	0–320	0–200 mA	0.005%+2 mV	0.005%+1 mV	1 mV rms	6357A**	$259
	0–600	0–200 mA	0.01%+5 mV	0.01%+5 mV	1 mV rms	6358A**	$450

*Whichever is greater **All-silicon supplies

High-speed programming supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
High-speed programming by resistance, voltage or current; constant voltage/constant current with automatic crossover.	0–18	0–1.5	0.01%+2 mV	0.01%+2 mV	200 μV rms	855C	$179
	0–40	0–0.5	0.01%+2 mV	0.01%+2 mV	200 μV rms	865C	$179

High-speed programming power supply/amplifier

6823A Power Supply/Amplifier

Continuously variable supply providing an output −20 to +20 V, 0 to 0.5 amp; load regulation 0.02% +5 mV, line regulation the same, ripple and noise 2 mV rms; two fixed auxiliary outputs −20 V at 0-100 mA, +20 V at 0 to 100 mA; use this supply as a direct-coupled power amplifier, 40 V p-p maximum output at 0 to 0.5 amp, variable voltage gain 0 to 10. Model 6823A, $194.

Micromodular power supplies

Power supplies designed specifically for integrated circuit applications. Featured is a totally independent overvoltage circuit (in addition to the normal series regulator) which shorts the output within 10 microseconds if the preset voltage threshold is exceeded. Short circuit protection also provided. Output voltages adjustable 2 to 4.5 V and 4.5 to 7.5 V. Current capacities of 8, 15, 30, 60 and 120 amperes. Half and full rack width models available. Model 6380 Series. Prices start at $205.

Klystron power supplies

Two types of supplies, one powers more than 250 models of reflex klystrons, with 0-800 V reflector supply, 250-800 V beam supply negative to chassis ground, 6.3 V adjustable filament supply; continuous direct-reading controls for accurate voltage setting, high regulation, internal and/or external modulation. Relays disconnect the beam and filament supplies to protect klystrons, should the filament voltage exceed specified limits. Model 716B, $875. The other supply is designed for low-power applications, delivers 250-400 V at 30-50 mA beam supply, 0-900 V reflector supply, 6.3 V filament supply. Model 715A, $365.

continued on next page

POWER SUPPLIES

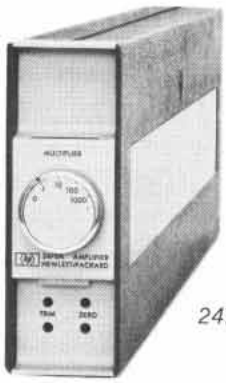
continued

Special-use, versatile supplies

Instrument	Output V	Output A	Load regulation	Line regulation	Ripple/noise	Model	Price
Versatile supplies, Auto-Series, Auto-Parallel, programmable, remote sensing, bench or 1/3 rack.	0–18	0–3	0.03% or 2 mV*	0.02% or 1 mV*	500 μV rms	6224A	$340
	0–36	0–1.5	0.02% or 2 mV*	0.02% or 2 mV*	500 μV rms	6226A	$325
Strain gage power module, all semiconductor.	0–25	0–0.2	2 mV	2 mV	100 μV rms	801C	$149
Solid-state, compact, protected supply for transistor work, metered output.	0–30	150 mA	0.3% or 30 mV*	0.3% or ±15 mV*	150 μV rms	721A	$145
Dual-range convertible for rack or bench; Auto-Series, Auto-Parallel; range selected by plug-in card.	0–32 0–64	0–2 0–1	0.02% or 3 mV*	0.03% or 5 mV*	200 μV rms	6242A	$435
Versatile supply for bench or systems, compact, programmable, 1/3 rack, metered output.	0–40	500 mA	20 mV	10 mV	150 μV rms	723A	$240
Versatile 100 V supply, Auto-Series, Auto-Parallel, plug-in cards.	0–100	0–1	0.02% or 0.005V*	0.02% or 0.005 V*	200 μV rms	881A	$475
Special, no switching 500 V supplies; metered output, voltage and current.	0–500 12.6 rms	100 mA 3	0.5% or 1 V*	0.5% or 1 V*	<1 mV	711A	$275
	0–500 −300 6.3 rms	200 mA 50 mA 10	<50 mV	<100 mV	<500 μV	712B	$490

*Whichever is greater

AMPLIFIERS



2470A Data Amplifier

Data amplifiers

Instrument	Frequency resp.	Gain	Noise (max)	Output	Model	Price
Guarded data amplifier, 134 db CMR, for use with 2401C DVM (page 3).		+1, +10	.005 mV (2401C 10 mV range)	10.5 V	2411A	$1200
Differential data amplifier (with internal power supply).	dc-50 kHz	10, 30, 100, 300, 1000	5 μV rms rti	±10 V	2470A	$ 585
Differential data amplifier (with internal power supply).	dc-75 kHz	1–1000	5 μV rms rti	±10 V	8875A	$ 495
Narrowband differential amplifier	dc-100 Hz	1000	3 μV p-p	±5 V	860-4300	$ 425

Solid-state operational amplifier

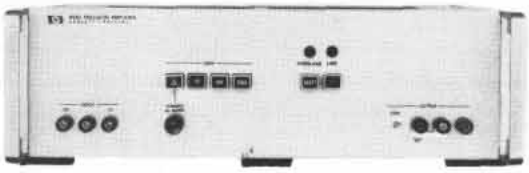
Instrument		Frequency response	Gain	Output	Model	Price
Operational amplifier, uses one of four plug-ins below to suit it for specific applications; <4 μV p-p noise.		depends on plug-in	5 x 10^7 at dc (open loop)	10 V, 10 mA	2460A	$445
2460A Plug-ins	**Data systems unit**	350 Hz–25 kHz	10, 30, 100, 300, 1000; inverting		2461A-M1	$ 85
	Bench-use unit	350 Hz-50 kHz	1, 10, 100, 1000; inverting		2461A-M2	$125
	Plus-one gain unit		X1, non-inverting		2461A-M4	$ 35
	Patch unit	Brings input, output, summing point, feedback circuits to front panel for operational functions			2461A-M3	$ 75

Fast pulse amplifiers

Rise time	Input Ƶ	Gain	Noise (max)	Output	Model	Price
3 nsec	200Ω	20 db into 200Ω	<10 db	+3.2 V, −8 V into 300Ω	460 AR	$225
3 nsec	200Ω	15 db into 200Ω	<6 db	+8 V, −60 V into 200Ω	460 BR	$275
<4 nsec	50Ω	40, 20 db	40 μV at 40 db	1 V p-p into 50Ω	462A	$325

General-purpose amplifiers

Frequency response	Input Ƶ	Gain	Noise (max)	Output (max)	Model	Price
5 Hz–2 MHz (±1 db)	1 MΩ/15 pf	40, 20 db	40 μV at 40 db	10 V into 3000Ω	450A	$165
1 kHz–150 MHz (±1 db)	50Ω	40, 20 db	<40 μV at 40 db	0.5 V rms into 50Ω	461A	$325
100 Hz–50 kHz (±0.1 db) <2db down at 5 Hz and 1 MHz	10 MΩ/<20 pf	40, 20 db	<25 μV referred to input	<5 V rms into 50Ω	465A	$190
10 Hz–1 MHz (±0.5 db)	1 MΩ/25 pf	40, 20 db	75 μV rms	1.5 V rms into 1500Ω	466A (battery operated)	$165



463A Precision Amplifier

Power and voltage amplifiers

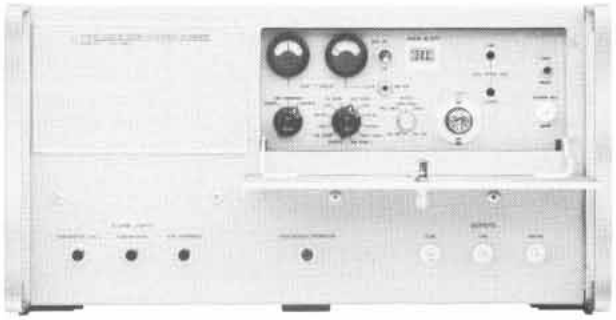
Instrument	Frequency response	Gain	Output	Model	Price
Precision amplifier, both voltage and power, ultra low distortion, input Ƶ 1 MΩ/<20 pf, noise 200 μV referred to input (depending on range).	dc–100 kHz, (±0.01%) usable to 1 MHz	X10, X100, X1000; continuously adjustable 0-1000	100 V rms to 50 ma into 2 kΩ	463A	$590
Power amplifier is also ±1 V to ±20 V ½ amp power supply, input Ƶ 50 kΩ/100 pf, noise <5 mV p-p.	dc–1 MHz (±1%)	X1, X2, X5, X10	20 V peak–0.5 A peak	467A	$575
Tunable power amplifier, source of high-level rf power when used with signal generators.	10–500 MHz	30, 27, 24 db, depending on frequency	0–15 V into 50Ω	230A	$1200
Microwave power amplifiers; TWT devices; amplitude modulation capability with internal 20 db, 500 kHz modulation amplifier.	1–2 GHz	30 db	1 W	489A	$2250
	2–4 GHz	30 db	1 W	491C	$2250
	4–8 GHz	30 db	1 W	493A	$2600
	7–12.4 GHz	30 db	1 W	495A	$2600

Also see Model 6823A Power Supply/Amplifier, page 19.

FREQUENCY, TIME STANDARDS

Cesium beam frequency standard

Atomic frequency standard with an accuracy of $2/10^{11}$ designed for primary standard applications; solid-state control circuitry, compact design. Only 8¾" high, 65 lbs. Utilizes cesium 133, with cesium beam tube resonator stabilizing the output of a high-quality quartz oscillator in a closed loop, continuously monitoring circuit. Outputs 5 MHz, 1 MHz, 100 kHz sinusoidal, 100 kHz clock drive. Price, $15,500.



5060A Cesium Beam Standard

Quartz oscillators

Instrument	Frequency output	Voltage output	Power requirements	Model	Price
Vacuum-tube 1 MHz oscillator, $5/10^8$/week stability; timing comb provides pips at 100, 1000, 10,000 μsec. intervals, scope for frequency comparison, compact.	Sine: 1 MHz, 100 kHz, 10 kHz, 1 kHz, 100 Hz, 10 Hz; pulse: 10 kHz, 1 kHz, 100 Hz, 10 Hz	Sine: 5 rms; pulse: 15 V p-p	115 or 230 V, 50–1000 Hz, 140 W max.	100E, 100ER (rack mount)	$1100
Solid-state 1 MHz oscillator, $5/10^8$/week stability; capable of supplying several instruments simultaneously, useful for driving up to 20 5275A Time Internal Counters (page 25); low cost.	1 MHz, 100 kHz sine	1 V rms, 50Ω	115 or 230 V, 50–1000 Hz, 2–15 W, dep. on oven cycle	101A	$ 600
Solid-state 2.5 MHz oscillator, $5/10^{11}$/day long-term stability, $1.5/10^{11}$ short-term stability; buffered outputs for stability; high spectral purity; high reliability.	5 MHz, 1 MHz, 100 kHz sine; 100 kHz clock drive	1 V rms, 50Ω sine; 0.5 V, 1000Ω clock drive	22–30 V dc, external	106A	$3450
			115 or 230 V, 50–1000 Hz; contains internal 22–30 V dc standby battery	106B	$3900
Solid-state militarized 5 MHz oscillator, $>5/10^{10}$/day long-term stability, $1.5/10^{11}$ short-term stability; extreme spectral purity for microwave spectroscopy; compact (5¼" high), shock and vibration resistant, watertight.	5 MHz, 1 MHz, 100 kHz sine; 100 kHz clock drive	1 V rms, 50Ω sine, clock drive	22–30 V dc, external	107AR	$2400
			115 or 230 V, 50–1000 Hz; contains internal 22–30 V dc standby battery	107BR	$2750

Frequency divider and clock

For time standard use: Capable of deriving a low clock frequency from the output of an ultrastable frequency source (typically, a precision quartz oscillator) without degrading its accuracy. Calibrated time reference makes possible precise comparisons against broadcasts from standards stations such as WWV, WWVH, NBA, MSF, JJY, etc., to maintain time or to measure drift rate, frequency offset (see Hewlett-Packard Application Note 52). Accepts inputs from Hewlett-Packard precision quartz oscillators and the 5060A Cesium Beam Standard. (A Model 115BR served in the famous "flying clock"—See Hewlett-Packard Journal, Vol. 16, No. 8, April 1965.) Features time comparison to ±10 μsec, 0.1 sec visually, 0.01 sec with stroboscopic technique. 115BR, ruggedized for mobile use, with auxiliary outputs of 100, 10, and 1 kHz, $2750. Model 115CR, for lab applications not requiring auxiliary outputs, $1500.

VLF comparator

Compares received 60 kHz signal (National Bureau of Standards station WWVB, referred to U.S. Frequency Standard) and user's frequency standard (100 kHz output); comparison accuracy to 1 x 10^{-8} possible in 8 hours. Receives signal, plots strip-chart record of phase difference which can be interpreted to measure frequency offset, drift rate of user's local standard; no other instruments required. Includes antenna with preamplifiers (for up to 1000-foot cable) and 100-foot cable. Model 117A, $1300.

Standby power supplies

Instrument	Voltage output	Max. current	Standby capacity	Model	Price
Economical standby supply protects frequency/time standards against power failures; takes over when external power fails; automatic operation, no switching.	24+1 −2 V dc	500 mA	2 amp-hour battery	725AR	$ 645
			25 amp-hour battery	724BR	$ 950
Standby power supply for atomic frequency standard (5060A Cesium Beam Standard, page 22); provides protection in case of external power failure.	24 V±2 V dc	2 A (2.5 A for 30 min.)	21 amp-hour battery	5085A	$1250

Frequency synthesizers

Three precision frequency synthesizers are available from Hewlett-Packard as highly accurate sources with fast, convenient manual (pushbutton) or remote switching; small increment switching over wide frequency ranges; extremely high spectral purity. Refer to Signal Sources, page 27.

