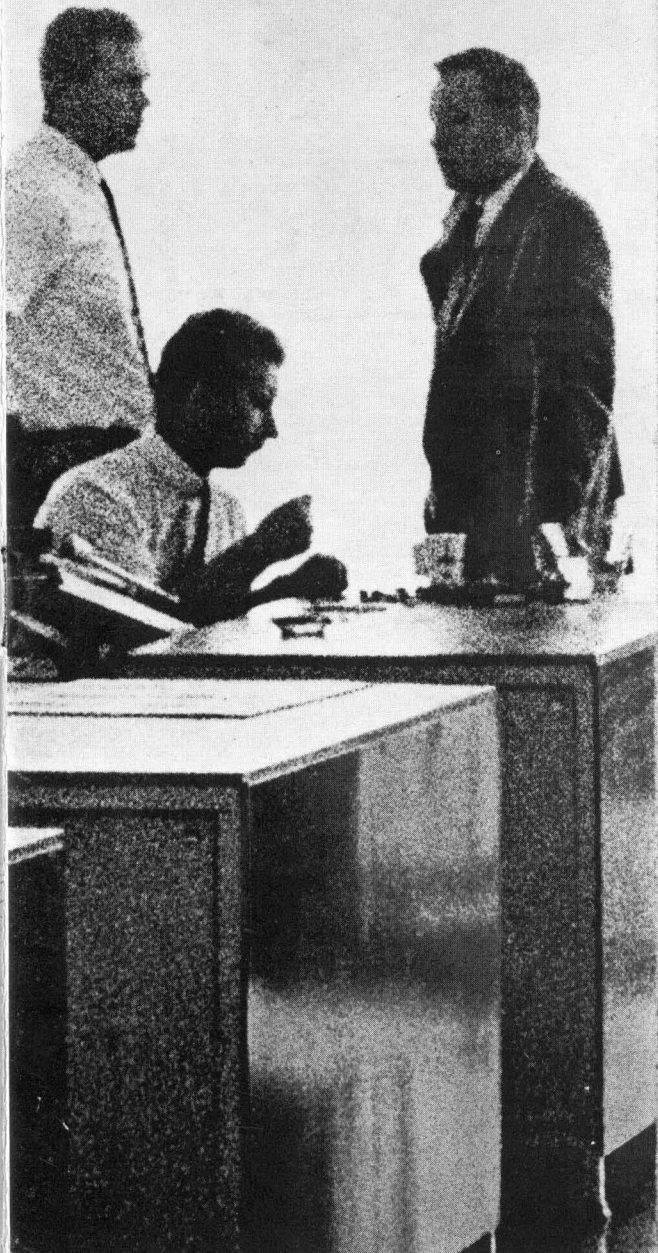




**SHORT
FORM
CATALOG
1964 • 65**



HEWLETT PACKARD ELECTRONIC TEST INSTRUMENTS

*Complete product
listings for*

BOONTON RADIO
DYMEC
HARRISON LABS
HEWLETT-PACKARD
F. L. MOSELEY
SANBORN

This catalog is intended to serve as an index, outlining only the basic specifications and prices of the instruments listed. Detailed specifications and ordering information should be obtained from your Hewlett-Packard field office listed on the back cover of this catalog. A complete data sheet is available on each product listed in this Short Form.

*Where to find
the products:*

Amplifiers—8-19-20-21-26-27-28-29-30-31
Analyzers—8-26-27
Counters, Converters—10-11
Data Acquisition Systems—30-31
Frequency Synthesizers—9
Frequency-Time Standards—9
Impedance Bridges, Meters—26-27-28-29
Meters, Analog—6-7-22-23
Meters, Digital & Differential—6-7-30-31
Microwave Test Equipment—24-25-26-27
Oscillators—16-17
Oscilloscopes—2-3-4-5
Power Supplies—12-13-14-15
Pulse, Square Wave Generators—18
Recorders, Continuous—4-9-19-20-21-22-23
Recorders, Digital—9-30-31
Recorders, X-Y—22-23
Signal Generators—24-25-28-29

LOW FREQUENCY SCOPES

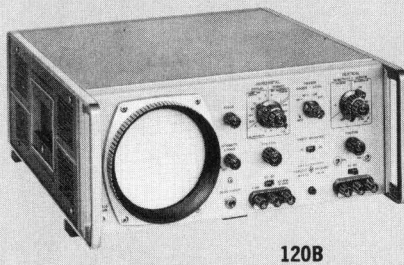
- Bandwidths to 500 kc, sensitivities to 200 $\mu\text{V}/\text{cm}$
- Single or dual channels
- Automatic triggering on all models, calibrated sweeps
- No-parallax, no-glare 10 x 10 crt's

120B Scope DC to 450 KC—Four calibrated vertical ranges, 10 mv/cm to 10 v/cm; 15 calibrated sweeps from 5 $\mu\text{sec}/\text{cm}$ to 200 msec/cm, $\pm 5\%$; x5 sweep magnifier has 3 calibrated steps 100 mv/cm to 10 v/cm. For x-y, phase shift between vertical and horizontal amplifier less than $\pm 2^\circ$ to 100 kc. Beam Finder quickly finds trace. Modular cabinet for rack or bench use.

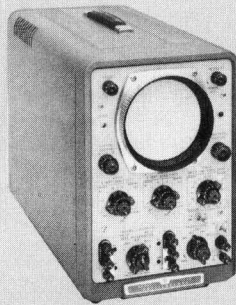
122A Scope 200 KC Dual Channel—Provides separate traces for simultaneous study of signals, chopped or on alternate sweeps, single trace when desired. Each

vertical amplifier has four calibrated ranges, 10 mv/cm to 10 v/cm, differential input at all sensitivities. 15 calibrated sweeps from 5 $\mu\text{sec}/\text{cm}$ to 200 msec/cm, $\pm 5\%$; x5 sweep magnifier works on all ranges.

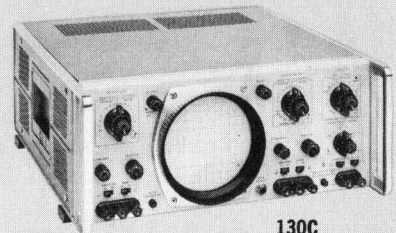
130C Scope 500 KC, 200 $\mu\text{V}/\text{CM}$ —Identical x and y amplifiers having 16 calibrated ranges 200 $\mu\text{V}/\text{cm}$ to 20 v/cm, differential input on all ranges, less than 1° phase shift between amplifiers to 100 kc. 21 calibrated sweeps 1 μsec to 5 sec/cm, $\pm 3\%$; x2, x5, x10, x20, x50 magnifier extends fastest sweep to 0.2 $\mu\text{sec}/\text{cm}$. Beam Finder quickly locates trace. Modular cabinet for rack or bench use.



120B



122A



130C

140A DUAL PLUG-IN SCOPE

- Bandwidths to 20 mc, sensitivities to 10 $\mu\text{V}/\text{cm}$
- Sweep speeds to 20 nsec/cm
- Accepts single or dual plug-ins
- 7.5 kv crt, internal graticule, beam finder

140A Main Frame accepts all 1400 series plug-ins; 7.5 kv post accelerator crt with 10 x 10 cm internal graticule, 1 v and 10 v $\pm 1\%$ calibrator; Beam Finder for locating trace. Modular cabinet for rack or bench use.

VERTICAL PLUG-INS

1400A 100 $\mu\text{V}/\text{CM}$ Differential—100 $\mu\text{V}/\text{cm}$ to 20 v/cm in 17 calibrated ranges. Bandwidth, dc to 400 kc, selectable. Differential input on all ranges with common mode rejection of 40 db.

1401A 1 MV/CM Dual Trace—Two traces presented in chopped or on alternate sweeps. Each channel has 13 calibrated ranges 1 mv/cm to 10 v/cm with bandwidth of dc to 450 kc. Differential input with common mode rejection of 40 db. Sync amplifier allows scope to trigger internally on channel A while in alternate mode of operation.

1402A 20 MC Dual Trace—Two traces presented in chopped or on alternate sweeps. Each channel has 11 calibrated ranges 5 mv/cm to 10 v/cm with bandwidth of 20 mc. A + B or B - A also available. Signal delay included for viewing leading edges of pulses. Sync amplifier allows scope to trigger internally on channel A while in alternate mode of operation.

1403A 10 $\mu\text{V}/\text{CM}$ AC Differential—10 $\mu\text{V}/\text{cm}$ to 100 mv/cm in 13 calibrated ranges with bandwidth 0.1 cps to 400 kc. Both upper and lower limits are selectable. Differential input with common mode rejection of 94 db. Noise, 20 μV p-p at 100 kc bandwidth.