FREQUENCY MEASUREMENT

Solid-state plug-in counter

Measure 0-50 MHz directly, up to 500 and 3000 MHz with plug-in converters, and up to 18 GHz with other accessories; more measurements with greater accuracy than any other counter available. Measures frequency, period, multiple period average, ratio, multiple ratio and time interval. Also scales by decade factors to 10^9. Sensitivity 100 mV, time base stability better than $3/10^9$/day; 8-digit in-line display, BCD output; optional remotely programmable time base and function controls. 5245L (without plug-ins), $2950. (See page 46 for printers, D-to-A converters.)

5245L Counter with 5255A 3-12.4 GHz Plug-in

Plug-ins for 5245L Solid-state Counter	Model	Price
Converter plug-in increases counter range to 100 MHz, retains accuracy, stability of counter.	5251A	$300
Prescaler plug-in increases basic counting rate to 350 MHz, no tuning, multiple scaling factors.	5252A	$685
Converter plug-in increases counter range to 500 MHz.	5253B	$500
Converter plug-in increases counter range to 300–3000 MHz.	5254A	$825
Converter plug-in increases counter range to 3-12.4 GHz.	5255A	$1650
Video amplifier plug-in increases sensitivity to 1 mV rms, 10 Hz–50 MHz; input impedance 1 MΩ, 15 pf.	5261A	$325
Time interval plug-in for measurements with 0.1 μsec resolution; direct measurements 1 μsec to 10^8 sec.	5262A	$300
Preset unit plug-in for normalized measurements read directly in engineering units (measure N x frequency, N x period, N x ratio; count N events; divide input frequency by N; N = 1–100,000).	5264A	$650
Digital voltmeter plug-in for measuring dc voltage 10–1000 V f.s., 5% overrange capability.	5265A	$575

continued on next page

FREQUENCY MEASUREMENT

continued

Solid-state general-purpose counters

Standard features of Hewlett-Packard solid-state counters include display storage (continuous display of most recent measurements until the count actually changes), 100 mV sensitivity, higher sampling rates (time between counts independent of gate time), −20° to +65° operating temperature, BCD output (on most models) for recorder and systems (see page 46 for printers, D-to-A converters), multiple period average techniques for highest accuracy, modular construction for rack and bench use in a single instrument.

3734A Counter

H22-5211B Counter

Instrument	Frequency range	Measures*	Readout	Time base aging rate (gate times)	Model	Price
Versatile, low-cost counters (in 5211A, BCD output optional).	2 Hz to 300 kHz	F, R	4 digits columnar	Power line (0.1, 1 sec)	5211A	$ 600
				Power line (0.1–10 sec)	5211B	$ 725
			4 digits in-line	Power line (0.1–10 sec)	H22-5211B	$ 825
Counter with superior trigger level controls usable in all functions.	0 Hz to 300 kHz	F, P, MPA, R, MR, TI	5 digits in-line	$\pm 2/10^6$/week (10 μsec–10 sec)	5223L	$1325
Reliable counters at moderate cost.	2 Hz to 300 kHz	F, P, MPA, R, MR	5 digits columnar	$\pm 2/10^6$/week (0.01–10 sec)	5212A	$ 975
			5 digits in-line		5512A	$1050
	2 Hz to 1.2 MHz	F, P, MPA, R, MR	6 digits columnar	$\pm 2/10^6$/week (0.01–10 sec)	5232A	$1300
			6 digits in-line		5532A	$1450
Economical high-frequency counter with stable trigger controls, versatile. BCD output optional.	0 Hz to 2 MHz	F, P, MPA, R, MR, TI	6 digits in-line	$\pm 2/10^7$/month (10 μsec–10 sec)	5233L	$1750
Compact, high-performance counter, versatile.	2 Hz to 2.5 MHz	F, P, MPA, R, MR, TI	5 digits in-line	$\pm 2/10^6$/week (0.01–1 sec, to 10 sec optional)	3734A	$1075**
High counting rate, high accuracy counter.	0 Hz to 50 MHz	F, P, MPA, R, MR	7 digits in-line	$\pm 2/10^7$/month (1 μsec–10 sec)	5244L	$2225

*Measurement code: F—Frequency, P—Period, MP—Multiple Period, MPA—Multiple Period Average, TI—Time Interval, R—Ratio, MR—Multiple Ratio.

**Price in U.S., f.o.b. Palo Alto, California. For price in other countries, contact local hp field office.

Reversible plug-in counter

Plug-in reversible counter which counts at a 2 MHz rate, reverse counts at a 1 MHz rate. Useful for totalizing individual frequencies; count sum or difference of 2 input signals; totalize 1 signal with the direction of the count as a function of the polarity or the 90° phase lag or lead of a second signal. Price of counter, Model 5280A, $1450; price of universal input plug-in for basic operation, 5285A, $450. Other plug-ins for increasing versatility to come.

5280A Reversible Counter with 5285A Plug-in

Vacuum-tube plug-in counters

Economy and versatility are combined in these Hewlett-Packard plug-in electronic counters, which measure frequency, time interval, period, ratio. Stability is $3/10^8$ short term, $5/10^8$ /week long term. Recorder output is optional. Basic counters measure 10 Hz to 10.1 MHz. The two basic counters differ in readout: the 524C offering 8 digits, in-line, $2900; the 524D, 8 digits columnar, $2650.

Plug-ins for 524C, 524D vacuum-tube counters	Model	Price
Frequency converter, extends counter frequency 10 MHz to 100 MHz; video amplification 10 Hz–10.1 MHz.	525A	$350
Frequency converter, extends counter frequency 100 MHz to 220 MHz.	525B	$425
Frequency converter, extends counter frequency 100 to 510 MHz; video amplification, 50 kHz–10.1 MHz.	525C	$475
Video amplifier unit, increases counter sensitivity from 1 V to 10 mV rms, 10 Hz–10 MHz.	526A	$250
Time interval unit, converts counter to time-measuring device with 0.1 μsec. resolution, 1 μsec.–10^7 sec.	526B	$275
Period multiplier unit, increases period measurement accuracy of counter, 0–100 kHz, up to 10^4 periods.	526C	$250
Phase unit, for phase angle measurements with accuracy up to $\pm 0.1°$; range: 0–360° lead or lag, 1 Hz to 20 kHz. Direct readout in degrees 396–404 Hz.	526D	$850

Vacuum-tube general-purpose counters

Instrument	Frequency range	Measures	Readout	Time base (gate times)	Model	Price
Low-cost utility counters for a wide variety of measurements; easily read, easy to use; measure frequency, rpm, time, random events, totalize elapsed time. Recorder output is optional. Input sensitivity 200 mV (100 mV on 523C/D). For rack mount style, add suffix "R" to model number.	1 Hz to 120 kHz*	Frequency	4 digits columnar	Power line** (0.1, 1 sec)	521A	$650
	1 Hz to 120 kHz*	Frequency	5 digits columnar	0.01% crystal (0.1–10 sec)	521C	$800
	1 Hz to 120 kHz*	Frequency	4 digits in-line	Power line** (0.1, 1 sec)	521D	$900
	1 Hz to 120 kHz*	Frequency	5 digits in-line	0.01% crystal (0.1–10 sec)	521E	$1125
	1 Hz to 120 kHz*	Frequency, time interval, period	5 digits columnar	$1/10^5$/week crystal (0.001–10 sec)	522B	$1100
	1 Hz to 1.2 MHz	Frequency, elapsed time	5 digits columnar	Power line** (0.1, 1 sec)	521G	$750
	1 Hz to 1.2 MHz	Frequency, period, time interval, phase delay, ratios	5 digits in-line	$2/10^6$/week crystal (0.001–10 sec)	523C	$1950
			5 digits columnar		523D	$1700

*220 kHz with Option 03, $35 additional. **0.01%/ crystal, add $100.

Preset counter

This Hewlett-Packard counter measures normalized rates, ratio, normalized ratio and time for N events to occur. It is ideal for direct reading rpm, psi, gpm and similar engineering units. N may be preset to any integer between 1 and 100,000. Remote programming of number N, with separate outputs available to operate external equipment. Basic range is 2 Hz-300 kHz (2 Hz-100 kHz for preset Input A, time Input A, ratio Input B), BCD output. Model 5214L, $1475.

Time interval counter

This counter permits measurement of time interval with 10 nanosecond resolution. 10 nanosecond to 0.1 second range; counted frequency 100 MHz from external 1 MHz standard. Ideal for precise digital measurement of short time intervals between events; solid-state, BCD output. Seven-digit registration in neon columns, reads in microseconds with decimal point. Model 5275A, $2500.

continued on next page

FREQUENCY MEASUREMENT

continued

5260A Automatic Frequency Divider

Frequency-extending counter accessories

Instrument	Model	Price
Automatic frequency divider for direct readout of freq., 0.3-12.4 GHz on 5245L Counter. No ambiguity, offset or arithmetic processing.	5260A	$3250
Frequency converter using phase-lock technique to increase frequency range of 5245L Counter (with 5253B Plug-in) to 15 GHz (18 GHz optional), with full counter accuracy. Observe jitter, FM, AM (on scope); measure carrier frequency of pulsed signals.	2590B	$1900
Transfer oscillator extends frequency range of 5245L Counter to 12.4 GHz for all types of frequency; measure frequency of FM signals, determine FM deviation, measure frequency of pulsed signals.	540B	$1050
Harmonic mixer, with 540B Transfer Oscillator, extends counter measurement to 18 GHz, fixed-tuned to eliminate adjustments.	P932A	$250

Frequency and tachometer indicators

Instrument	Model	Price
Frequency meter directly measures frequency or rep rate of signals (0.2 V rms sine-wave sensitivity, 1 V min. positive pulses) 3 Hz–100 kHz; expanded scale feature for increased resolution.	500B	$335*
Tachometer indicator, calibrated directly in rpm, otherwise identical to 500B; 15–6,000,000 rpm.	500C	$345*
Optical tachometer, useful with electronic counters, tachometer indicators, to measure rps, rpm with no mechanical connection; no moving parts, uses light reflection technique; 1 rps–300,000 rpm.	506A	$195
Compact, low-torque tachometer generators for use with counters, provide shaft speed measurements accurate within ±1 rpm; direct indications in rpm, rps; A, B, C, D models differ in measurement range, (15–40,000 rpm) and output (60–360 cycles/revolution).	508	$125

*Rack mount, add suffix "R" to model number

Coaxial and waveguide frequency meters

Direct-reading coaxial frequency meter measures 3.7-12.4 GHz, with no spurious responses. High resolution with a spiral dial over 80 inches (2030 mm) long. Accuracy 0.17%, including dial calibration, temperature over a 20°C range, relative humidity, backlash. Model 537A, $500. Other coaxial and waveguide frequency meters measure 0.96-40 GHz.

537A Coaxial Frequency Meter

Instrument	Frequency range	Model	Price
Wavemeter, measure the rf frequency of pulsed microwave signals, ±0.5 MHz accuracy.	1070–1110 MHz	8905A	$395
Coax frequency meter with high resolution, easy-to-read dial, no spurious responses; direct measurement, high accuracy.	0.96–4.2 GHz	536A	$500
Coax frequency meter, same characteristics as 536A, improved accuracy, extremely wide frequency coverage in single unit.	3.7–12.4 GHz	537A	$500
Waveguide frequency meters similar to 536A, 537A, models for G, J, H, X, M, P, K, R Bands.	3.95–40 GHz	532 Series	$200-$400

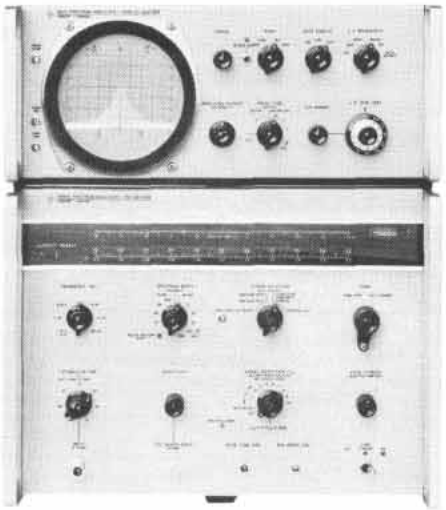
SPECTRUM ANALYSIS

Spectrum analyzer

Fully calibrated controls, plus close attention to human factors in the design are features of the 851B/8551B Spectrum Analyzer. Covering the range from 10.1 MHz to 40 GHz, the analyzer provides the accuracy and flexibility needed for applications such as RFI measurements, spectrum surveillance, spectrum signature work, and semiconductor evaluations.

Separate rf and display sections are interconnected to comprise a triple-conversion superheterodyne receiver with swept first local oscillator and oscilloscope readout. Ten calibrated spectrum widths from 100 kHz to 2 GHz permit detailed examination of individual signals or investigation of broad frequency bands.

Other key specifications include 4 GHz image separation; input sensitivity of −65 to −100 dbm, depending on frequency; 60 db display range on 7 x 10 cm crt in LOG mode (also choice of linear or square displays); display accuracy ±3% f.s. linear, ±5% f.s. square, ±2 db log. 60 db input attenuator allows input signal levels up to 1 watt. Frequency response typically <1.5 db over 100 MHz spectrum widths, ±2 to ±5 db over full 2 GHz span. 851B Display Section, $2400; 8551B RF Section, $7100.



851B/8551B Spectrum Analyzer

Spectrum analyzer accessories

Frequency comb generator provides highly accurate markers for frequency calibration of the Hewlett-Packard 851B/8551B Spectrum Analyzer; markers with 1, 10 and 100 MHz spacing are usable from fundamental marker frequency to beyond 5 GHz, 0.01% accuracy. Model 8406A, $500.

Bandpass and low-pass filters, coaxial preselectors for the spectrum analyzer, limit input to a specific range and minimize interference from signals outside that range. 8430 Bandpass Series, $210 to $275; 360 Low-Pass Series, $50 to $70.

Notch filter offers narrow rejection (2 MHz) at 2 GHz for observation of broadband signals without interference from signals at spectrum analyzer's 2 GHz IF frequency; 8439A, $240.

Crystal filter (20 MHz) improves skirt characteristics of the 1 kHz IF of the display section for greater resolution of closely spaced signals; 8442A, $225.

SIGNAL SOURCES, MODULATORS, ATTENUATORS

Frequency synthesizers

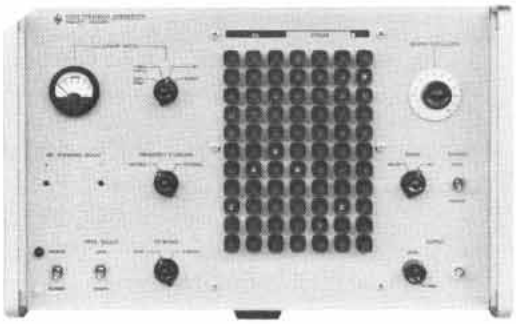
Fast digital and remote frequency selection (<20 μsec) of signals with high spectral purity, dc to 50 MHz—from one of three frequency synthesizers from Hewlett-Packard. Aging rate of internal oscillator (<3

continued on next page

SIGNAL SOURCES, MODULATORS, ATTENUATORS

continued

parts in 10^9 per day) is preserved in output, superior signal-to-noise ratio, high spurious signal rejection, continuous output level control, search oscillator for continuous tuning of any selected column, external sweep capability. Three solid-state instruments, varying in frequency output, output increments. Each provides 1 V rms ±1 db into 50-ohm resistive load, may be used with internal oscillator or external standard.

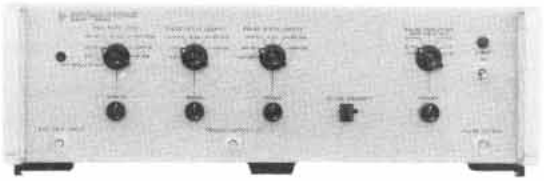


5102A Frequency Synthesizer

Instrument*	Output frequency	Output increments	Spurious signals	Frequency response	Switching time	Model	Price
Dual-range synthesizer.	0.1 Hz–1 MHz	0.1 Hz	70 db down	Flat within ±0.5 db	<20 μsec	5102A	$6500
	0.01 Hz–100 KHz	0.01 Hz	90 db down				
Dual-range synthesizer.	1 Hz–10 MHz	1 Hz	50 db down	Flat within ±0.5 db on 1 MHz range, ± 1 db on 10 MHz range	<20 μsec	5103A	$7100
	0.1 Hz–1 MHz	0.1 Hz	70 db down				
Two-unit high-frequency model incorporating driver and synthesizer.	dc-50 MHz	0.01 Hz	90 db down	±1 db, 100 kHz–50 MHz +2–4 db, 50 Hz–100 kHz	<20 μsec	5100A Synthesizer	$8150
						5110A Driver	$4350

*Time base aging rate ±3/10^9/24 hours, all models

Pulse and square-wave generators



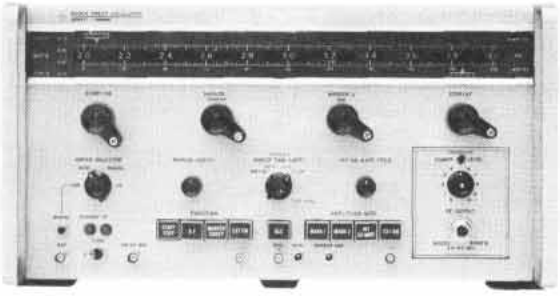
222A Pulse Generator

Instrument	Repetition rate	Rise time	Output	Model	Price
Square-wave generator has symmetry control and permits exact square-wave balance, sync input, ideal for video and audio amplifier testing.	1 Hz–1 MHz	<20 nsec <100 nsec	−3.5 V into 75 Ω adjustable −27 V into 600 Ω adjustable	211A	$350*
Pulse generator, + or − pulses, 50 w peak, pulse width variable 0.07–10 μsec, pulse position variable 10 μsec advance to 100 μsec delay, external triggering and sync.	50 Hz–5 kHz	20 nsec	±50 V into 50 Ω adjustable	212A	$775
Pulse generator may be externally triggered up to 100 kHz, 100 nsec flat pulse width, total 2 μsec width.	Approximately 100 kHz	<0.1 nsec	±175 mV into 50 Ω, fixed. 50 Ω source impedance	213B	$215
Pulser, solid-state unit with advance trigger, output pulse flat >100 nsec.	100 kHz	<1 nsec (−) <1.2 nsec (+)	±10 V into 50 Ω adjustable	8000A	$375**
Pulse generator delivers 200 watts; single, gated or double pulses; pulse position adjustable 10 msec advance or delay of sync out, width 0.05 μsec–10 msec, external triggering with selectable trigger point.	10 Hz–1 MHz	<13 nsec (15 nsec at 100 V)	±100 V into 50 Ω adjustable	214A	$875

Instrument	Repetition rate	Rise time	Output	Model	Price
Pulse generator, external triggering with selectable trigger point, single and gated pulses, width continuously adjustable to 100 nsec, position adjustable 140 nsec advance to 10 nsec delay of sync out.	100 Hz–1 MHz	<1 nsec	±10 V into 50Ω adjustable. 50Ω source impedance	215A	$1875
Pulse generator, economical general-purpose instrument, width 30 nsec-5 msec continuously adjustable, single pulses, external triggering.	10 Hz-10 MHz	<4 nsec	±10 V into 50Ω adjustable. 50Ω source impedance	222A	$690
Pulse generator, internal or external triggering, very accurately controlled and specified pulse shape, width 5-100 nsec, pulse bursts or continuous pulses.	1–100 MHz	<2.5 nsec	±10 V into 50Ω adjustable. 50Ω source impedance	216A	$1775
Digital delay generator uses plug-ins (below) to produce 2 accurate time delay intervals; delays 0.1–9999 μsec or 1–10,000 periods of external time base; rack mounting.	10 Hz–10 kHz			218A	$2250
Dual trigger plug-in, one pulse at beginning of time intervals or at end of one interval, with second pulse at end of other interval, >1.5 μsec wide.		0.1 μsec	+25 V into 50Ω	219A	$125
Dual pulse plug-in is similar to 219A, with adjustable amplitude, adjustable 0.2–5 μsec width.		60 nsec	±25 V into 50Ω adjustable	219B	$490
Digital pulse duration plug-in produces variable duration, variable delay pulses, width or delay 1–10,000 μsec.		30 nsec (90Ω)	−7.5 V into 90Ω adjustable −45 V into 500Ω adjustable	219C	$375

*Add $5 for rack mount. **Price in U.S. f.o.b. Palo Alto, California. For price in other countries, contact local hp field office.

Sweep oscillators



8690A Sweep Oscillator with 8692B Plug-in Module

Maximum versatility and utility are yours with new hp 8690 Series Sweep Oscillators. Single main frame (8690A) accepts plug-in BWO modules to cover complete 1-40 GHz range. Compact (8½" high) sweepers have 13" full-width slide-rule type frequency scale for easy readability, high resolution. Neat, human-engineered front panel provides pushbutton mode selection plus quick-reading, calibrated dial indicators for start, stop and marker frequencies. Completely flexible sweep modes provide: Start-stop sweep, up or down, between any points in the range; marker sweep, for expanding any portion of the range; ΔF sweep, for detailed study of symmetrical area centered on any frequency; manual sweep, for complete operator control; automatic recurrent sweeps; sweep synchronized, internally or externally. Outputs for scope or x-y recorder. Model 8690A main frame, $1550, accepts BWO modules listed in table below. (Also see Model 1416A Swept Frequency Indicator, page 10.)

Instrument	Frequency range	Power (maximum leveled across band)	Frequency accuracy	Model	Price
Frequency module plug-ins for 8690A sweep oscillator; "B" models have PIN diode attenuators for amplitude modulation and leveling independent of the BWO. Total frequency range 1-40 GHz (see next page.)	1–2 GHz	≥100 mw	±1%	8691A	$1900
		≥70 mw	±10 MHz	8691B	$2200
	2–4 GHz	≥70 mw	±1%	8692A	$1700
		≥40 mw	±10 MHz	8692B	$2000
	4–8 GHz	≥30 mw	±1%	8693A	$1575
		≥15 mw	±20 MHz	8693B	$1900

continued on next page

SIGNAL SOURCES, MODULATORS, ATTENUATORS

continued

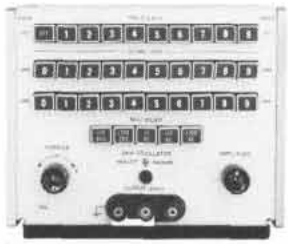
Instrument	Frequency range	Power (maximum leveled across band)	Frequency accuracy	Model	Price
Frequency module plug-ins for 8690A sweep oscillator; "B" models have PIN diode attenuators for amplitude modulation and leveling independent of the BWO.	8–12.4 GHz	≥50 mw	±1%	8694A	$1575
		≥30 mw	±30 MHz	8694B	$1925
	12.4–18 GHz	≥40 mw	±1%	8695A	$1700
	18–26.5 GHz	≥10 mw	±1%	8696A	$2500
	26.5–40 GHz	≥5 mw	±1%	8697A	$4300

Sweep signal generator

For testing rf passband amplifiers 4.5-120 MHz; includes precision cw signal generator, sweep frequency generator providing linear frequency deviation ±1% to ±30% of center frequency. AM capability included for cw output. Marker system produces birdie-type markers, adjustable pip interpolation markers and a composite signal containing the markers added to the response of the system under test. Useful for checking selectivity and sensitivity of circuits, study of bandpass characteristics, etc. Model 240A, $1995.

Oscillators and signal generators ...to 10 MHz

3300A Function Generator with 3302A Plug-in



241A Pushbutton Oscillator

Instrument	Dial accuracy	Frequency range (response)	Model	Price
Variable-phase function generator, four simultaneous outputs with one variable phase square and sine wave adjustable over a 360° range and one fixed phase square and sine wave. Rise and fall times of square waves <200 μsec. Amplitude stability ±0.1 db. Each output has 40 db variable attenuator. Maximum output 30 V p-p open circuit. 7 ranges; 0.00005 Hz available on special order.	±1%	0.005 Hz–60 kHz (±1%)	203A	$1200
Low-frequency function generator, continuously variable sine, square, triangular waves for simulating mechanical, physical, medical phenomena; maximum output 30 V p-p into 4 kΩ; 5 ranges.	±2%	0.008 Hz–1200 Hz (±1 db)	202A	$550*
Function generator with plug-in capability, variable phase and phase lock; sine, square, triangular output; linear voltage programmability; single cycle, multiple cycle, free-run modes, isolated dual-output amplifiers; single-ended floating outputs.	±1%	0.01 Hz–100 kHz (±1%)	3300A	$570
Auxiliary plug-in permits standard operation of 3300A.			3301A	$ 20
Trigger/phase lock plug-in, for single and multiple cycle operation of 3300A, with variable start/stop phase and phase lock.	±10°		3302A	$190
Audio oscillator, high power, 3 watts output (42.5 V into 600Ω), 40 db attenuator in 10 db steps, distortion <1%, output Ƶ 600Ω, 3 ranges.	±1%	20 Hz–20 kHz (±1 db)	201C	$250**
Audio signal generator; high power, 5 watts; <1% distortion; 2 panel meters measure input and output of device being tested; output Ƶ balanced 50, 200, 600 and 5000Ω; 3 ranges.	±2%	20 Hz–20 kHz (±1 db)	205AG	$600*

Instrument	Dial accuracy	Frequency range (response)	Model	Price
Audio signal generator; <0.1% distortion; metered output variable in 0.1, 1 and 10 db steps; output Z balanced 50, 150 and 600 Ω; 3 ranges.	±2%	20 Hz–20 kHz (±0.2 db)	206A	$900*
Audio oscillator, balanced output 1 w or 24.5 V into 600 Ω, distortion <1%, 4 ranges.	±2%	20 Hz–40 kHz (±1 db)	200AB	$165**
Low-frequency oscillator, balanced output 10 V or 160 mw into 600 Ω, <0.5% distortion, 5 ranges.	±2%	1 Hz–100 kHz (±1 db)	202C	$325**
Battery-operated oscillator, floating output 10 mw into 600 Ω, <1% distortion, typical short-term stability 5 parts in 10^4, 5 ranges (optional ac line operation).	±3%	5 Hz–560 kHz (±3%)	204B	$315
Test oscillator, rechargeable battery or ac line operation, monitor meter and 6-position attenuator calibrated in volts. Option O1 has monitor meter and 110-db attenuator calibrated in dbm.	±3%	5 Hz–560 kHz (±3%)	208A	$525
			208A/ Option O1	$535
Wide-range oscillator, economical, low distortion (±0.2%), output 10 V into 600 Ω, 5 ranges. Special order H20-200CD has very low ±0.06% distortion.	±2%	5 Hz–600 kHz	200CD	$195
			H20-200CD	$250
Oscillator, useful with 739AR Frequency Response Test Set (page 6), rack mount, 5 ranges.	±2%	5 Hz–600 kHz	200S	$225**
Pushbutton oscillator, 3-digit frequency resolution, 4500 increments with vernier overlap, maximum distortion 1%, output +10 to −30 dbm into 600 Ω.	±1%	10 Hz–1 MHz	241A	$490
Test oscillator, wide frequency range, low distortion (<1%), 90 db attenuator, output monitor, ±0.1% amplitude stability; output 200 mw into 50 Ω, 16 mw into 600 Ω, 6.32 V open circuit; 6 ranges.	±2%	10 Hz–10 MHz (±2%)	651A	$590