1405A 5 MC Dual Trace—Two traces presented in chopped or on alternate sweeps. Each channel has 11 calibrated

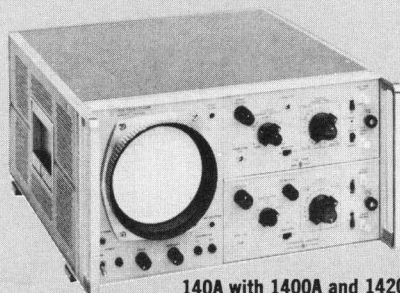
ed ranges 5 mv/cm to 10 v/cm with a bandwidth of 5 mc. A + B or B - A also available.

HORIZONTAL PLUG-INS

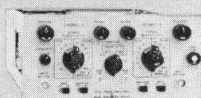
1420A Time Base—22 ranges 0.5 $\mu\text{sec}/\text{cm}$ to 5 sec/cm $\pm 3\%$; x10 magnifier extends fastest sweep to 50 nsec/cm. Triggers internally to over 20 mc, single sweep.

1421A Time Base and Delay Generator—21 ranges 0.2 $\mu\text{sec}/\text{cm}$ to 1 sec/cm $\pm 3\%$; x10 magnifier extends fastest sweep to 20 nsec/cm. Triggers internally to over 20 mc; single sweep. Calibrated delay time 0.2 μsec to 10 sec continuously variable. Incremental delay accuracy 0.2%. Time jitter less than 1 part in 50,000. Mixed sweep for slow and fast sweep signal display.

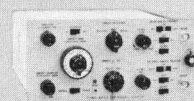
1415A Time Domain Reflectometer—For measuring discontinuities in broadband devices. A system rise time of 150 psec permits reflections only 1 inch apart to be resolved. High sensitivity, calibrated in ρ/cm , allows reflection coefficients as small as 0.001 to be measured. Ideal for antenna, cable or connector impedance matching work.



140A with 1400A and 1420A



1401A



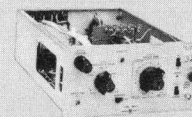
1421A



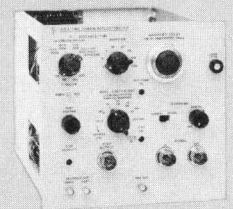
1402A



1405A



1420A



1415A

LOW FREQUENCY OSCILLOSCOPES

Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
120B	One	dc to 450 kc	10 mv/cm to 10 v/cm	1 μs/cm to 200 ms/cm	Beam Finder, automatic sync	\$475
122A	Two	dc to 200 kc	10 mv/cm to 10 v/cm	1 μs/cm to 200 ms/cm	Diff. input, automatic sync	\$695
130C	One	dc to 500 kc	200 μv/cm to 20 v/cm	0.2 μs/cm to 5 sec/cm	Identical vertical and horizontal amplifiers, diff. input	\$695

PLUG-IN OSCILLOSCOPES

Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
140A	Up to two	Up to 20 mc	Up to 10 μv/cm	From 20 nsec/cm to 5 sec/cm	10 x 10 cm display, 7.5 kv crt	\$575

Vertical Plug-Ins

1400A	One	dc to 400 kc	100 μv/cm to 20 v/cm		Diff. input, selectable bandwidth	\$210
1401A	Two	dc to 450 kc	1 mv/cm to 10 v/cm		Diff. input	\$325
1402A	Two	dc to 20 mc	5 mv/cm to 10 v/cm		Algebraic input; delay lines	\$550
1403A	One	0.1 cps to 400 kc	10 μv/cm to 100 mv/cm		Diff. input, selectable bandwidth	\$350
1405A	Two	dc to 5 mc	5 mv/cm to 10 v/cm		Diff. input	\$325

Combination Plug-In

Description	Use	Features	Price
1415A Time Domain Reflectometer	Analyze discontinuities in test cables, connectors, strip lines, attenuators, networks and other broadband devices	System rise time of 150 psec allows discontinuities only 1 inch apart to be resolved; time base is calibrated in cm of line/cm of display, and sensitivity is calibrated in p/cm for easy operation; high sensitivities permit reflection coefficients as small as 0.001 to be measured	\$1050

Horizontal Plug-Ins

1420A	Time Base	Provides sweeps for 140A	0.5 μsec/cm to 5 sec/cm, x10 magnifier automatic triggering	\$325
1421A	Time Base	Provides normal and delayed sweeps for 140A	0.2 nsec/cm to 1 sec/cm, x10 magnifier; delay time, 0.2 μsec to 10 sec	\$625

Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
175A*	Up to four	Up to 50 mc	Up to 1 mv/cm	10 nsec/cm to 5 sec/cm	6 x 10 cm display, tunnel diode triggering	\$1325

Vertical Plug-Ins**

1750B	Two	dc to 50 mc	50 mv/cm to 20 v/cm		Algebraic input, 7 nsec rise time	\$325
1751A	One	dc to 50 mc	50 mv/cm to 20 v/cm		7 nsec rise time	\$160
1752A	One	dc to 22 mc, 50 mv/cm, 18 mc at 5 mv/cm	5 mv/cm to 20 v/cm		Diff. input, 4 low ranges	\$225
1752B	One	dc to 40 mc, 50 mv/cm, 30 mc at 5 mv/cm	5 mv/cm to 20 v/cm		Diff. input, all ranges	\$285
1754A	Four	dc to 40 mc	50 mv/cm to 20 v/cm		Sync amplifier, 9 nsec rise time	\$595
1755A	Two	50 mc at 10 mv/cm-5 v/cm, 40 mc at 5 mv/cm, 20 mc at 1 mv/cm	1 mv/cm to 5 v/cm		Sync amplifier, algebraic input, 7 nsec rise time	\$575

Horizontal Plug-Ins	Description	Use	Features	Price
1780A	Auxiliary	Allows 175A to perform standard functions	Normal or single sweeps	\$25
1781B	Sweep Delay	Allows detailed analysis of complex signals or pulses	Sweep delays, 0.5 μsec to 10 sec; jitter less than ±0.002%; mixed sweep	\$325
1782A	Display Scanner	Permits permanent recordings on x-y recorder of waveforms	30 mc bandwidth, internal or external scanning	\$425
1783A	Time Mark Generator	Provides synchronized intensity modulated time markers	Range: 10, 1 and 0.1 μsec; accuracy ±0.5%	\$130
1784A	Recorder	Provides a permanent record of any displayed waveform	Easy to use	\$775

SAMPLING OSCILLOSCOPES

Model	Channels	Rise Time	Sensitivity	Sweep Range	Other Features	Price
185B	Up to two	Up to 90 psec (4000 mc)	Up to 1 mv/cm	0.1 nsec/cm to 10 μsec/cm	Sync to 1000 mc, Beam Finder	\$2000

Vertical Plug-ins

186A	One	0.5 nsec	4 mv/cm to 10 v/cm		1 nsec, 20 v pulse generator, 2 power supplies	\$1700
187C	Two	350 psec	1 mv/cm to 200 mv/cm		100 K, 2 pf probes, diff. input; accessories included	\$1250
188A	Two	90 psec	1 mv/cm to 200 mv/cm		Feed-thru 50 ohm input, diff. input	\$1500

Sampling Accessories

Description	Use	Features	Price
1100A*** Delay line for 187B/C	View signals where suitable triggers are not available	Includes delay line, sync take-off and load	\$300
1102B Accessory Kit	Convenient probing when 1100A used with 187B/C; also for 188A and 186A	Includes dividers and blocking capacitors	\$190
1103A Trigger Countdown	Permits stable triggering to 10 gc		\$265

MILITARIZED OSCILLOSCOPES

Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
H02-160B	Up to Two	Up to 15 mc	Up to 20 mv/cm	20 nsec/cm to 5 sec/cm	Meets rugged military environmental specifications	\$2250

Vertical Plug-Ins

H02-162A	Two	14 mc	20 mv/cm to 20 v/cm		Diff. input	\$420
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Horizontal Plug-Ins

Description	Use	Features	Price
H02-166A Time Mark Generator	Provides synchronized intensity modulated time markers	Range: 10, 1, 0.1 μsec; accuracy: ±0.5%	\$165
H02-166B Auxiliary	Allows H02-160B to perform standard functions	Normal or single sweeps	\$35
166E Sweep Delay Generator	Allows detailed analysis of complex signals or pulses	Sweep delays, 1 μsec to 10 sec; mixed sweep	\$435

Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
170B, BR	Up to two	Up to 30 mc	Up to 20 mv/cm	20 nsec/cm to 5 sec/cm	Meets rugged military environmental specifications	\$2350

Vertical Plug-In

162C	Two	22 mc	20 mv/cm to 20 v/cm		Diff. input	\$420
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Horizontal Plug-Ins	Description	Use	Features	Price
166E	Sweep Delay Generator	Allows detailed analysis of complex signals or pulses	Sweep delays, 1 μsec to 10 sec; mixed sweep	\$435
166F	Auxiliary	Allows 170B, BR to perform standard functions	Normal or single sweeps	\$35

*Extra fast writing model also available for photographing high speed transients. Ask your field engineer about the hp H30-175A.

**Special plug-ins with 2.5 nsec rise time also available. Ask your field engineer about the K01-1759A and K02-1759A.

***For 187B, order 1100A; for 187C, order 1100A Option 01.

Data subject to change. Prices f.o.b. factory.

hp OSCILLOSCOPES

175A 50 MC UNIVERSAL OSCILLOSCOPE

- Bandwidth to 50 mc, sensitivities to 1 mv/cm
- Single, dual, or four channel
- 6 x 10 cm display with no-parallax, reflection or defocusing
- Easy to calibrate and maintain, no distributed amplifiers
- Preset tunnel diode triggering over entire bandwidth

175A Main Frame—6 x 10 cm display on 13 kv post accelerator crt with internal graticule. Beam Finder locates trace. 24 calibrated sweeps 0.1 μ sec to 5 sec/cm, $\pm 3\%$; x10 magnifier extends fastest sweep to 10 nsec/cm. Preset internal triggering to over 50 mc. 1% calibrator.

VERTICAL PLUG-INS

1750B 50 MC Dual Channel—Two traces presented in chopped or on alternate sweeps. Each channel has nine calibrated ranges 50 mv/cm to 20 v/cm with bandwidth dc to 50 mc (7 nsec rise time). Algebraic addition with common mode rejection of 40 db. Has a sync amplifier for triggering on Channel B input.

1751A 50 MC Single Channel—Nine calibrated sensitivities 50 mv/cm to 20 v/cm with 7 nsec rise time, bandwidth dc to 50 mc.

1752A 5 MV/CM Differential—Twelve calibrated ranges 5 mv/cm to 20 v/cm with bandwidth of dc to 18 mc on 5 mv/cm to 20 mv/cm ranges and 22 mc on 50 mv/cm and above. Differential input on ranges 5 mv/cm to 50 mv/cm.

1752B 5 MV/CM Wide Band Differential—Nine calibrated sensitivities 50 mv/cm to 20 v/cm with dc to 40 mc bandwidth, x10 amplifier gives 5 mv/cm sensitivity with dc to 30 mc bandwidth. Differential input on all ranges. Two attenuators allow mixing signals on different levels.

1754A 40 MC Four Channel—Four traces presented in chopped or on alternate sweeps. Each channel has nine calibrated ranges 50 mv/cm to 20 v/cm with bandwidth dc to 40 mc (9 nsec rise time). Has sync amplifier for triggering on any channel and trace identifier.

1755A 50 MC Dual Channel, 1 MV/CM—Two traces presented in chopped or on alternate sweeps. Each channel has ten calibrated ranges. In x1 sensitivity mode the bandwidth is 50 mc from 10 mv/cm to 5 v/cm and 40 mc on 5 mv/cm. In x5 sensitivity mode the bandwidth is 20 mc with 1 mv/cm sensitivity. Algebraic addition with common mode rejection of 40 db. Has a sync amplifier for triggering on Channel B input.

HORIZONTAL PLUG-INS

1780A Auxiliary—Allows 175A to perform all standard functions. Single sweep included.

1781B Sweep Delay—Provides calibrated delay times from 0.5 μ sec to 10 sec with $\pm 0.2\%$ linearity. Time jitter less than 1 part in 50,000. Mixed sweep for slow and fast sweep signal display.

1782A Display Scanner—Permits permanent recordings of crt display with x-y or strip chart recorders. Scanning is internal, manual or external.

1783A Time Mark Generator—Provides synchronized 0.5% accuracy intensity modulated time markers on the 175A trace. Markers are selectable at 10 μ sec, 1 μ sec, or 0.1 μ sec internals. Markers also available for external use.

1784A Recorder—Provides a recording of any repetitive signal displayed by a 175A. Easy to operate. There is no need to worry about lens and shutter settings. Simply push a button to record. Make 20 recordings for the cost of one photograph.

PROBES, ADAPTERS, AND VIEWING HOODS

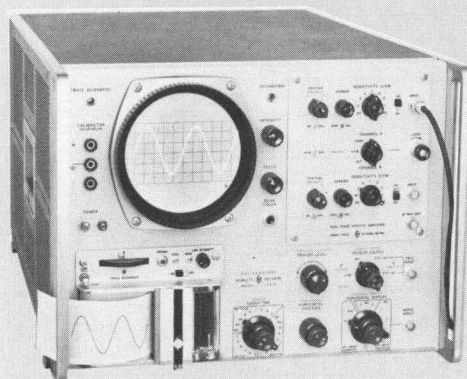
Probe	Atten.	Bandwidth (0.5 db)	Resistance (megohms)	Capacitance	Length
10001A/C*	10:1	dc to 30 mc	10	10 pf	5'
10001B/D*	10:1	dc to 30 mc	10	20 pf	10'
10002A/C*	50:1	dc to 30 mc	9	2.5 pf	5'
10002B/D*	50:1	dc to 30 mc	9	5 pf	10'
10003A/B*	10:1	dc to 40 mc	10	10 pf	4'

*These probes have black identification boots; the others have red. Price \$30 each.

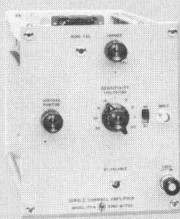
Model	Description	Price
10035A	Probe tip kit; includes pincer jaw, banana, pin, hook, and spring tips for 10000 series probes	\$5
10010C	BNC tip for 10000 series probes	\$10
10025A	Probe, pincer tip, terminated in dual banana plug	\$9
10110A	BNC male to dual banana post	\$5
10111A	Shielded banana pin to female BNC	\$7
10175A	Polarized viewing hood	\$10
10175B	Viewing hood	\$7

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

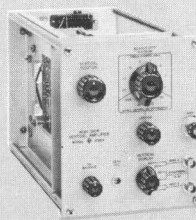
175A MADE VERSATILE WITH THESE VERTICAL, HORIZONTAL PLUG-INS



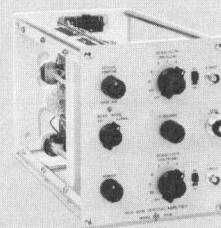
175A with 1750B and 1784A



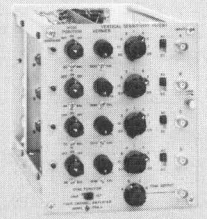
1751A



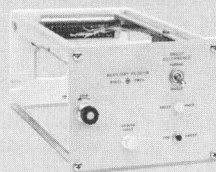
1752A



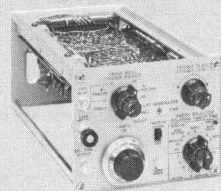
1752B



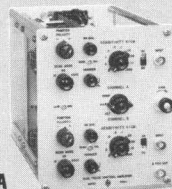
1754A



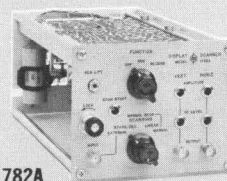
1780A



1781B



1755A



1782A



1783A

185B SAMPLING OSCILLOSCOPE

- Bandwidth to 4000 mc, sensitivities to 1 mv/cm
- Bridging sampler avoids terminating signals
- High impedance probes, 100 K shunted by 2 pf
- Calibrated sweeps to 0.1 nsec/cm
- Complete line of accessories

185B Scope—Ten calibrated sweep ranges 10 nsec/cm to 10 μ sec/cm $\pm 5\%$; x1 to x100 magnifier increases maximum sweep to 0.1 nsec/cm. Delay control permits any portion of unmagnified trace to be viewed when using a magnified sweep. Triggers to over 1000 mc; sensitivity, 15 mv in sensitive position, 200 mv at 50 to 1000 mc in high frequency position. 1.5 v sync output pulse

for triggering external equipment. Has output for x-y recorder, internal graticule and Beam Finder.

PLUG-INS

186A Switching Time Tester—Includes a 1 nsec rise time, 20 v pulse generator, 0.5 nsec rise time vertical amplifier and two bias supplies for general purpose circuit tests and for displaying transistor and diode switching characteristics. Pulse generator output adjustable from 0.1 v to 20 v in eight steps. Vertical amplifier has sensitivity range 10 mv/cm to 10 v/cm (vernier to 4 mv/cm). Supply #1 provides 0 to ± 30 v; supply #2, 0 to ± 10 v. Supplies may be referenced to ground or stacked. Circuit test boards for transistors and diodes included.

187C 1000 MC Dual Channel—Signal input is through high impedance probes (100 k shunted by 2 pf) for minimum circuit loading. A special 50-ohm Tee is provided for bridging 50-ohm transmission lines. Each channel has 8 cali-

brated ranges from 1 mv/cm to 200 mv/cm (0-4 mv/cm with vernier). Noise approximately 1 mv p-p. Differential input (A-B). Accessories included.

188A 90 Psec Rise Time Dual Channel—Bridging sampler in 50 ohm line allows signals to be monitored without terminating unless desired. Each channel has 8 calibrated ranges 1 mv/cm to 200 mv/cm with 90 psec rise time (4.0 gc bandwidth).