*Rack mount $15 less **Rack mount, add $5

3200B VHF Oscillator

Oscillators and signal generators . . . above 10 MHz

Instrument	Frequency range	Model	Price
Signal generator, broad modulation capability, output 3 V into 50 Ω, high stability with 8708A Synchronizer, constant output across band. (Model 606A, $1350, similar but cannot be stabilized with 8708A.)	50 kHz–65 MHz	606B	$1550**
VHF oscillator, general-purpose signal source with 25–250 mw output, AM 0–30%; 13515A doubler probe extends frequency range to cover 500–1000 MHz, is priced at $95.	10–500 MHz	3200B	$475
FM/AM signal generator for vhf, TV; 0.1 μV–0.2 V, AM 0–100%.	54–216 MHz	202H	$1475
Telemetering signal generator, similar to 202H above.	195–270 MHz	202J	$1595
VHF signal generator, output 1 V into 50 Ω.	10–480 MHz.	608C	$1200*
VHF signal generator, direct calibration; 0.1 μV–1 V into 50 Ω, constant internal impedance; AM, pulse modulation, low incidental FM, constant output level, low envelope distortion.	10–480 MHz	608E	$1450*
VHF signal generator, similar characteristics to 608E above; 0.5 V into 50 Ω, works with 8708A Synchronizer, narrow-band phase or frequency modulation.	10–455 MHz	608F	$1600*
UHF signal generator, 0.1 μV–0.5 V output into 50 Ω; direct calibration, AM and pulse or square-wave modulation.	450–1230 MHz	612A	$1400*
UHF signal generator, ½ mw 800–900 MHz, 1 mw 900–2100 MHz; direct calibration, pulse or frequency modulation.	800–2100 MHz	614A	$1950*
UHF signal generator, calibrated output +10 to −127 dbm into 50 Ω; calibrated and leveled below 0 dbm; internal square-wave, external pulse, AM, frequency modulation.	800–2400 MHz	8614A	$2100
UHF signal source, output 15 mw into 50 Ω, precision attenuator, internal square-wave, external pulse or frequency modulation.	800–2400 MHz	8614B	$1450

continued on next page

SIGNAL SOURCES, MODULATORS, ATTENUATORS

continued

Instrument	Frequency range	Model	Price
Signal generator, output 0 dbm to −127 dbm into 50Ω; FM or pulse modulation; direct calibration.	1.8–4.2 GHz	616B	$1950*
Signal generator, output +10 to −127 dbm into 50Ω (+3 dbm maximum above 3 GHz), calibrated and leveled below 0 dbm; internal square-wave, external pulse modulation, AM, frequency modulation.	1.8–4.5 GHz	8616A	$2100
Signal source; output 15 mw 1.8–3 GHz, 3 mw 3–4.5 GHz, precision attenuator.	1.8–4.5 GHz	8616B	$1450
SHF signal generator; output 1 mw or 0.223 V to 0.1 μV into 50Ω, direct calibration; FM, pulse or square-wave modulation.	3.8–7.6 GHz	618C	$2250*
SHF signal generator; output 0.223 V to 0.1 μV into 50Ω; direct calibration, FM, pulse or square-wave modulation.	7–11 GHz	620B	$2250*
SHF signal generator; output 1 pw to 10 mw (−90 to +10 dbm); direct calibration, FM, pulsed or square-wave modulation.	10–15.5 GHz	626A	$3400*
SHF signal generator; similar to 626A above.	15–21 GHz	628A	$3400*

*Add $20 for rack mount **Rack mount $15 less

Frequency stabilizing synchronizers

These instruments provide absolute control of frequency signals by phase-locking the output of the controlled instrument to an internal or external frequency standard. Ideal for stable signals for doppler systems, radio astronomy, microwave spectroscopy, microwave frequency standards, parametric amplifier pumps, radar cross-section studies, etc.

8708A Synchronizer

Instrument	Model	Price
Signal generator synchronizer uses a sampling phase-lock technique to provide a stability of 2 parts in 10^7 for ten minutes with 606B (50 kHz–65 MHz) and 608F (10–455 MHz) signal generators. This 250-times improvement in stability simplifies and speeds all tests in this important frequency range. The synchronizer also provides capability for very linear frequency and phase modulation of the 606B and 608F signal generators.	8708A	$1800
Oscillator synchronizer stabilizes frequencies 0.1–40 GHz, permits FM up to 0.5 MHz deviation, manual tuning over 2 MHz range; automatic search oscillator for easy synchronization.	2650A	$1450
Frequency standard synchronizer, use with 5 MHz standards for phase-locked synthesis of standard microwave signals, 60 MHz steps 1–12.4 GHz; high spectral purity with typically 80 db signal/spurious rejection ratio.	2654A	$1750

Communication test sets, air navigation signal generators

Instrument	Model	Price
Portable communications test set for aligning, maintaining multichannel communication systems; 5 Hz–560 kHz oscillator, −72 to +52 dbm voltmeter; patch panel to match oscillator and voltmeter to 135-, 600-, 900-ohm systems. Special telephone patch panels available; provide standard telephone jacks for input, output functions; also internal holding coil, dial through and talk positions.	3550A	$1150
Telephone test oscillator to align, test and maintain telephone circuits, both wet and dry. Standard telephone jacks; balanced outputs, 135, 600, 900 ohms; hookswitch control; holding coil and dial jacks; +10 to −31 dbm output in 0.1 dbm steps; frequency 50 Hz–560 kHz in 4 ranges; distortion 40 db below fundamental; lightweight, portable and transistorized; operates from battery or ac line.	236A	$525

Instrument	Model	Price
Omni-range signal generator, 88–140 MHz, crystal oscillator 110.1 and 114.9 MHz; output 0.1 μV–0.2 V/50 ohms, AM modulation capability.	211A	$2190
Glide slope signal generator for FAA instrument landing system; 2 generators, RF and IF, 100% modulation, internal or external; RF 329.3–335 MHz in 0.3 MHz steps; IF 20.7 MHz or changeable by crystal change.	232A	$2375
DME/ATC test set for testing, calibrating transponder aircraft equipment; 962–1213 MHz, −10 to −100 dbm/50 ohms; pulse modulation; simulation of TACAN bearing information, direct readout of ATC reply frequency, side lobe suppression capabilities, DME pulse shape.	8925A	$12,090
SHF test set includes signal generator, power meter, frequency meter; 5925–7750 MHz*, measures receiver sensitivity, selectivity, transmitter tuning, power level; 0 dbm output; internal FM; external FM, pulse or square-wave modulation.	623B	$2250
H-band test set, same functions as 623B above; higher power (+15 dbm); 7.1–8.5 GHz, covers government communications band.	5636	$3800
X-band test set, same functions as 623B above; 0 dbm output; 8.5–10 GHz; internal FM.	624C	$2265**

*Using any of 3 klystrons **Rack mount model $15 less

Frequency converters, doublers, mixers

Instrument	Output frequency	Model	Price
Univerter extends frequency of 202H, 202J Signal Generators (page 31), stability 0.001% (5 min.); output 1 μV–1 V.	100 kHz–55 MHz	207H	$595
Frequency doubler, accessory for use with signal generators, frequency synthesizers, sources, 0.5 MHz–500 MHz; input 180 mw max.	1 MHz–1 GHz	10515A	$120
Frequency doubler set for use with 9–13.25 GHz signal sources, up to 100 mw input power, conversion loss 18 db at 10 mw input.	18–26.5 GHz	938A	$1700*
Frequency doubler set for use with 13.25–20 GHz signal sources, up to 100 mw input power, conversion loss 18 db at 10 mw input.	26.5–40 GHz	940A	$1700*
Double balanced mixer mixes, amplitude or pulse modulates; L&R port input 40 mw or 40 mA max.; X port 20 mw or 20 mA max./50 ohms; 7 db noise; 8 db loss; low intermodulation.	L&R 500 kHz–500 MHz; X dc–500 MHz	10514A	$250
Spectrum generator generates train of 1 nsec-wide pulses, 0.75 V min. pulse height/50 ohms; 10–75 MHz input.	25–50 MHz	10511A	$150

*Add $20 for rack mount

Attenuators, modulators

354A Variable Coaxial Attenuator

Instrument	Frequency range	Attenuation range	Model	Price
Variable lab attenuators, 5 w power capacity (500 ohms, 350C; 600 ohms, 350 D).	dc-1 MHz	110 db, 1 db steps	350C 350D	$125 $125
VHF attenuators, 0.5 w average, 350 V peak/50 ohms.	dc-1000 MHz	12 db, 1 db steps 120 db, 10 db steps	355C 355D	$140 $140
Variable coax attenuator; turret-type, small, convenient for bench or rack, removable base, low residual attenuation, simple knob rotation.	dc-12.4 GHz	0-60 db, 10 db steps	354A	$450
Continuously variable coax attenuators; direct reading, calibrated variable directional coupling, isolation.	500-1000 MHz 1000-2000 MHz	5-120 db 6-120 db	393A 394A	$525 $550
Coaxial pads; wide range, 10 db or 20 db options, ±1 db over full range; attenuation measured at four frequencies and marked on each pad.	dc-12.4 GHz	10 db, 20 db options	8491A	$ 50
Variable waveguide attenuators, S- through R-Bands, flap attenuators.	2.6-40 GHz	20 db, variable	375A	$100–$200
Precision variable waveguide attenuators, S- through R-Bands, <1.15 swr.	2.6-40 GHz	0-50 db*	382A/B/C	$275–$700

continued on next page

SIGNAL SOURCES, MODULATORS, ATTENUATORS

continued

Instrument	Frequency range	Attenuation range	Model	Price
PIN diode modulators eliminate incidental FM, permit pulse modulation, leveling, AM, absorb rf power independent of signal source.	0.8-12.4 GHz	35 db and 80 db versions	8730 Series	$300-$500
Modulator for driving 8730 PIN Modulators above, or other microwave sources.			8403A	$700

*S-Band B, C, models 0-60 db

COAXIAL AND WAVEGUIDE INSTRUMENTS

Hewlett-Packard microwave test equipment includes a wide range of high-quality, value-priced coaxial and waveguide items for measurement of virtually all microwave parameters. Special care in design and manufacture of these instruments, plus complete testing, assures high performance in all applications. Much of the waveguide equipment is available in several frequency bands. See bands to right.

Many Hewlett-Packard coaxial instruments are available with the new 7mm precision connectors to provide greater measuring accuracy at frequencies to 18 GHz. Ask your hp field engineer for up-to-date information on these instruments.

Waveguide band	Frequency (GHz)
S	2.6 to 3.95
G	3.95 to 5.85
J	5.3 to 8.2
H	7.05 to 10
X	8.2 to 12.4
M	10 to 15
P	12.4 to 18
K	18 to 26.5
R	26.5 to 40

Crystal detectors, bolometers and crystal mounts

J424A Waveguide Detector Mount

X424A Waveguide Detector Mount

423A Coaxial Crystal Detector

Instrument	Frequency range	Max. swr	Model	Price
Coax crystal detectors for use with 415, 416 Meters, sensitivity 420A, 0.1 mV/μw; 420B, 0.05 mV/μw; 420B available in matched pairs.	10 MHz–12.4 GHz 1–4 GHz (useful to 12.4)	3	420A 420B	$ 50 $ 75
Waveguide crystal detectors for K- and R-Band application, for use with 415, 416 Meters; matched pairs available.	18–26.5 GHz 26.5–40 GHz	2.5 3	K422A R422A	$230 $230
Coax crystal detector, flat response (< ±0.2 db/octave 10 MHz–8 GHz, < ±0.5 db total range), high sensitivity; matched pairs available.	10 MHz–12.4 GHz	1.5	423A	$125
Waveguide crystal detectors, flat response (±0.5 db max.), high sensitivity; 7 models, S- to P-Bands.	2.6–18.0 GHz	1.5	424A	$135-$250
Bolometer mount uses barretter-like fuses as detection elements.	10–1000 MHz	1.25:1	476A	$ 85
Waveguide detector mounts, tunable, offered in G- through X-Bands, four models.	3.95–12.4 GHz	1.5	485B	$75-$120

Directional detectors and couplers

786D Coaxial Directional Detector

Instrument	Frequency range	Model	Price
Coax dual-directional couplers; high directivity min. 40 db (30 db with 777D), low swr, low insertion loss; 50 w av., 10 kw peak.	215–450 MHz	774D	$200
	450–940 MHz	775D	$200
	940–1900 MHz	776D	$200
	1900–4000 MHz	777D	$250
Coax directional couplers, flat frequency response, high directivity, low swr, low insertion loss.	0.96–2.11 GHz	796D	$200
	1.9–4.1 GHz	797D	$200
	3.7–8.3 GHz	798C	$225
Coax directional detectors, flat frequency response (0.5 db max. swept-frequency tested), high directivity (17–30 db), high sensitivity; ideal for leveling applications, especially useful with sweep oscillators; X781A for monitoring between coax source and waveguide system.	0.96–2.11 GHz	786D	$300
	1.9–4.1 GHz	787D	$300
	3.7–8.3 GHz	788C	$325
	8–12.4 GHz	789C	$350
	8–12.4 GHz	X781A	$350
Waveguide directional couplers, high coupling accuracy (3, 10, 20 db), directivity better than 40 db, low swr; S- through R-Bands.	2.6–40 GHz	752A, C. D	$125-$450
Crossguide directional couplers; 20, 30 db coupling; high accuracy, low swr, save space, weight; S- through X-Bands.	2.6–12.4 GHz	750D, E	$60-$150