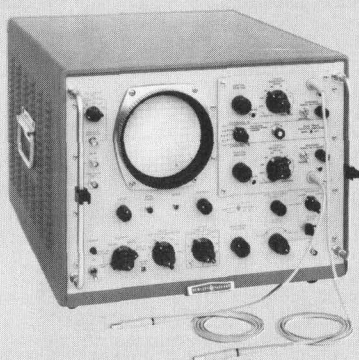
ACCESSORIES

1100A 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 amplifier input of the scope. Input impedance is 50 ohms; rise time, approximately 0.25 nsec.

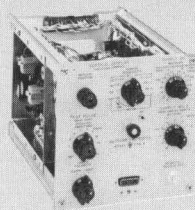
1103A Trigger Countdown—Permits stable triggering to 10 gc. With the 185B Sampling Scope, cw signals as low as 5 millivolts can be displayed with less than 30 picoseconds of jitter.

CAMERAS	Features	Price
196A	75mm, f1.9 lens, 3¼ x 4¼ Polaroid for std. crt's	\$395
196B	75mm, f1.9 lens, 3¼ x 4¼ Polaroid for std. and IG crt's	\$445
CURRENT PROBE AND AMPLIFIER		
1110A	Probe: 1 mv/ma, 1700 cps to 45 mc	\$100
1111A	Amplifier: 1 ma/cm to 5 a/cm, 50 cps to 20 mc	\$160

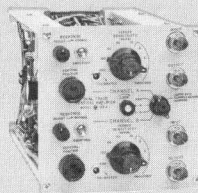
TESTMOBILES	Features	Price
1115A	For 175A, 120B, 130C, 140A, storage compartment	\$115
1116A	For 160B, 170A, 185B, tray for accessories	\$85
1117A	For all hp scopes; provision for rack mtg. auxiliary equipment	\$125
ACCESSORIES		
See General Catalog for complete list of probes, adapters, viewing hoods and service aids.		



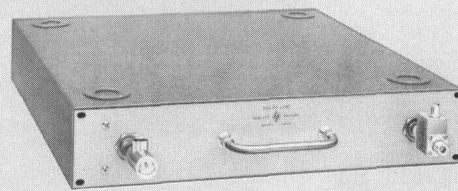
185B with 187C



186A



188A



1100A

MIL SCOPES and ACCESSORIES

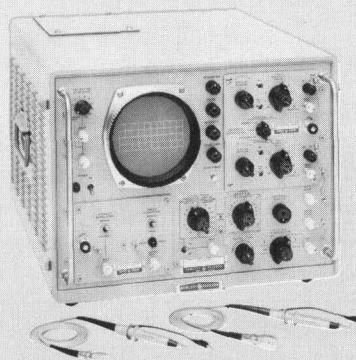
H02-160B, dc to 15 mc, and *170B*, dc to 30 mc are militarized oscilloscopes offering rugged dependability under a wide range of environmental conditions.

The *hp 196B Camera* is designed specifically for photographing no-parallax internal graticule crt's. It features a black light for illuminating the graticule, *f*/1.9 lens, shutter speeds 1/100 to 1 sec (plus T & B) and a detented moving lens for multiple exposures. *hp 196A*, without black light, also available.

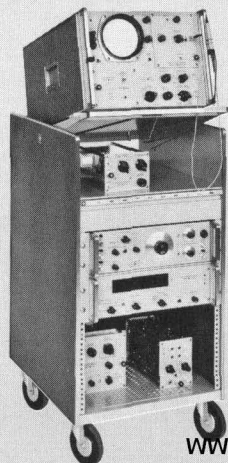
The *hp 1110A Probe* and *1111A Current Amplifier* permit observation of fast rise time ac current waveforms. The clamp-on probe obviates breaking

leads and circuit loading. The probe may be used with or without the amplifier. By itself, the 1110A Probe has a sensitivity of 1 mv/ma. With the amplifier, sensitivity is directly calibrated in ma/cm on the scope with a maximum sensitivity of 1 ma/cm.

The *1115A*, *1116A*, and *1117A Testmobiles* provide easy mobility of hp oscilloscopes or other equipment. They have storage capability for plug-ins and accessories and adjustable viewing angle for easy viewing.



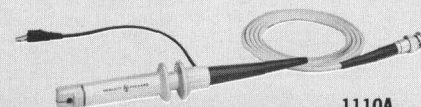
170B



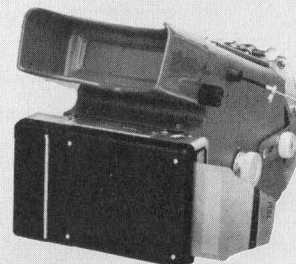
1117A



1111A



1110A



196B

hp INSTRUMENTS for BASIC MEASUREMENT

Basic electronic measurements are easy, fast and accurate with Hewlett-Packard instruments including voltmeters, ammeters, ohmmeters amplifiers, as well as distortion and waveform analyzers which are described on page 8.

Voltage measurements are accurate and simple with a wide assortment of hp instruments. The *hp 400D Vacuum Tube Voltmeter* is a moderately priced stable instrument for ac applications, offering $\pm 2\%$ accuracy. Other instruments in the 400 Series include the *hp 400H VTVM*, which offers 1% accuracy in ac measurements, and the *hp 400L*, which provides a logarithmic scale for ac measurements, plus a linear 12 db scale. The *hp 403B AC Voltmeter* is a compact, solid state model offering accuracy of $\pm 2\%$ to 1 mc, $\pm 5\%$ to 2 mc. The *hp 3400A* provides true rms readings of ac voltages having crest factors of 10:1 at full scale (higher for down scale readings) over the frequency range 50 cps to 1 mc with 1% accuracy and 10 cps to 10 mc with 5% accuracy. The *hp 3440A Digital Voltmeter* is a compact, accurate, rapid and multiple-function digital voltmeter. The choice of automatic ranging, remote and manual operation is obtained by using the 3441A, 3442A, 3443A or 3444A plug-ins, which are interchangeable with any 3440A. DC voltages up to 999.9 volts of either polarity are displayed in four significant digits with an accuracy of better than $\pm 0.05\%$ of reading. The 3443A High Gain/Auto-Range Plug-In features automatic and remote controllable 100 mv to 1000 v full scale ranges, with 10 μ v resolution. The 3444A DC Multi-Function Unit Plug-In features measurement capabilities from 100 mv to 1000 v dc, 1000 ohms to 10 megohms resistance and 100 μ a to 1000 ma current. Measurement, polarity, function and decimal location are presented in four-line, binary-coded decimal voltages in the 1-2-2-4 code (1-2-4-8 available on special order). The decimal,

polarity and the four digits are in parallel-coded form and are completely compatible with the *hp 562A Recorder*. Especially useful for low level measurements is the *Dymec DY-2401B Integrating Digital Voltmeter* whose floating and guarded input permits accurate measurement even in the presence of high common mode or spurious noise. *Dymec DY-2410B AC/Ohms Converter* expands DY-2401B capability to include floated and guarded wide-band, low-level ac and resistance measurements. The all-purpose *hp 410C VTVM* is ideal for audio, rf, vhf measurements, also measures dc voltages and resistance and provides a dc output proportional to meter indication. The *hp 411A RF Millivoltmeter* is a sensitive instrument for measurement to 1 gc. Versatility is a major advantage of the *hp 412A Precision Volt-Ohm-Ammeter*, providing accuracy of $\pm 1\%$ on dc voltage measurements and $\pm 2\%$ on dc current measurements.

The *hp 413A DC Null Voltmeter* is a null meter, dc voltmeter and amplifier in one instrument, featuring input isolation and high input impedance. Low drift and high sensitivity make the *hp 425A Microvolt-Ammeter* ideal for low-level measurements of voltage and current. The *hp 738AR Voltmeter Calibrator* and the *hp 739AR Frequency Response Test Set* are useful instruments for a wide range of voltmeter and oscilloscope calibration tasks.

Current measurements possible with Hewlett-Packard instrumentation also cover a wide range of applications. The *hp 428B Clip-on DC Milliammeter* permits measurement without breaking leads, making dc connections or loading circuits under test. Use the *hp 3528A Clip-on Current Probe* and the *3529A Magnetometer Probe*, with the 428B for special applications involving measurements on large cables, pipes or waveguides and measurement of magnetic fields, ac fields, earth's field.

Similar types of measurements may be made with the *hp 400D, H or L Voltmeters*, employing the *hp 456A AC Current Probe* which, used with the *hp 456A-21B 100:1 Divider* permits measurement up to 25 amps. The *457A AC-to-DC Converter* simplifies ac measurements with standard hp digital voltmeters.

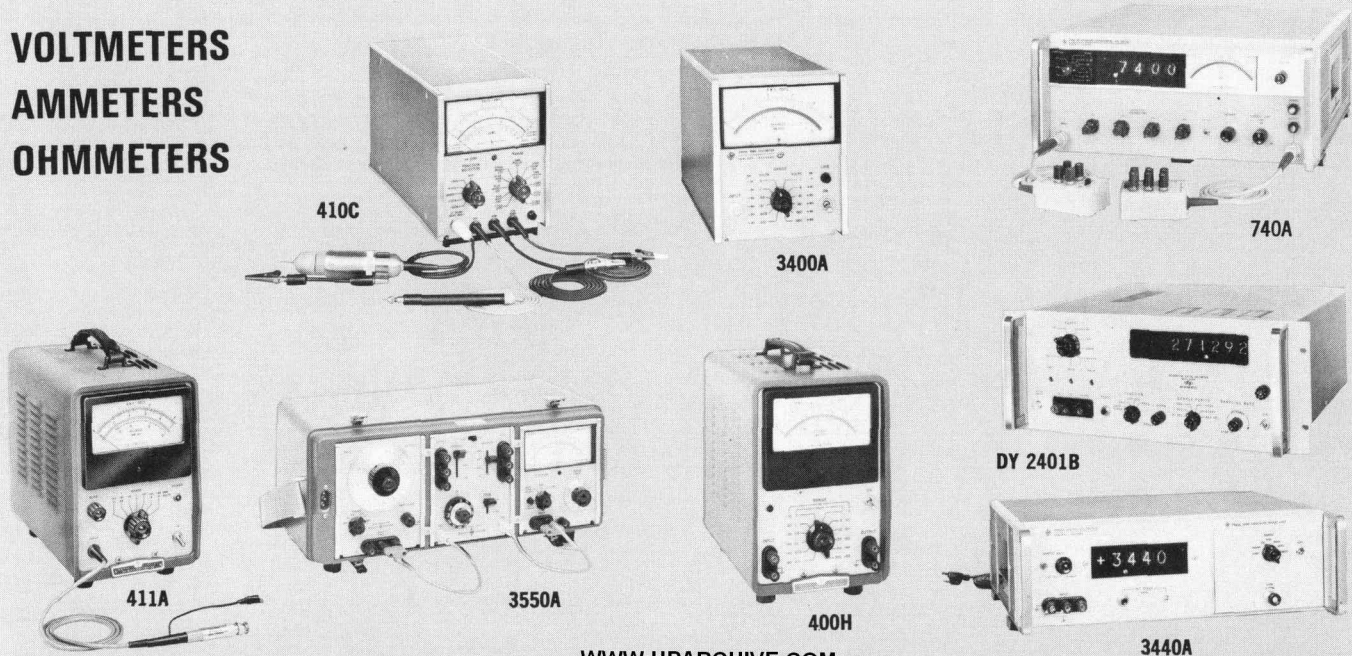
Resistance measurement capability from Hewlett-Packard is offered in multi-purpose instruments, the 410B, 410C 412A and the 3440A/3444A, described above.

DC Standard—The *Model 740A* as a dc standard delivers continually adjustable voltages from 0 to 1 kv with 0.01% accuracy. Stability is better than 0.003% per month. The output is floated and guarded. As a dc differential voltmeter the 740A offers input impedances $>10^9$ on most ranges (independent of null) and compares dc voltages from 0 to 1000 volts dc with absolute accuracy of 0.01%. As a dc power amplifier the 740A will deliver up to 60 db voltage gain, with stability better than 0.001%, output up to 25 watts. As a dc voltage amplifier the 740A delivers up to 120 db gain at the isolated recorder terminals. The 740A may be used as an electronic dc voltmeter, with full scale ranges from 1 μ v to 1000 volts (2% accuracy). Input impedance is <1000 megohms. All modes of operation are guarded and floating. The *Model 740A*, in a single instrument is ideal for such uses as precision calibration of digital voltmeters, comparison of standard cells and measurement of precision attenuators.

Special test instrumentation available from Hewlett-Packard includes the *hp 3550A Portable Test Set*, which combines an oscillator, voltmeter and patch panel in a portable instrument designed specifically to measure transmission line and system characteristics such as attenuation, frequency response or gain.

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

VOLTMETERS AMMETERS OHMMETERS



METERS

Instrument	Primary Uses	Frequency Range	Voltage or Current Range	Input Impedance	Price
400D	Wide range ac measurements, high sensitivity, amplifier	10 cps to 4 mc	0.001 to 300 v full scale, 12 ranges	10 meg, 15, 25 pf shunt	\$250*
400H	High accuracy wide range ac measurements, amplifier	10 cps to 4 mc	0.001 to 300 v full scale, 12 ranges	10 meg, 15, 25 pf shunt	\$325*
400L	Log voltages, linear db measurements, amplifier	10 cps to 4 mc	0.001 to 300 v full scale, 12 ranges	10 meg, 15, 25 pf shunt	\$325*
403A	Battery-operated portable; fast, accurate, hum-free ac measurements	1 cps to 1 mc	0.001 to 300 v full scale, 12 ranges	2 megohms, 40, 20 pf shunt	\$275
403B	AC voltage measurements in lab or field; ac line or battery operation	5 cps to 2 mc	1 mv to 300 v full scale	2 megohms	\$310
405BR 405CR	Digital voltage measurement, automatic range, polarity; 405CR has printer output	dc	0.001 v to 1000 v (accuracy $\pm 0.2\%$ of reading ± 1 count)	11 megohms to dc	\$890 \$960
410B	Audio, rf, vhf measurements; dc voltages; resistances	dc; ac, 20 cps to 700 mc	dc, 1 to 1000 v full scale ac, 1 to 300 v full scale	dc, 122 megohms ac, 10 megohms/1.5 pf	\$245†
410C	DC voltage; resistance, current; audio, rf, vhf measurements with ac probe	dc; ac, 20 cps to 700 mc	dc v, 15 mv to 1500 v full scale, dc amps, 1.5 μ a to 150 ma full scale, ac v, 0.5 to 300 v full scale	dc v, 100 megohms ac, 10 megohms/1.5 pf	\$425**
411A	Millivolt, db readings to gc range	500 kc to 1 gc	10 mv to 10 v full scale, 7 ranges	Typically 200 K at 1 mc, 1 v	\$450*
412A	Precision voltage, current, resistance measurements	dc	1 mv to 1000 v full scale, 1 μ a to 1 amp	10 to 200 megohms, depending on range	\$400*
413A	DC null meter, dc voltmeter, amplifier	dc	1 mv to 1000 v full scale, 13 ranges	10 to 200 megohms, depending on range	\$350*
425A	Read μ v, μ a; 100 db amplifier; medical, biological, physical, chemical	dc voltages; 100 db amplifier	10 μ v to 1 v full scale, 10 μ a to 3 ma full scale	1 megohm $\pm 3\%$	\$500*
428B	Clip-on milliammeter eliminates direct connection, circuit loading; wider range, recorder output for dc to 400 cps	dc on meter, dc to 400 cps on recorder	1 ma to 10 amps full scale, 9 ranges		\$600*
456A	Current measurements on meters, scopes; clip-on probe	60 cps to 4 mc, (-3 db at 25 cps and $>$ 20 mc)	1 ma to 1 amp rms (25 amps with divider)		\$190
457A	AC-to-dc converter	50 cps to 500 kc	0 to 300 v rms, 4 decade ranges	1 megohm 30 pf shunt	\$450
738AR	Voltmeter calibrator	dc pos. or neg. 400 cps sine wave	300 μ v to 300 v	Works into 3 to 10 megohms	\$950
739AR	Frequency response test set	300 kc (5 cps with hp 200SR) to 10 mc	3 v output		\$600
740A	DC standard, differential voltmeter; analog voltmeter, dc amplifier	dc; floating and guarded in all modes of operation	0-1 v, 0-10 v, 0-100 v, 0-1000 v, 6-digit resolution, $\pm 0.01\%$ accuracy input voltage ranges 1 mv to 1000 v full scale; null ranges 1 mv to 1 kv $\pm 0.01\%$ accuracy	$>10^9$ ohms above 10 mv; $>10^8$, 1 mv to 10 mv; $>10^7$, 1 μ v to 1 mv (independent of null condition)	\$2350
DY-2401B	Integrating digital voltmeter; measure voltage in presence of high common mode noise	dc auto-ranging optional	99.999 mv to 999.99 v in 5 ranges; optional 9.9999 mv range	10 megohm, 10 v range and above; 1 megohm, 1 v range; 100,000 ohms, 0.1 v range	\$3950
DY-2410B	Convert ac voltage and resistance to dc voltage	50 cps to 100 kc	ac 99.999 mv to 750 v peak, 5 ranges; resistance 99.999 ohms to 9.9999 meg, 6 ranges	1 megohm 100 pf shunt	\$2250***
3400A	True rms readings of complex ac waveforms; crest factor 100	10 cps to 8 mc	0.001 to 300 v full scale	10 megohms, 25 pf shunt	\$525
3440A	Plug-in flexibility, digital voltage measurement, automatic polarity, dc range, printer output requires a plug-in to operate	dc	0.001v to 1000 v (accuracy $\pm 0.05\%$ of reading ± 1 count)	10.2 megohms to dc	\$1160
3441A	Manual range selector plug-in unit for 3440A	dc	10 v, 100 v, 1000 v	10.2 megohms	\$40
3442A	Auto range selector plug-in unit for 3440A	dc	10 v, 100 v, 1000 v auto-ranging	10.2 megohms	\$135
3443A	High gain, auto range selector plug-in unit for 3440A	dc	100 mv, 1000 mv, 10 v, 100 v, 1000 v, auto-ranging	10.2 megohms	\$450
3444A	Multifunction plug-in unit for 3440A for measuring dc volts, current, resistance	dc	voltage: same as 3443A (except manual operation); current: 100 μ a to 1000 ma; resistance: 1000 ohms to 10 megohms	10.2 megohms	\$575
3445A	AC/DC range unit plug-in for 3440A for measuring ac and dc volts	dc ac: 50 cps-50 kc	10 v, 100 v, 1000 v auto-ranging	10.2 megohms (dc) 10.2 megohms shunted by 20 pf (ac)	\$600 (T)
3528A	Current measurements in large conductors	dc to 300 cps (with 428B)	1 ma to 10 amps (with 428B)		\$450
3529A	Magnetic field measurements	dc to 80 cps (with 428B)	1 mgauss to 10 gauss (428B)		\$75
3550A	Portable test set for transmission line, system measurements	Oscillator: 5 cps to 560 kc Voltmeter: 5 cps to 2 mc	Voltmeter: 0.001 to 300 v rms full scale, -72 dbm to $+52$ dbm	Voltmeter, 2 megohms; patch panel matches to 900, 600, and 135 ohm lines	\$1150