Terminations, shorts, loads and reflections

Instrument	Frequency range	Model	Price
Coax terminations, the 906A movable low-reflection load for terminating 50-ohm systems; 908A non-movable; low swr (less than 1.05).	1–12.4 GHz	906A	$325
	dc–4 GHz	908A	$ 35
Waveguide terminations; low swr (typically 1.015 to 1.04); permit matched load; S- through P-Bands.	2.6–18 GHz	910A, B	$35-$75
High-power waveguide termination; 500 w average power, peak power 100 kw.	8.2–12.4 GHz	X913A	$100
Waveguide shorting switch to provide removable short circuit in waveguide system.	8.2–12.4 GHz	X930A	$160
Waveguide adjustable shorts, S- through R-Bands, (except X-Bands, see below), provide reference point in system.	2.6–40 GHz	920A, B	$85-$155
Waveguide movable short for fast phasing and reference plane independent of frequency; ideal for swept-frequency applications.	8.2–12.4 GHz	X923A	$ 75
Waveguide movable loads, S- through R-Band; max. swr 1.01.	2.6–40 GHz	914A, B	$60-$250
Waveguide standard reflections, for standardizing swr-measuring set-ups.	8.2–12.4 GHz	X916A-E	$125

Tuners, phase shifters

Instrument	Frequency range	Model	Price
Coax slide-screw tuner for correcting discontinuities or flattening waveguide, coax systems; match loads, bolometers, antennas to impedance; correctable swr 5; insertion loss at max. correctable swr 0.5 db; characteristic Z 50 ohms.	500–4000 MHz	872A	$525
Waveguide slide-screw tuners for correcting discontinuities, matching loads, terminations, bolometers, antennas to characteristic impedances; S-through R-Bands.	2.6–40 GHz	870A	$130-$300
Waveguide phase shifters, full 360-electrical-degree range; direct-reading, high accuracy; J-, X-, P-Bands.	5.3–8.2 GHz	J885A	$550
	8.2–12.4 GHz	X885A	$425
	12.4–18 GHz	P885A	$600

continued on next page

COAXIAL AND WAVEGUIDE INSTRUMENTS

continued

Adapters, low-pass filters

Instrument	Frequency range	Model	Price
Coax/waveguide adapters, swr <1.25:1; S- through X-Bands.	2.6–12.4 GHz	281A	$25-$50
Waveguide adapters for transition between systems; H/X, M/X, M/P, N/P, N/K.	8.2–22 GHz	292A, B	$25-$40
Coax low-pass filters, suppress harmonics, increase swr measurement accuracy; cutoff frequencies 700, 1200, 2200 and 4100 MHz.		360A, B, C, D	$50-$70
Waveguide low-pass filters, suppress harmonics, increase swr measurement accuracy; X- through R-Bands.	8.2–40 GHz	362A	$325-$385

Frequency meters, attenuators, thermistor mounts

See frequency meters on page 26, attenuators on page 33, and thermistor mounts on page 37.

POWER MEASUREMENT

Power meters

Microwave power meter, with extremely low drift, uses self-balancing bridges and thermistor mounts, one set to sense and measure rf power, the other to correct the meter for ambient temperature changes. Just one zero set for all ranges. Thermistor mounts for use with the meter cover 10 MHz to 40 GHz, each mount marked with Calibration Factor and Effective Efficiency on nameplate. Efficiency switch normalizes meter reading to account for thermistor mount calibration factor. Taut-band, individually calibrated meter with mw and dbm scales. Model 431C.

431C Power Meter

Instrument	Power range (full scale)	Instrument accuracy	Frequency range	Model	Price
Microwave power meter reads directly in mw and dbm, instantaneous readings; uses external bolometer element; meter furnishes bolometer bias.	0.1 mw–10 mw	within ±5% of full scale	bolometer mounts to 40 GHz	430C	$275*
Power meter (temperature-compensated as described with photo), offers Calibration Factor control, recorder output, provides leveling capabilities. **	10 μw–10 mw	±1% +20° to +35°C; ±2.5% 0° to +55°C	10 MHz to 40 GHz with mounts described below	431C	$475

*Rack mount $5 additional

**H01-8401A Leveler Amplifier ($200) provides additional leveling-loop gain when required

Instrument	Power range (full scale)	Power accuracy	Frequency range	Model	Price
Calorimetric power meter with just two controls—meter range switch and zero set. Stable, less than 5 sec. for full-scale deflection, low input swr; reads direct in watts and dbw.	10 mw–10 w	within ±5% of full scale	dc to 12.4 GHz	434A	$1600*

*Rack mount $15 less

Thermistor mounts

Instrument	Power range	SWR	Frequency range	Model	Price
Coaxial mount, fixed-tuned, low zero-drift, protected from burnout; swr > 1.5 full frequency range.	0.01–10 mw (with 430C Power Meter)	<1.5 over full range	10 MHz–10 GHz	477B	$ 75
Waveguide mounts, S- to R-Bands, no tuning required; 9 models.	10 mw max. (with 430C Power Meter)	1.5 (G-through P-Bands)	2.6–40 GHz	487	$75-$275
Temperature-compensated coax mount for 50-ohm systems; no tuning required; Calibration Factor and Effective Efficiency data furnished.	1 μw–10 mw (with 431 Power Meter)	1.6 maximum	10 MHz–10 GHz	478A	$155
Waveguide mounts, no tuning required, S- to R-Bands, 9 models; Calibration Factor, Effective Efficiency engraved on nameplate.	1 μw–10 mw (with 431 Power Meter)	1.5 (G-through P-Bands)	2.6–40 GHz	486A	$145-$375

Power meter calibrator

You can verify full-scale calibration and check meter tracking on the Hewlett-Packard 431 Series power meters, measure operating resistance of a thermistor mount, or use with a precision voltmeter to measure rf power by a dc substitution method. Constant current supply is provided for the thermistor mount which permits dc calibration of power meter and mount within ±0.16%. Calibration range 0.01-10 mw full scale, dc substitution range 1 μw-10 mw. Price of 8402B, $475.

Peak power calibrator

Convenient for reading rf peak power of pulse directly. Readings virtually independent of duty cycle, can be standardized against external bolometer or calorimeter. 50-2000 MHz, 200 mw peak f.s., accurate ±1.5 db; rf pulse >0.25 μsec width, 1.5 MHz max. rep rate. 8900B, $485.

MICROWAVE NOISE FIGURE MEASUREMENT

Noise figure meters

Noise figure measurement in microwave receivers is made possible with Hewlett-Packard noise figure meters and noise sources covering IF through waveguide ranges. The 340B and 342A give continuous display of noise figure automatically. They also may be operated manually. Four noise sources are available for use with the meters. They measure noise figure 0 to 15 db with a 5.2 db noise source and 3 to 30 db with a 15.2 db source, indication to infinity. Accuracy is ±½ db, 0-15 db (noise diode scale) and

continued on next page

MICROWAVE NOISE FIGURE MEASUREMENT

continued

(gas tube scale) ±½ db, 10-25 db, and ±1 db, 3-10 db. Frequency coverage: 340B, 30 or 60 MHz, special frequencies, 10-62 MHz available on order; 342A, 30, 60, 70, 105 and 200 MHz, special frequencies, 38-200 MHz available on order. Price: 342A, $815; 340B, $715, rack mount models $15 less.

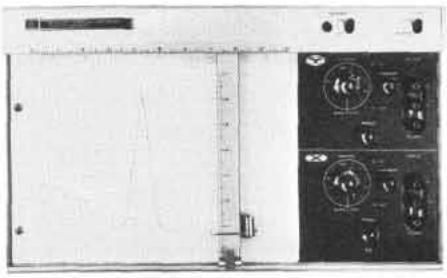
Noise sources

Instrument	Frequency range	Excess noise	Model	Price
IF noise source	30 or 60 MHz center	5.2 db into conjugate load	345B	$125
VHF noise source	10–600 MHz	5.2 db ±0.1 db, 10–200 MHz; 5.2 db ±0.25 db, 200–400 MHz; 5.2 db ±0.35 db, 400–600 MHz	343A	$100
UHF noise source	400–4000 MHz	15.6 ±0.6 db, 400–1000 MHz; 15.7 ±0.5 db, 1000–4000 MHz	349A	$325
Waveguide noise sources	2.6–3.95 GHz	15.1 ±0.5 db	S347A	$390
	3.95–5.85 GHz	15.2 ±0.5 db	G347A	$310
	5.3–8.2 GHz	15.2 ±0.5 db	J347A	$300
	7.05–10.0 GHz	15.7 ±0.5 db	H347A	$275
	8.2–12.4 GHz	15.9 ±0.5 db	X347A	$225
	12.4–18.0 GHz	16.0 ±0.5 db	P347A	$275

RECORDING AND DATA ACQUISITION

X-Y recorders

Hewlett-Packard x-y recorders are offered in a variety of chart sizes. Most offer a choice of bench or rack mounting, English or metric scaling, 115- or 230 volt-operation and 50 or 60 Hertz power requirement. Standard features include exclusive Autogrip* electric paper holddown; compact, modular solid-state design; zener-controlled electronic reference, electronic time base. Options include electric pen lift, retransmitting potentiometers, rear input and others.



7035A X-Y Recorder

Plotting area	Instrument	Input range	Model	Price
7 x 10 inches (180 x 250 mm)	Bench and rack recorder in one, portable, time base on x-axis, solid state, Autogrip.	0.5 mV–50 V/in (0.2 mV–20 V/cm)	135	$1650
	High-impedance version of 135 above, with 1 MΩ at null.		135A	$1650
	Two-pen recorder for plotting two curves at once, time base on x-axis, solid state, Autogrip.	0.5 mV–50 V/in (0.2 mV–20 V/cm)	136A	$2650
	High-sensitivity recorder, 1 MΩ input impedance, high CMR, time base (either axis), solid state, Autogrip.	0.1 mV–20 V/in (0.05 mV–10 V/cm)	7030A	$1895
	Economy recorder, guarded input, solid state, Autogrip.	1 mV–10 V/in (0.4 mV–4 V/cm)	7035A	$795

*Trade mark pat. pend.

Plotting area	Instrument	Input range	Model	Price
10 x 15 inches (250 x 380 mm)	Versatile solid-state recorder, with time base on x-axis, Autogrip.	0.5 mV–50 V/in (0.2 mV–20 V/cm)	2D-2	$1950
	High-impedance version of 2D-2 above, with 1 MΩ at null.		2D-2A	$1950
	Similar to 2D-2 above, with capability of accepting 100 V computer reference.		2D-3	$2050
	Economy recorder, solid state, floating inputs.	0.5 mV–10 V/in (0.2 mV–5 V/cm)	2D-4	$1490
	Two-pen recorder, with time base and Autogrip.	0.5 mV–50 V/in (0.2 mV–20 V/cm)	2FA	$3375
	High-sensitivity recorder accepts both dc and ac inputs, constant 1 MΩ input impedance, time base (either axis), guarded input, solid state, Autogrip.	DC: 0.1 mV–20 V/in (0.05 mV-10 V/cm) AC: 5 mV-20 V/in (2.5 mV-10 V/cm)	7000A	$2495
	Same as 7000A above, but without ac input.		7001A	$2175
	Automatic data plotting system; null detector and character printer built in, solid state, floating inputs.	0.5 mV-10 V/in (0.2 mV-5 V/cm)	7590C	$1985
30 x 30 inches (762 x 762 mm)	Large-display recorder for table or wall mount, floating inputs, zener reference.	1 mV-10 V/in	7	$3950

Recorder accessories

Instrument	Use for	Model	Price
Line follower system, photoelectrically follows lines made with pencil or pigment-type ink; adjustable readout delay for transport delay simulation; adjustable error alarm, consists of tracking unit and separate control box and tracking head.	2D Series Recorders	7500A	$1595
	680 Series Strip-Chart Recorders	7501A	$1650
	7100B Series Recorders	7502A	$1650
Line follower, photoelectric unit replaces recorder pen, optically follows pencil or pigment-type ink lines; factory installation required.	2D and 7000A Series Recorders	F-3B	$795
Waveform translator, converts high-speed repetitive waveforms on scope to x-y plots; uses sampling technique, supplies dc to recorder.	All hp/Moseley x-y recorders	101	$675
Roll chart adapters to convert x-y recorder to basic strip-chart recording capabilities; 17008A features automatic pushbutton full-frame advance.	2D, 7000A Series	17006A	$ 85
		17007A	$575
		17008A	$575
Logarithmic converters for dc or ac signals (20 Hz–100 kHz); dc 0.00316–316 v, ac 0.001–100 v, 60 db dynamic range.	one-channel conversion	7561A	$595
	dual-channel conversion	7560A	$975
Character printers replace the pen on most x-y recorders to identify points or curves when plotting families of digital data; plots to 360 characters/min; 6 characters furnished, 10 available.	Phone plug input	17009A	$ 95
	Miniplug input	17009B	$ 95
Keyboard permits plotting of tabular data in point-graph form.	2D and 7000A Series Recorders	40D	$975
Null detector controls plotting of continuous, discontinuous, or point function data.	2D and 7000A Series Recorders	G-2	$265

Transducers

A wide variety of transducers for converting physical phenomena to electrical signals are available from Hewlett-Packard. They are capable of converting linear displacement, velocity and acceleration, gas and fluid pressures and low forces. Ask your Hewlett-Packard field engineer for details.

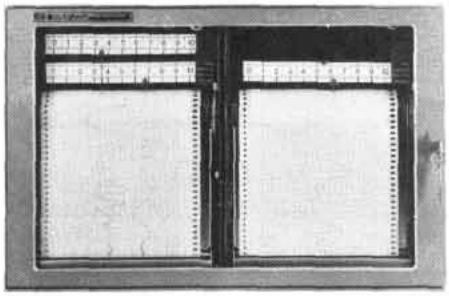
Event recorders

Produce sharp, clear traces of events as short as 1.3 msec on dry, electrosensitive charts; pulsed writing, solid-state plug-in writing cards available for fixed or variable logic levels, low-level signals, etc.; meet rugged MIL RFI specs. Event recorder Model 361, 30 channels, from $2250, with three writing controls (eight types available); Model 360, 120 channels (without writing control) $3900.

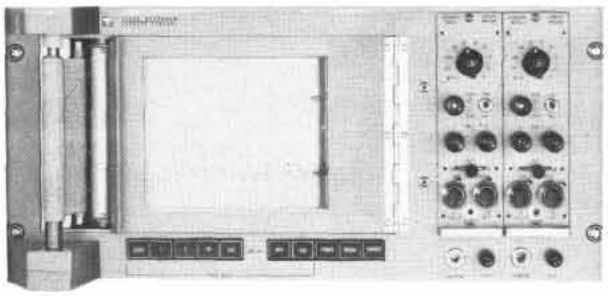
continued on next page

RECORDING AND DATA ACQUISITION

continued



5700-Series Industrial Strip-chart Recorders



7702A Two-channel Recording System

Continuous-chart recorders (1 and 2 channels)

A broad selection of Hewlett-Packard continuous-chart recorders include strip-chart and oscillographic types for both ac and dc measurements. The recording instrumentation group includes portable, mobile and rack types, models with fixed and plug-in signal conditioners, and models for specialized applications.

Plotting width per channel	Number of channels	Instrument	Chart speeds	Model	Price
32 mm	1	Portable dc-100 Hz recorder, 10 mV-10 V/div (div = 1/32 inch).	5, 50 mm/sec	299	$800
	1	Portable dc-100 Hz recorder with built-in excitation source for carrier transducer inputs, 10 μV/div (div = 1/32 inch).	5, 50 mm/sec	301	$850
50 mm	2	Portable dc-125 Hz general-purpose recorder, 0.5 mV-1 V/mm.	1, 5, 20, 100 mm/sec	320	$1650
	2	Portable dc-125 Hz recorder with built-in excitation source for carrier transducer inputs, 10 μV/mm.	1, 5, 20, 100 mm/sec	321	$1650
	2	Portable general-purpose dc-125 Hz recorder, 10 mV-10 V/mm.	1, 5, 20, 100 mm/sec	322	$1395
	2	Plug-in dc-125 Hz recording system, 0.1 V/mm, uses 8800 Series plug-in preamps (see page 41).	1, 5, 20, 100 mm/sec	7702A	$1675*
	2	Plug-in dc-125 Hz recording system, 0.1 V/mm, uses 350 Series plug-in preamps (see page 42).	1, 5, 20, 100 mm/sec	7712A	$1770*
100 mm	1	High-resolution dc-30 Hz plug-in oscillographic recorder with case, 0.5 μV-250 V/mm, uses 8800 Series plug-in preamps (see page 41).	0.5, 2.5, 10, 50 mm/sec	7701A	$1325*
5 inches (127 mm)	1	General-purpose dc strip-chart recorder, 5 mV-100 V full span.	1, 2, 4, 8″/min 1, 2, 4, 8″/hr	680	$750
6 inches (152 mm)	2	Industrial dc strip-chart recorder; select one of ten spans, 1 mV-100 V f.s.; high reliability.	Select one of 21 speeds, 0.5″/hr to 10″/min	5700A	$1325
	1	Same as 5700A above, except one channel.	Same as 5700A above	5701A	$825
10 inches (254 mm)	2	Solid-state dc strip-chart recorder with plug-in span versatility.	12 speeds: 1″/hr to 2″/sec	7100B	$1300*
	1	Same as 7100B above, except one channel.	Same as 7100B above	7101B	$1140*
		Plug-in for 7100B/7101B; 5 mV-100 V, full span.		17500A	$250
		Plug-in for 7100B/7101B; 1 mV-100 V, full span.		17501A	$350

Plotting width per channel	Number of channels	Instrument	Chart speeds	Model	Price
10 inches (254 mm)		Plug-in for 7100B/7101B; single selectable span to match thermocouples.		17502A	$250
	2	Single-span, single-speed dc strip-chart recorder; select one of seven spans 1 mV–1 V f.s.	Select one of nine speeds, 1″/hr to 4″/min	7102A	$1100
	1	Same as 7102A above, except one channel.	Same as 7102A above	7103A	$875
11 inches (279 mm)	2	Industrial dc strip-chart recorder; select one of ten spans, 1 mV–100 V f.s.; high reliability.	Select one of 21 speeds, 0.5″/hr to 10″/min	5702A	$1895
	1	Same as 5702A above, except one channel.	Same as 5702A above	5703A	$995

*Price, plus appropriate plug-in units

Thermal recording systems

(4, 6, 8 channels)

Inkless thermal systems use basically the same recorder, varying in four versions according to the electronics used. In common, they offer 9 chart speeds, 0.25-100 mm/sec, dc-150 Hz response within 3 db. The systems are designated as the 7700 Series.

50 mV, 8-channel system

This Hewlett-Packard system offers eight channels true rectilinear, ideal for telemetry and computer outputs; versatile, simple, reliable; 50 mV-250 V/div. sensitivity; solid state. Just turn on the system, calibrate with an internal source, set input range, position stylii and select chart speed; ideal for long, unattended recording. A complete 7709A System is packaged in single mobile cabinet, $5030. Rack mounting Option 01, $4730, requires only 24½ vertical inches of rack space.

7708A Thermal Recording System

Solid-state plug-in systems

Basic systems (and plug-in solid-state preamplifiers)	Model	Price
4-channel solid-state system, interchangeable plug-in preamplifiers, horizontal pull-out recorder for table top marking, sensitivity 1 μV/div-250 V f.s., 9 mechanically changed speeds.	7704A	$4020*
6-channel solid-state system, interchangeable plug-in preamplifiers, flush front recorder with nine electrically controlled pushbutton speeds.	7706A	$4820*
8-channel solid-state system, same as 7706A above.	7708A	$5495*
Low-gain dc plug-in preamp with calibrated zero suppression, for use with solid-state systems; 5–5000 mV/div sensitivity, 500 K input Ƶ, CMR 48 db min.	8801A	$ 275
Medium-gain dc plug-in preamp, similar to 8801A above, 1–1000 mV/div sensitivity, 180 K input Ƶ, CMR 48 db min.	8802A	$ 325
High-gain dc plug-in preamp, similar to 8801A above, 1 μV–5000 mV/div sensitivity, 1 Meg input Ƶ. CMR 160 db at dc.	8803A	$ 600
Carrier plug-in preamp, similar to 8801A above, 10 μV/div sensitivity, 100 K input Ƶ, CMR 40 db min.	8805A	$ 400
Phase-sensitive demodulator plug-in preamp, similar to 8801A above, 0.5 mV/div sensitivity, 1 Meg input Ƶ, CMR infinite; calibrated phase shifter inserts 60 Hz (8806-02A), 400 Hz (8806-03A), 5 kHz (8806-04A), $75 each.	8806A	$ 475 (plus inserts)
AC-DC converter, similar to 8801A above, 1 mV-20 mV/db, 1 Meg input Ƶ, CMR 40 db min. (50 Hz–100 kHz).	8807A	$ 700
Special-purpose dc plug-in preamp, adjustable input 20 mV-50 mV/div, switch-selected input Ƶ 1500Ω or higher than 100 K; CMR 50,000:1 at dc.	8809A	$ 75

*Plus price of preamplifiers

continued on next page

RECORDING AND DATA ACQUISITION

continued

Vacuum-tube plug-in amplifier systems

Basic systems (and plug-in vacuum-tube preamplifiers)	Model	Price
4-channel economical, high-performance system with horizontal pull-out recorder for table-top chart marking, nine mechanically changed speeds, plug-in preamplifiers for each channel.	7714A	$3970*
6-channel version; uses flush-front, vertical chart plane recorder; nine electrically controlled pushbutton speeds.	7716A	$5325*
8-channel version of 7716A above.	7718A	$6350*
DC plug-in preamp, dc coupling; 1 mv/div sensitivity, 5 Meg input Ƶ, gain 100, dc-100 Hz.	350-1000B	$325
Carrier plug-in preamp, provides excitation (2400 Hz, 4.5-5 V), accepts outputs; 100 μV input provides 1 V; sensitivity reduction by factors of 2, 5, 10, 20, 50, 100, 200.	350–1100C	$425
Phase-sensitive demodulator plug-in preamp, dc out proportional to in-phase component of an ac signal; 4 mV (in-phase) produces 1 V dc at output.	350–1200E	$400
DC coupling plug-in preamp, 5 mV/div.	350–1300C	$250
Logarithmic plug-in preamp accepts ac 100 mV–100 V rms, dc −10 to +40 db.	350–1400A	$475
High-gain plug-in preamp, accepts inserts for sensitivity 20 μV in for 1 V out; max. gain 50,000; inserts for plug-in (ie, 350–2B dc with zero suppression, $165; 350–4A strain gage, $130).	350–1500A	$525 (plus inserts)
Frequency meter plug-in preamp, measures frequency 30 Hz–50 kHz, providing dc output for recording.	350–2800A	$415

*Plus price of preamplifiers

Identical-channel systems

Basic systems (and amplifiers)	Model	Price
6-channel economy system; records variables 0–150 Hz; accepts one of four 6-channel solid-state amplifiers below; sensitivities 10 μV–500 mV/div; useful for a variety of applications.	7726A	$3125*
Same as 7726A above, except 8 channels and uses 8-channel amplifiers below.	7728A	$3425*
High-gain dc amplifiers for identical-channel systems; 10–2000 μV/div, 100 K input Ƶ; CMR 140 db min., dc, 120 db min. at 60 Hz.	958–1500–01 (6 channel)	$3600
	958–1500 (8 channel)	$3800
Medium-gain dc amplifiers for identical-channel systems; 0.5 mV–20 V/div; 0.5 Meg input Ƶ; CMR same as above.	958–3400–01 (6 channel)	$3330
	958–3400 (8 channel)	$3500
Medium-low-gain dc amplifiers for identical-channel systems; 10 mV–10 V/div; 5 Meg (balanced to ground) each side; CMR 34 db on most sensitive range.	958–2900–01 (6 channel)	$2290
	958–2900 (8 channel)	$2500
Low-gain dc amplifiers for identical-channel systems; 0.05–2 V/div; 550 K (balanced to ground); CMR 40 db typical.	958–3600–01 (6 channel)	$2340
	958–3600 (8 channel)	$2500

*Plus price of amplifier unit for 6- or 8-channel operation

Optical recording systems (to 25 channels)

Completely integrated amplifier-galvanometer-recorder system, to 25 channels for directly connecting 0-5 kHz signals rear or front, recording signals 2.5 mV/in-625 mV/in. Prices for 4500 Series 8-channel systems start at $4800, plus amplifiers. Three 8-channel amplifier choices (6-channel also available) include 625 mV/in galvanometer driver 658-2000, $2200; 50 mV/in low-gain 658-2900, $2895; 2.5 mV/in medium gain 658-3400, $3780.

Magnetic tape recording systems (7, 14 channels)

Unique, mechanically simple Hewlett-Packard tape transport assures reliability, long life. These low-cost recording systems have high quality performance with less adjustment and maintenance than comparable systems. Six electrically switchable speeds, plug-in record and reproduce electronics for complete flexibility at minimum cost.

3950 Magnetic Tape Recording System

Systems	Bandwidth	Channels	Model	Price
High-performance systems, with improved flutter, distortion specs; six speeds, 1-7/8" to 60"/sec with no capstan change; IRIG compatibility; solid-state plug-in FM, direct, pulse record/reproduce electronics. Accessories include voice channel amp, tape loop adapter, remote control unit.	50 Hz–100 kHz	7	3907B	$6185*
		14	3914B	$8415*
Similar to 3907B, 3914B systems (above), except for bandwidth and price.	50 Hz–250 kHz	7	3917B	$6935*
		14	3924B	$9915*
Use similar tape transport as above systems, provides wider bandwidths for direct record telemetry, similar applications; easy to use, IRIG compatibility, minimum adjustments; push-bar equalizers simplify speed changes.	400 Hz–1.5 MHz	up to 14	3950-Series	Prices on request

*Basic system price; add prices of amplifier and speed equalization plug-ins for each active channel; approx. $215 per channel (direct), $245 per channel (FM)

Digital data acquisition systems

Hewlett-Packard digital data acquisition systems are standard models, offering fast delivery, the economy of standardization, proved performance and complete, reliable specifications. Any system may be selected from a data sheet. Each series of systems is built around a particular measuring device, and the models differ in type of input scanner and recorded output,

2010C Data Acquisition System

which ranges from printed paper tape to magnetic tape. The following charts outline the basic series of systems and the models in each series.