*Cabinet price, rack mount instruments \$5 additional
(T) Tentative price

**With hp 1103A ac probe

***AC only \$1850, ohms only \$1650

†Cabinet price, rack mount \$20 additional

hp AMPLIFIERS, DISTORTION and WAVEFORM ANALYZERS

Amplifiers offered include the *hp 450A General-Purpose Amplifier*, *hp 460AR*, *460BR Wideband Amplifiers*, *hp 466A AC Amplifier*, *Dymec DY-2460A Solid State DC Amplifier*, made versatile with a wide range of plug-ins, and the *860-4000 Series* of amplifiers from Sanborn (see pages 19-21).

The *hp 461A, 462A Amplifiers* are compact solid state devices offering 20 and 40 db gain. The 461A delivers 0.5 v rms into a 50-ohm load over the frequency range of 1 kc to 150 mc. The 462A delivers 1 v p-p into a 50-ohm load with

a rise time <4 nsec, making an ideal amplifier for pulse work.

The *hp 467A Solid State Power Amplifier* increases the output capabilities of oscillators and other low power devices, providing an excellent driving source for power applications. A maximum voltage of 40 volts p-p is available from dc to 1 mc. The 467A also operates as a dc power supply ± 20 volts at currents up to $\pm 1/2$ amp.

Distortion and waveform analyzers from Hewlett-Packard are especially simple to operate, as indicated by the direct-reading *hp 302A* and *hp 310A*

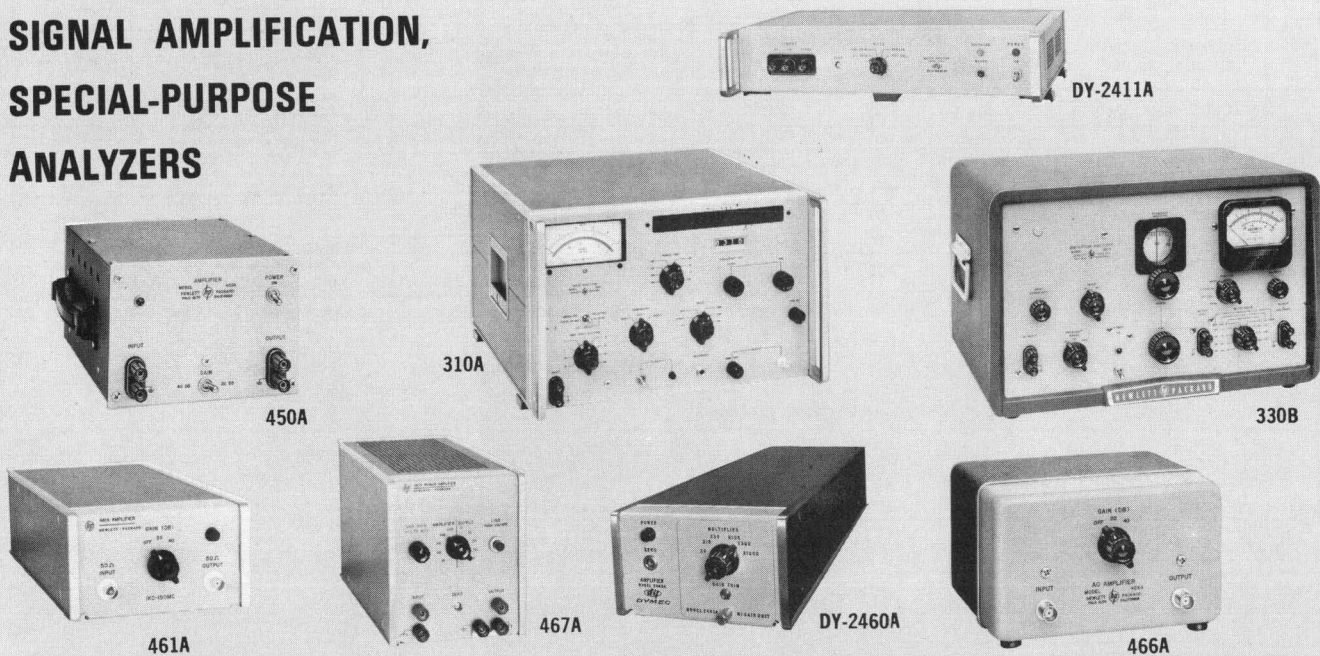
Wave Analyzers, solid-state instruments which require no calibration. The 302A will operate from ac line or from batteries, is hum free. The *hp 297A Sweep Drive* is a useful accessory for the 302A and 310A, converting the waveform analyzer to a sweep oscillator-tuned voltmeter for automatic frequency response measurements. The 302A operates to 50 kc, the 310A to 1.5 mc. The *hp 330 Series Distortion Analyzers* are four instruments in one, measuring total audio distortion, voltage and amplifier gain, noise and hum level and, with an AM detector, envelope distortion of AM rf carriers.

AMPLIFIERS Instrument	Primary Uses	Frequency Range	Characteristics	Price
450A	General purpose lab amplifier	10 cps to 1 mc	20 and 40 db gain, frequency response ± 0.5 db	\$160**
460AR	Wideband, pulse amplification	20 kc to 120 mc	20 db gain, rise time 0.003 μ sec	\$225
460BR	Pulse amplification, high output	20 kc to 120 mc	15 db gain, 110 peak volts	\$275
461A	General purpose lab amplifier	1 kc to 150 mc	20 and 40 db gain, frequency response ± 1 db $1/2$ volt rms into 50 ohms	\$325
462A	Pulse amplification	Gaussian response, 3 db point 100 mc	20 and 40 db gain 1 v p-p into 50 ohms; leading and trailing edges, rise time <4 nsec	\$325
466A	General purpose ac lab amplifier	10 cps to 1 mc	20, 40 db gain, frequency response ± 0.5 db. Ideal for driving memory cores and similar devices; excellent long term stability; provides a stable dc amplifier and power source; also a power supply which delivers up to ± 20 volts dc with a current capability of ± 500 ma	\$165
467A	Power amplifier and dc power supply	dc to 1 mc	Guarded, programmable, +1 and +10 gain, 10,000 meg input resistance	\$650(T)
DY-2411A	Permits 10 mv full scale measurements with DY-2401B Digital Voltmeter	dc	All solid state, photoconductive chopper; four versatile plug-ins for system and bench applications; drift <1 μ v/week, noise <4 μ v	\$1150
DY-2460A	High reliability for low-level signal amplification	dc		\$445*

ANALYZERS Instrument	Primary Uses	Frequency Range	Voltage and Current Range	Input Impedance	Price
297A	Sweep drive for 302A, 310A Wave Analyzers		Provides x-axis output		\$350‡
302A	Waveform analysis; direct reading, no calibration required	20 cps to 50 kc	30 μ v to 300 v full scale	Determined by input attenuator	\$1800†
310A	High frequency waveform analysis; direct reading, continuous tuning	1 kc to 1.5 mc	10 μ v to 100 v full scale	Determined by input attenuator	\$2200
330B	Measure total audio distortion; includes input amplifier, vtm	20 cps to 20 kc	0.03 v to 300 v full scale, 10 cps to 100 kc	Distortion meter, 200 K; voltmeter, 1 megohm	\$500†
330C	For AM, FM broadcast measurements; special VU meter to meet FCC rules	20 cps to 20 kc	0.03 v to 300 v full scale, 10 cps to 60 kc	Distortion meter, 200 K; voltmeter, 1 megohm	\$525†
330D	For AM, FM broadcast measurements; AM detector and VU meter to meet FCC requirements	20 cps to 20 kc 500 kc to 60 mc	0.03 v to 300 v full scale, 10 cps to 60 kc	Distortion meter, 200 K; voltmeter, 1 megohm	\$575†

* Plug-ins from \$35 to \$125. † Cabinet price, rack mount instruments \$15 less. ‡ \$375 for 230 volt operation. (T) Tentative price.
** Cabinet price, rack mount \$5 additional.

SIGNAL AMPLIFICATION, SPECIAL-PURPOSE ANALYZERS



hp RECORDERS, FREQUENCY-TIME INSTRUMENTS

This precision instrumentation from Hewlett-Packard includes the 5100A/5110A Frequency Synthesizer, plus a broad range of highly accurate frequency and time standards, recorders, clocks and related instruments especially useful in frequency measurement and recording to 40 gc.

Frequency Synthesizer—The 5100A/5110A Frequency Synthesizer provides frequencies from dc to 50 mc in steps as small as 0.01 cps. Output is low in noise and spurious modulation and is selected by pushbuttons or may be remotely programmed to any frequency in less than 1 msec. Accuracy and long term stability are the same as the frequency standard used as the prime driver (± 3 parts in 10^9 per day with the internal standard).

Frequency-Time Standards—The new hp 5060A Cesium Beam Frequency Standard is an atomic frequency standard with accuracy of $2/10^{11}$ designed for primary standard applications. It features solid-state control circuitry, and compact design— $8\frac{3}{4}$ " panel height, 65 lbs. For precision frequency standard applications the hp 107AR, BR Quartz Oscillators offer outputs of 5 mc, 1 mc and 100 kc with outstanding stability and spectral purity. The 5 mc output is particularly suitable for multiplication into the microwave region. The 100E Frequency Standard is ideal for test, production and lab use; the 101A 1 MC Oscillator is designed specifically as a time base for the 5275A Counter. Use of the hp 114BR Time Comparator and the 115BR Frequency Divider and Clock in conjunction with hp quartz oscillators permits maximum accuracy through comparison of signals with broadcast standard time and frequency signals. Model 117A VLF Comparator makes accurate phase comparisons between local frequency standards and the 60 kc signal from WWVB (NBS, Boulder, Colo.) and provides a strip chart record. Also available for systems use: hp 724BR, 725AR Standby Power Supplies, which continue operation of the system in case of line power failure.

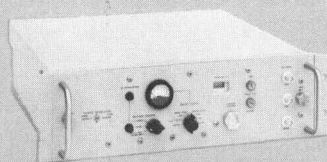
Related Equipment—The hp 540B Transfer Oscillator and related equipment make possible measurement to 40 gc with standard hp counters. Other hp instrumentation especially useful in frequency measurement and recording includes 560A, 561B, 562A Digital Recorders; 565A Digital Printer; 570A, 571B Digital Clocks; 580A and 581A Digital-to-Analog Converters.

Instrument	Description, Characteristics	Price
100E	Frequency standard, $5/10^9$ stability; outputs include six standard sine and four pulse signals; timing comb provides output pips at 100, 1000, 10,000 μ sec intervals; ideal for test, production, lab use	\$1000*
101A	Designed as time base for 5275A Time Interval Counter (see pages 10, 11), also useful for other applications; 1 mc oscillator, stability 5 parts/ 10^8 per week, output at least 1 v into 50-ohm load	\$500
107AR	Precision quartz oscillator for primary frequency and time standard system; extremely rugged; stability 5×10^{10} /day; outputs, 5 mc, 1 mc; 100 kc sinusoidal, 100 kc clock drive	\$2400
107BR	Similar to 107AR except includes 2-hour standby power supply	\$2750
114BR	Time comparator, accepts standard input from hp precision oscillators, facilitates comparison with standard time signal broadcast transmissions; uses oscilloscope as indicator	\$1200**
115BR	Frequency divider and clock, permits adjustment of frequency or time standards for maximum absolute accuracy by making precise comparisons with broadcast standard time and frequency signals	\$2750**
115CR	Similar to 115BR except designed for laboratory environment	\$1500
117A	Compares phase of received 60 kc vlf signal (WWVB) to local 100 kc standard; provides strip chart recording of phase difference; comparison accuracy to 1×10^{10} in 8 hours	\$1150
5060A	Compact, self-contained primary frequency standard of the atomic beam type, utilizing cesium 133. The cesium beam tube resonator stabilizes the output of a high quality quartz oscillator in a closed loop, continuously monitoring circuit. Accuracy is $\pm 2 \times 10^{-11}$, outputs 5 mc, 1 mc, 100 kc sinusoidal; 100 kc clock drive.	\$15,500
5100A/5110A	Provide digitally selected frequencies from 0.01 cps to 50 mc in 0.01 cps steps which retain stability of 1-mc driving signal ($\pm 3 \times 10^{-9}$ /day internal standard); remotely programmable in less than 1 ms; voltage-tuned search oscillator varies output as much as 1 mc with manual or remote control	\$15,250
500B,C	Frequency meter, tachometer indicator, directly measures frequency of ac voltage 3 cps to 100 kc; 500C provides scale calibration in rpm for greater convenience in tachometry work	\$300***
506A	Tachometer Head, light source and photocell for use as a transducer with hp electronic counters, 500B,C; measures up to 300,000 rpm	\$150
508A,B,C,D	Tachometer generators, rotational speed transducers for use with counters or frequency meters for accurate rpm measurements, 15 to 40,000 rpm	\$125 each
540B	Transfer oscillator, used with hp counters, permits measurements into microwave region, measures to 18 gc with fixed tuned mixers, to 40 gc with external mixers and microwave amplifiers	\$900†
560A	Digital recorder, useful for recording from hp electronic counters and digital voltmeters, speed of five 11-digit lines/sec, the 11-digit line (12-digit on special order) allowing secondary or coding data to be entered	\$1400‡
561B	Digital recorder, similar to hp 560A offers 10-line coded decimal entry input, one connection for each position of each print wheel	\$1150‡
562A	Digital recorder, solid state device with parallel data entry and low-inertia moving parts allowing printing rates as high as 5 lines/sec, each line up to 11 digits (12 digits available on special order); data storage feature permits driving source to transfer data in 2 msec; available for BCD and 10-line codes	1600‡ Depends on Options
565A	Digital printer, fast 11-column printer for use in custom systems; similar to printing mechanism in 560, 561, 562	\$750‡
570A	Digital clock, mount in left side of 560A Digital Recorder, provide time-of-day information and control rates at which measurements are made; hours, minutes, seconds (24 hour basis), in-line display	\$1050‡
571B	Digital clock, similar to 570A, for 561B	\$1000‡
580A, 581A	Digital-to-analog converters, accept 4-line BCD output from counters, digital voltmeters, etc., provide output for galvanometer and potentiometer strip-chart recorders; differ only in physical dimensions	\$525
724BR	Standby power supply to permit continued operation of hp frequency divider and clock, quartz oscillators in systems applications in event of power failure; vented nickel-cadmium battery, 28 ampere hour	\$950
725AR	Same as 724BR, incorporates sealed nickel-cadmium battery, 2 ampere hour	\$645
P932A	Harmonic mixer, used with 540B Transfer Oscillator to increase measurement to 18 gc	\$250

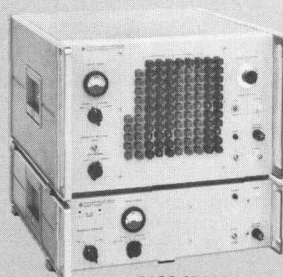
*Rack mount \$25 less. **Rack mount model. ***Rack mount add \$5. †Rack mount \$15 less. ‡Slight additional charge for 230-volt, 50-cycle operation.

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

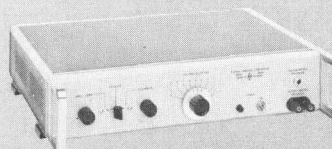
FREQUENCY SYNTHESIZER, ACCURATE TIME STANDARDS, RECORDING DEVICES



107BR



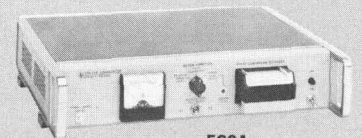
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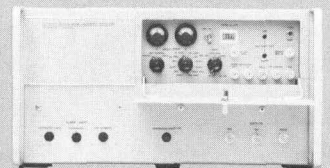
117A



115BR



580A



5060A

hp SOLID STATE, VACUUM TUBE COUNTERS, ACCESSORIES

Hewlett-Packard electronic counters and related instruments are available for applications ranging from precision high speed measurements to economical production testing. They permit measurement of frequency, period, multiple period average, ratio, multiple ratio and time interval.