*2010 Series Data Acquisition Systems**

Voltage ranges	Frequency range	Display	Scanner input	Effective CMR	Measurement speed	Output	Model	Price
100 mV-1000 V full scale in five ranges; to ±300% overranging; optional 10 mV full scale	5 Hz–300 kHz; sample period 0.01, 0.1 or 1 second	6 digits of data, range, function (polarity), channel number are all included in readout and recording.	Stepping switch scanner; to 25 3-wire inputs, to 100 channels with slaves; programming permits measurement of mixed types, levels of signals.	105 db	5 channels/sec	Printed paper tape	2010A	$8310
					10 channels/sec	Perforated tape	2010B	$10,225
					1 channel/sec	Punched card (IBM 526)	2010E	$9425
					10 channels/sec	Digital magnetic tape	2010H	$16,275
			Guarded crossbar scanner; to 200 guarded 3-wire inputs; to 600 1-wire inputs; can be programmed with accessory pinboard or punched tape programmer.	130 db	5 channels/sec	Printed paper tape	2010C	$10,660
					10 channels/sec	Perforated tape	2010D	$12,500
					1 channel/sec	Punched card (IBM 526)	2010F	$11,700
					10 channels/sec	Digital magnetic tape	2010J	$18,550

*Measuring instrument 2401C Integrating Digital Voltmeter (see page 3)

continued on next page

RECORDING AND DATA ACQUISITION

continued

*2013 Series Data Acquisition Systems**

Voltage ranges	Display	Scanner input	Measurement speed	Output	Model	Price
10, 100, 1000 V full scale	4 digits of data, range, polarity, channel number are all included in readout and recording.	25 2-wire or 50 1-wire single-ended inputs; upper limit scan selection.	100 channels/min	Printed paper tape	2013A	$4495
			60 channels/min	Perforated tape	2013B	$5410
			40 channels/min	Typewritten sheet	2013C	$5645
			40 channels/min	Punched card (IBM 024, 026)	2013D	$4420
		To 25 3-wire sources; to 100 channels with slave scanners; single-ended inputs, channels individually selected.	100 channels/min	Printed paper tape	2013J	$4850
			60 channels/min	Perforated tape	2013K	$5765
			40 channels/min	Typewritten sheet	2013L	$6000
			40 channels/min	Punched card (IBM 024, 026)	2013M	$4775

*Measuring instrument 3440A Digital Voltmeter (see page 3)

*2015 Series Data Acquisition Systems**

Voltage ranges	Display	Scanner input	Measurement speed	Output	Model	Price
1, 10, 100, 1000 V full scale	6 digits of data, range, polarity, channel number are all indicated in readout and recording.	Stepping switch scanner; to 25 3-wire inputs; to 100 channels with slaves; programming permits measurement of mixed types and levels of signals.	5 channels/sec	Printed paper tape	2015A	$8160
			7 channels/sec	Perforated paper tape	2015B	$10,075
			1 channel/sec	Punched card (IBM 526)	2015E	$9275
			7 channels/sec	Digital magnetic tape	2015H	$16,125
		To 200 guarded 3-wire inputs, 100 6-wire, 300 2-wire, 600 1-wire inputs; can be programmed with accessory pinboard or punched tape programmer	5 channels/sec	Printed paper tape	2015C	$10,510
			9 channels/sec	Perforated paper tape	2015D	$12,350
			1 channel/sec	Punched card (IBM 526)	2015F	$11,550
			12 channels/sec	Digital magnetic tape	2015J	$18,400

*Measuring instrument 3460A Digital Voltmeter (see page 3)

*2017 Series Data Acquisition Systems**

Voltage ranges	Frequency ranges	Display	Scanner input	Output	Model	Price
100 mV-1000 V f.s.; ±300% overranging; 0.01% stability on highest ranges. Data linearizer permits readout of thermocouples, strain gage bridges and other transducers directly in engineering units.	10 Hz-300 kHz; linearizer programs sample period.	6 digits of data, measurement units (i.e. rpm, °C), range, polarity, channel number are all included in readout and recording.	Stepping switch scanner; to 25 3-wire inputs to 100 channels with slaves; programming permits measurement of mixed types, levels of signals. 105 db effective CMR.	Printed paper tape	2017A	$11,990
				Perforated tape	2017B	$13,785
				Punched card (IBM 526)	2017E	$12,940
				Digital magnetic tape	2017H	$19,790
			Guarded crossbar scanner; to 200 3-wire inputs; to 600 1-wire inputs; can be programmed with accessory pinboard or punched tape programmer.	Printed paper tape	2017C	$13,915
				Perforated tape	2017D	$15,690
				Punched card (IBM 526)	2017F	$14,790
				Digital magnetic tape	2017J	$21,640

*Measuring instrument 2401C Integrating Digital Voltmeter with 2417A Data Linearizer (see pages 3, 45)

Digital data plotting systems

These Hewlett-Packard systems produce easy-to-read graphical plots from digital data stored on punched cards, perforated tape or magnetic tape. A keyboard is included for manual data entry. The systems offer four-digit resolution on both x and y inputs; plotting accuracy is better than ±0.15% of full scale.

2031C Digital Data Plotting System

Type of input	Plotting area	Accessories	Model	Price
Punched card	10" x 15" on 11" x 17" paper Optional roll chart	Digital line segment generator permits interpolation between points to produce smooth curves; editor permits direct plotting of data recorded by data acquisition systems	2031A	$9490
Punched tape			2031B	$8500
Magnetic tape			2031C	$13,815

Digital system elements... input scanners and programmers

Instrument		
Stepping switch scanner scans up to 50 1-wire or 25 2-wire inputs, upper limit selectable at front panel; channel being measured indicated by in-line readout and BCD output.	2900B	$1420
Stepping switch scanner scans 25 3-wire inputs, programs all functions of associated system; pushbutton selection of channel to be measured; pinboard inside scanner programs measurement functions and delay on channel-by-channel basis; expandable in 25-channel increments to 100 channels with slave scanners.	2901A	$2375 (slaves $1975)
Guarded crossbar scanner for rejection of common mode noise; scans 200 3-wire, 600 1-wire, 300 2-wire, 100 6-wire inputs; lower, upper scan limits selectable at front panel, with random access to any channel; monitored channel indicated with in-line display and BCD output.	2911	$4650
Programmer for use with 2911 Scanner (above); permits mixing types, levels of inputs and skipping individual random channels.	2911C	$3425
Punched tape programmer programs digital voltmeter and signal conditioners; directs scanner to specific channels or groups of channels; controls data recording; optional tape search permits system control in response to comparison results or time from digital clock.	2560A	$3380
Digital scanner sequentially scans and transmits data from 3 digital sources (optionally to 6) such as counters, scalers, DVM's to single recording device such as paper tape punch, digital magnetic tape recorder.	2514A	$2500

Digital system elements... signal conditioners

Instrument	Model	Price
AC-to-DC converter produces 0-1 Vdc output proportional to average value in input ac 100 μV–300 V, 50 Hz–500 kHz; floating input, overrange capability.	457A	$ 450
AC/ohms-to-DC converter converts ac (0.1–1000 V f.s., 50 Hz–100 kHz) and ohms (100 ohms-10 Meg) to dc for measurement with 2401C or 3460A Digital Voltmeter; preserves DVM guarding; programmable.	2410B	$2250
Data linearizer, used with 2401C Integrating Digital Voltmeter, compensates for transducer "live" zero, scale factor and nonlinearity; provides readout directly in appropriate physical units:°C, psi, μin/in, gpm, etc; programmable.	2417A	$2650
Guarded data amplifier (see Amplifiers, page 20)	2411A	$1200

continued on next page

RECORDING AND DATA ACQUISITION

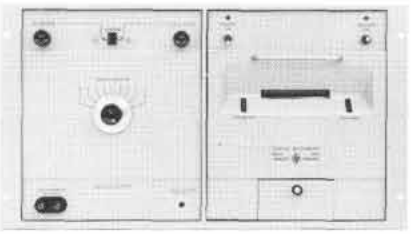
continued

Digital system elements... analog-to-digital converters

2212A V-to-F Converter

Instrument	Model	Price
Integrating digital voltmeter (see page 3).	2401C	$3950
Plug-in digital voltmeter (see page 3).	3440A	$1160
Integrating/potentiometric digital voltmeter (see page 3).	3460A	$3600
Voltage-to-frequency converter produces pulse train whose pulse rate is proportional to magnitude of dc input signal; 1, 10, 100, 1000 full scale Vdc in; (optional 0.1 v); 0–10,000 Hz out.	2210	$ 650
Voltage-to-frequency converter (see above) 0-1 Vdc in (optional 0.1 or 100 Vdc), 0–10,000 Hz out, floating input; polarity sensed automatically.	2211A	$1250
Voltage-to-frequency converter same as 2211A above except 0–100,000 Hz out.	2211B	$1250
Voltage-to-frequency converter (see above) 10 mV, 100 mV, 1 Vdc in; 100,000 Hz full scale out; bi-polar fast settling overload recovery; low input drift, 120 db CMR all ranges through differential circuits.	2212A	$ 900

Digital systems elements ...recorders, output couplers, auxiliary equipment



562A Digital Recorder with 581A D-A Converter installed

These Hewlett-Packard devices permit recording data acquisition system outputs for later study or computer processing. They also are very useful for providing printed records, perforated tape, punched card, or digital magnetic tape recordings of measurements made with electronic counters.

Instrument	Model	Price
Digital recorder prints five 11-digit lines/sec (12-digit on special order); voltage staircase input, parallel entry, analog output.	560A	$1400*
Digital recorder similar to 560A above, requires 10-line decimal parallel entry input, one connection for each position of each print wheel.	561B	$1150*
Solid-state digital recorder prints as fast as 5 lines/sec, 11 digits per line (12 available); 2 msec data transfer time; BCD or 10-line codes (plug-in conversion).	562A	$1085 to $2100**
Digital printer mechanism, fast 11-column device for use in custom systems; similar printing mechanism to 560, 561, 562.	565A	$ 750
Digital clock, designed to mount in lefthand panel openings with digital recorders/printers, provides bright display, can control external equipment; for use with 560A Recorder above.	570A	$1050
Digital clock, similar to 570A above, for use with 561B digital recorder.	571B	$1000

Instrument	Model	Price
Digital clock, similar to 570A above, for use with 562A digital recorder.	HO3-571B	$1225
Digital clock for systems use; supplies visual and BCD time information on demand; optionally will initiate system measurement at predetermined intervals from 1 hr to 1 sec; solid state.	2509A	$2250
Digital clock for systems use; visual and BCD time information.	2508A	$1980
Digital-to-analog converter accepts 4-line BCD input; operates galvanometers, potentiometers, strip-chart recorders; cabinet model 3½" high, 16¾" wide.	580A	$ 525
Digital-to-analog converter same as 580A above except size is 6¼" high, 7¾" wide.	581A	$ 525
Output coupler transfers data from parallel sources such as counters, digital voltmeters, digital clocks to serial entry recorders such as tape punches, card punches, typewriters; output code and format as specified by customer.	2540A	Consult factory
Card punch set couples digital sources (voltmeter, electronic counter) to IBM 526 Summary Punch, accepts 11 input characters (optionally to 20), punches up to 17 characters/sec, format flexibility through IBM patchboard.	2526	$3100
Paper tape punch set couples digital sources (voltmeter, electronic counter) to Teletype BRPE 11 Tape Punch (optional Tally 420), accepts 11 input characters (optionally to 15), records at 110 characters/sec, produces IBM 8-level code, (other codes optional); rack mounted punch available.	2545	$3900
Magnetic tape recorder set records digital voltmeter, electronic counter data on magnetic tape in standard IBM 7-channel NRZI code; operates with Cook Model 150 Incremental Tape Recorder; accepts up to 12 characters, records at 250 characters/sec asynchronous.	2546A	$9950
Digital comparator compares digital measurements from DVM or counter digit-for-digit against single or dual limits; 4-digit comparison, optional 5 or 6 digit, provides Hi/Go/Lo lamp indications and electrical outputs.	2539A	$1850

*Rack mount $15 less
**562A price depends on options

NUCLEAR MEASUREMENT

Scalers

Hewlett-Packard experience in electronic counters is brought to nuclear measurement with a variety of instruments that can operate with data systems. Instruments include scalers, a high-voltage power supply and scintillation detectors. The hp packaging format —modular cabinets for individual or rack-mount applications—simplifies use with other instruments for complex systems. Versatility is increased by packaging scintillation detector and amplifier in one unit, complete scaler-timer in another and power supply in a third. Premium selected NaI (T1) crystals and photomultiplier tubes and built-in amplifiers are used to obtain high performance, and provide sufficient gain and pulse shaping in scintillation detectors to drive a single-channel analyzer.

Hewlett-Packard scaler, high-voltage power supply and scintillation detector

Instrument	Model	Price
Scaler-Timer accepts pulses from nuclear detectors to accumulate, display, record nuclear events; contains a three-mode single-channel pulse height analyzer with 0.01% stability; 200 nsec pulse pair resolution, 6-digit in-line display, printer output, display storage, all solid state.	5201L	$1950
Identical to 5201L above, except incorporates a simple discriminator in lieu of a pulse height analyzer; input sensitivity 100 mV.	5202L	$1400
Similar to 5202L above, except does not incorporate a timer; ideal for use in multi-channel systems where it is slaved to another scaler-timer.	5203L	$ 950

continued on next page

High-voltage power supply

Instrument	Model	Price
Supply designed to provide stable output voltage for requirements of scintillation spectrometry; 170–1615 V at 1 mA, vernier adjustment for fine control of metered output.	5551A	$ 350

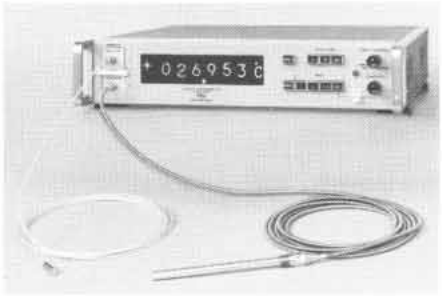
Scintillation detectors

Instrument	Crystal size	Crystal type	Guaranteed resolution	Model	Price
High-performance NaI (T1) detectors for integral, differential gamma scintillation counting, gamma spectrometry; low drift, premium resolution, built-in preamp and low-gain amplifier; very low response to magnetic fields, 50 Ω output impedance.	2" diam x 2"	Solid	8%	10601A	$ 835
	3" diam x 3"	Solid	8%	10602A	$1475
	2" diam x 2"	Well	10%	10611A	$ 885
	3" diam x 3"	Well	10%	10612A	$1565
	2" diam x 2"	Well	10%	10613A	$ 885
	3" diam x 3"	Well	10%	10614A	$1565

TEMPERATURE MEASUREMENT

Quartz thermometers

Measure temperature —80 to +250°C with 0.0001° resolution with this quartz thermometer. Direct digital readout in degrees C or F, high-accuracy absolute or temperature difference measurements, outputs for recording on digital recorder, punched tape, cards, magnetic tape or strip-chart. Ideal for both lab work and automatic monitoring. The thermometer measures the frequency of a temperature-sensitive quartz oscillator, rather than the voltages or resistances associated with thermocouples or platinum-resistance devices. Thus, you get direct readings in degrees without bridge balancing, conversion charts, temperature references or computer processing. Temperature probes may be located to 1000 ft. from thermometer. The Hewlett-Packard thermometer offers high performance under rugged environmental conditions. A wide variety of probes are available. Model 2801A, 2 sensor probes for 2-point monitoring or difference readings, 0.0001° resolution, $3250; Model 2800A, 1 probe, 0.1° resolution (optionally 0.01) $2250.



2801A Quartz Thermometer

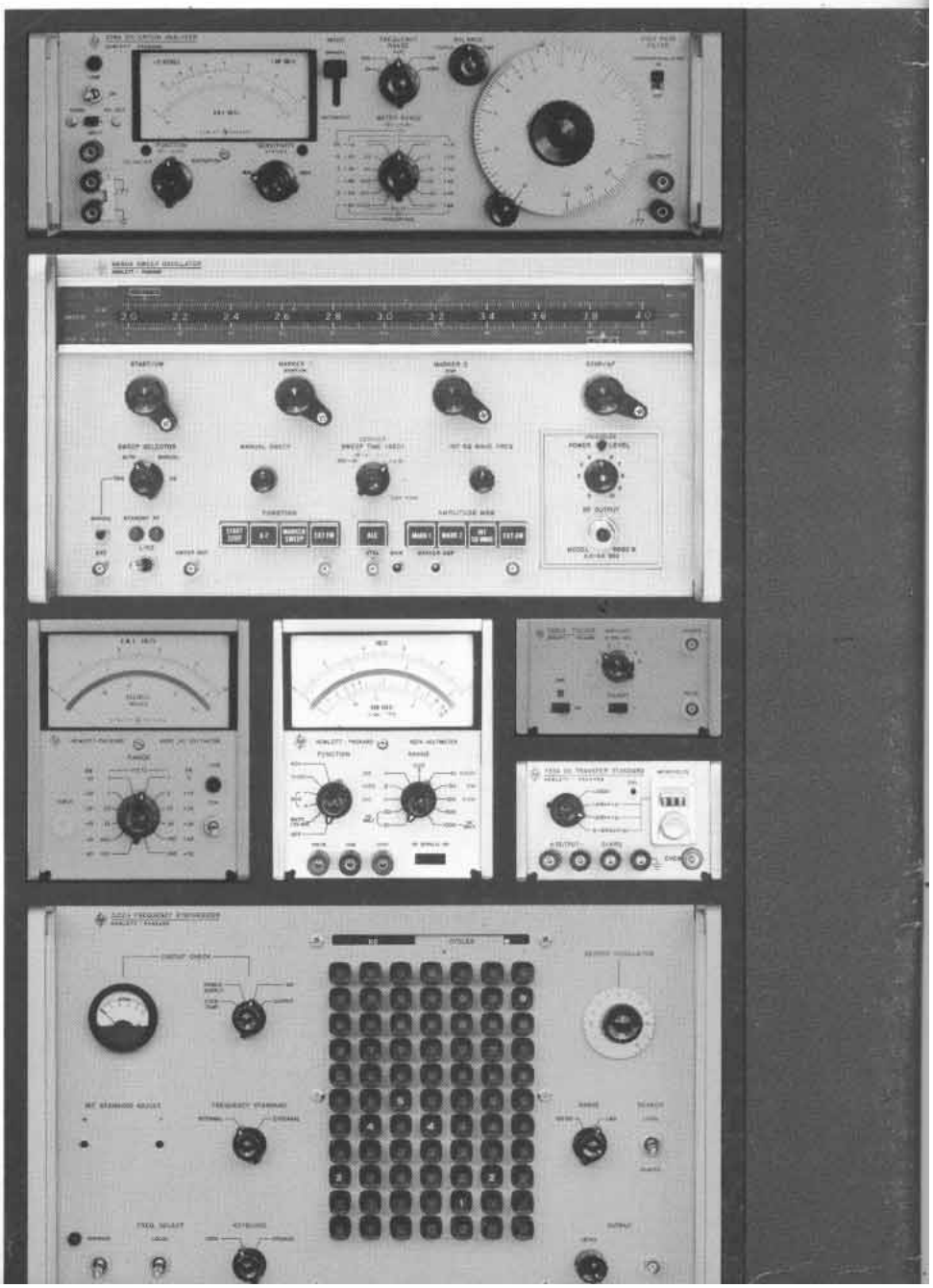
Thermometer accessories and complementary equipment

Instrument	Model	Price
Oscillator amplifier enables extended signal cables to be used with quartz thermometers; 40 db gain compensates for signal loss in about 2000 feet of cable; one amplifier can be used to extend cable to 3000 feet, two amplifiers to 5000 feet.	2831A	$ 100
Quartz thermometer temperature sensor assembly for oceanographic applications, measures temperature in ocean depths in excess of 36,000 feet; provides signal to electronic counter for digital readout.	2832A	$1950
Temperature sensor assembly, for use with quartz thermometer for measuring temperature at pressures to 10,000 psi and at distances up to 1 mile from thermometer itself, suitable for geological and industrial applications.	2833A	$ 750
Sensor selector for use with quartz thermometer, permits manual scanning of 10 sensors, with slave capability to permit measurement of up to 100 points; channel identification output provided for recording.	2840A	$ 650
Thermometer scanner, for automatic or manual measurement of up to 60 sensor inputs to quartz thermometer; single scan, continuous scan, and single channel monitor; upper and lower channel limit selection; channel number displayed, provided as BCD output.	2918A	$3750

HEWLETT-PACKARD SALES AND SERVICE OFFICES in the United States and Canada

1. **Vancouver, B.C.**
   Hewlett-Packard (Canada) Ltd.
   2184 W. Broadway
   (604) 738-7520
   TWX: 610-922-5059
2. **Bellevue, Washington 98004**
   11656 N. E. 8th St.
   (206) 454-3971
   TWX: 910-443-2303
3. **Sacramento, California 95821**
   2591 Carlsbad Ave.
   (916) 482-1463
   TWX: 916-444-8683
4. **Palo Alto, California 94303**
   1101 Embarcadero Rd.
   (415) 327-6500
   TWX: 910-373-1280
5. **North Hollywood, Calif. 91604**
   3939 Lankershim Blvd.
   (213) 877-1282 and 766-3811
   TWX: 910-499-2170
6. **San Diego, California 92106**
   1055 Shafter Street
   (714) 223-8103
   TWX: 714-276-4263
7. **Salt Lake City, Utah 84115**
   1482 Major St.
   (801) 486-8166
   TWX: 801-521-2604
8. **Scottsdale, Arizona 85251**
   3009 No. Scottsdale Rd.
   (602) 945-7601
   TWX: 602-949-0111
9. **Tucson, Arizona 85716**
   232 So. Tucson Blvd.
   (602) 623-2564
   TWX: 602-792-2759
10. **Englewood, Colorado 80110**
    7965 East Prentice
    (303) 771-3455
    TWX: 303-771-3056
11. **Albuquerque, N.M. 87108**
    6501 Lomas Blvd., N.E.
    (505) 255-5586
    TWX: 910-989-1665
12. **Las Cruces, N.M. 88001**
    114 S. Water Street
    (505) 526-2486
    TWX: 910-983-0550
13. **Oklahoma City, Oklahoma**
    (405) 235-7062
14. **Dallas, Texas 75209**
    P. O. Box 7166, 3605 Inwood Rd.
    (214) 357-1881 and 332-6667
    TWX: 910-861-4081
15. **Houston, Texas 77027**
    P. O. Box 22813
    4242 Richmond Ave.
    (713) 667-2407
    TWX: 713-571-1353
16. **St. Paul, Minnesota 55114**
    2459 University Ave.
    (612) 646-7881
    TWX: 910-563-3734
17. **Kansas City, Missouri 64114**
    9208 Wyoming Place
    (816) 333-2445
    TWX: 910-771-2087
18. **St. Louis, Missouri 63144**
    2814 South Brentwood Blvd.
    (314) 644-0220
    TWX: 910-760-1670
19. **New Orleans, Louisiana**
    (504) 522-4359
20. **Skokie, Illinois 60076**
    5500 Howard Street
    (312) 677-0400
    TWX: 910-223-3613
21. **Indianapolis, Indiana 46205**
    3919 Meadows Dr.
    (317) 546-4891
    TWX: 317-635-4300
22. **Dayton, Ohio 45409**
    1250 W. Dorothy Lane
    (513) 298-0351
    TWX: 513-944-0090
23. **Southfield, Michigan 48076**
    24315 Northwestern Hwy.
    (313) 353-9100
    TWX: 313-357-4425
24. **Cleveland, Ohio 44129**
    5579 Pearl Road
    (216) 884-9209
    TWX: 216-888-0715
25. **Monroeville, Pa. 15146**
    2545 Moss Side Blvd.
    (412) 271-5227
    TWX: 710-797-3650
26. **Toronto, Ontario**
    Hewlett-Packard (Canada) Ltd.
    1415 Lawrence Avenue West
    (416) 249-9196
    TWX: 610-492-2382
27. **Rochester, New York 14623**
    39 Saginaw Drive
    (716) 473-9500
    TWX: 510-253-5981
28. **Endicott, New York 13764**
    1219 Campville Rd.
    (607) 754-0050
    TWX: 510-252-0890
29. **Syracuse, New York 13211**
    5858 East Molloy Rd.
    (315) 454-2486
    TWX: 710-541-0482
30. **Ottawa, Ontario**
    Hewlett-Packard (Canada) Ltd.
    1762 Carling Avenue
    (613) 722-4223
    TWX: 610-562-1952
31. **Montreal, Quebec**
    Hewlett-Packard (Canada) Ltd.
    8270 Mayrand Street
    (514) 735-2273
    TWX: 610-421-3484
32. **Burlington, Mass. 01803**
    Middlesex Turnpike
    (617) 272-9000
    TWX: 710-332-0382
33. **Middletown, Conn. 06457**
    589 Saybrook Rd.
    (203) 346-6611
    TWX: 710-428-2036
34. **Poughkeepsie, N.Y. 12601**
    82 Washington Street
    (914) 454-7330
    TWX: 914-452-7425
35. **New York, New York 10021**
    236 East 75th Street
    (212) 879-2023
    TWX: 710-581-4376
36. **Englewood, New Jersey 07631**
    391 Grand Avenue
    (201) 567-3933
37. **Eatontown, New Jersey**
    (201) 542-0852
38. **West Conshohocken, Pa. 19428**
    144 Elizabeth Street
    (215) 248-1600 and 828-6200
    TWX: 510-660-8715
39. **Camp Hill, Pennsylvania**
    (717) 737-6791
40. **Baltimore, Maryland 21207**
    6660 Security Blvd.
    (301) 944-5400
    TWX: 710-862-0850
41. **Rockville, Maryland 20852**
    12303 Twinbrook Pkwy.
    (301) 427-7560
    TWX: 710-828-9684
42. **Richmond, Virginia 23230**
    2112 Spencer Road
    (703) 282-5451
    TWX: 710-956-0157
43. **High Point, N.C. 27262**
    1923 N. Main Street
    (919) 882-6873
    TWX: 510-926-1516
44. **Atlanta, Georgia 30305**
    3110 Maple Drive, N.E.
    (404) 233-1141
    TWX: 810-751-3283
45. **Huntsville, Alabama 35802**
    2003 Byrd Spring Rd. S.W.
    (205) 881-4591
    TWX: 510-579-2204
46. **Orlando, Florida 32803**
    621 Commonwealth Ave.
    (305) 425-5541
    TWX: 305-841-2568
47. **St. Petersburg, Florida 33708**
    410-150th Ave., Madeira Beach
    (813) 391-0211
    TWX: 813-391-0666
48. **Miami, Florida 33125**
    2907 Northwest 7th St.
    (305) 635-6461
49. **San Antonio, Texas 78226**
    (GOVERNMENT CONTRACTS)
    Hewlett-Packard
    Contract Marketing Division
    225 Billy Mitchell Road
    (512) 434-4171
    TWX: 512-571-0955

HEWLETT hp PACKARD



PRINTED IN U.S.A.