The advanced line of hp solid state counters incorporates as standard such features as display storage (continuous display of the most recent measurements until the count actually shifts), higher sampling rates (the time between counts is independent of gate time), -20 to $+65^{\circ}\text{C}$ operating range and BCD output for recorders and systems. Modular design introduces solid state counters that are bench and rack mount models in one instrument, with front panels only $3\frac{1}{2}$ " or $5\frac{1}{4}$ " high.

The hp 5245L Solid State Counter makes more measurements with greater accuracy than any other counter available today. It makes the measurements listed above and, additionally, scales by decade factor to 10^6 . Time base stability is better than 3 parts in 10^6 /day, and the counter offers 8-digit resolution in rectangular, close-spaced digital indicator tubes, plus remote programmability of time base and function controls. The 5245L measures to 50 mc directly, 500 mc and 3000 mc with plug-in converters. Other plug-ins include time interval, video amplifier, preset counting and dvm units.

The hp 5233L Counter is a universal 2 mc instrument which provides 6-digit resolution in an in-line display of rectangular

digital tubes, plus superior trigger, level controls. hp 5223L is identical except that its maximum counting rate is 300 kc.

The hp 5232A and 5532A Counters are identical 1.2 mc instruments, except for readout. Both offer 6-digit resolution, 5232A in improved neon columns and 5532A in long-life digital indicator tubes.

The hp 5212A and 5512A Counters have a maximum counting rate of 300 kc, offer 5-digit resolution, differ only in display, with 5212A offering neon columnar readout and the 5512A offering digital in-line tube readout.

The hp 5211A and B Counters use the power line frequency as a time base and measure frequency directly to a maximum counting rate of 300 kc. They also measure ratio, offering 4-digit resolution with neon columnar display. The 5211A offers gate times of 0.1 sec, 1 sec and manual. The 5211B has an additional 10 sec gate time.

The hp 5244L offers a maximum counting rate of 50 mc, and 7-digit resolution with rectangular, closely spaced digital indicator tubes. It is similar to the 5245L except for time base stability and plug-in versatility.

The hp 5275A Counter measures time intervals from 10 nsec to 0.1 sec by counting a 100 mc sine wave. This 100 mc sine wave is generated by a multiplying circuit that is driven from an external 1 mc time base such as the hp 101A. The 7-digit display is in neon columns.

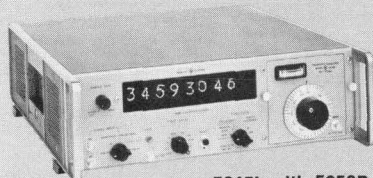
Other related solid state instruments available from Hewlett-Packard include the 5214L Preset Counter, which

makes standard counter measurements of frequency, ratio, time and totalizing, and also measures normalized rate; normalized ratio; time for N events to occur; counts N events, giving an output pulse at the start and end of the count. N may be set to any integer from 1 to 100,000. The hp 2590A Microwave Frequency Converter extends the range of hp Models 5243L and 5245L from 0.5 to 15 gc while retaining the accuracy of the counter. The 2590A also permits measurements of FM, pulsed and drifting signals.

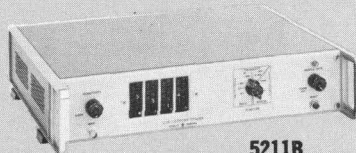
Vacuum Tube Electronic Counters from Hewlett-Packard include four basic instruments or series; the hp 524C,D Counters offer time base stability of 5 parts in 10^6 /week, plus plug-in versatility. They differ only in readout, the 524C with in-line display, the 524D with neon columnar display. Direct measurement covers 10 cps to 10.1 mc for frequency, 0 to 100 kc for period. The hp 523C,D Counters are all-purpose instruments which measure frequency 10 cps to 1.2 mc, time interval from 1 μsec to 27.8 hours, period 0.00001 cps to 100 kc. Model designations, as with the 524C,D, indicate the type of display. The hp 522B Counter is a low cost precision instrument covering 10 cps to 120 kc (220 kc optional). It measures frequency, period and time interval. The hp 521 Series Industrial Counters measure frequency, random events per unit of time and, with transducers, rps, speed, weight, pressure, etc., at rates to 120 kc (220 kc optional).

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

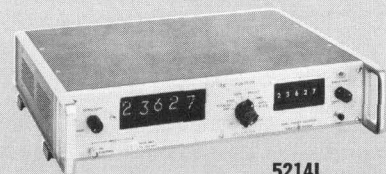
FULL RANGE OF INSTRUMENTS: HIGH-SPEED PRECISION MEASUREMENT TO ECONOMICAL PRODUCTION TESTING



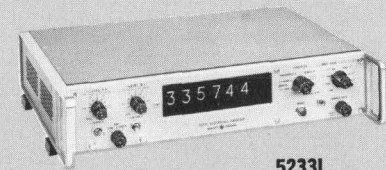
5245L with 5253B



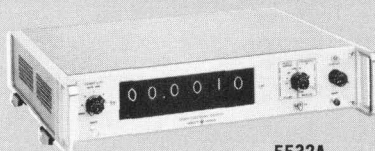
5211B



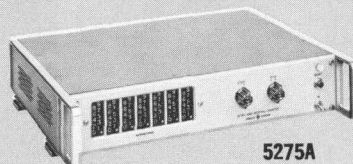
5214L



5233L



5532A



5275A



2590A

VACUUM TUBE INSTRUMENTS
Counter, Plug-in

Primary Uses

Frequency Range

Characteristics

Price

521A Counter†	Measure frequency, speed	1 cps to 120 kc, 220 kc optional, add \$35	Direct reading, accurate within ± 1 count $\pm 0.1\%$; 4-place neon readout	\$475***
521C Counter	Measure frequency, speed	1 cps to 120 kc, 220 kc optional, add \$35	Direct reading, accurate within ± 1 count $\pm 0.01\%$; 5-place neon readout	\$650***
521D Counter†	Measure frequency, speed	1 cps to 120 kc, 220 kc optional, add \$35	Same as 521A except has in-line readout	\$750***
521E Counter	Measure frequency, speed	1 cps to 120 kc, 220 kc optional, add \$35	Same as 521C except has in-line numeric readout	\$950***
521G Counter†	Measure frequency, speed, elapsed time	1 cps to 1.2 mc	Direct reading, accuracy ± 1 count $\pm 0.1\%$; 5-place neon readout	\$700***
522B Counter	Frequency, period, time interval measurements	10 cps to 120 kc, 220 kc optional, add \$35	Direct reading, stability 10 parts/10 ⁶ /week 5-place neon readout	\$915*
523C Counter	Frequency, period, time interval measurements	10 cps to 1.2 mc	Direct reading, stability 2 parts/10 ⁶ /week, 6-place in-line readout	\$1575**
523D Counter	Frequency, period, time interval measurements	10 cps to 1.2 mc	Direct reading, stability 2 parts/10 ⁶ /week 6-place neon readout	\$1350**
524C Counter	Frequency, period measurements	10 cps to 10.1 mc (freq.) 0 cps to 100 kc (period)	Direct reading, no interpolation; stability 5/10 ⁶ /week; 8-place in-line readout; accepts plug-in units	\$2400**
524D Counter	Frequency, period measurements	10 cps to 10.1 mc (freq.) 0 cps to 100 kc (period)	Direct reading, no interpolation; stability 5/10 ⁶ /week; 8-place neon readout; accepts plug-in units	\$2150**
525A Plug-in	Frequency converter, extends 524B,C,D range to 100 mc, increases basic sensitivity	10 cps to 100 mc	Accuracy same as basic 524 Counters; 0.1 v rms min. input	\$300
525B Plug-in	Frequency converter, extends 524B,C,D range to 220 mc	100 mc to 220 mc	Accuracy same as basic 524 Counters; 0.2 v rms min. input	\$300
525C Plug-in	Frequency converter, extends 524B,C,D range to 510 mc; amplifier for 50 kc to 10.1 mc	100 mc to 510 mc	Accuracy same as basic 524 Counters; min. input 20 mv rms 50 kc to 10.1 mc, 100 mv rms, 100 to 510 mc	\$475
526A Plug-in	Video amplifier, increases 524B,C,D sensitivity to 10 mv	10 cps to 10.1 mc	Accuracy same as basic 524 Counters; 10 mv rms min. input	\$200
526B Plug-in	Time interval unit for 524B,C,D, measures interval 1 μ sec to 100 days	1 μ sec to 10 ⁷ sec	Resolution to 0.1 μ sec	\$200
526C Plug-in	Period multiplier for multiple period measurement	Extends range of 524 Counters to measure 10,000 periods	Greater accuracy in period measurement	\$225
526D Plug-in	Phase unit for phase angle measurement with 524B,C,D	1 cps to 20 kc	Reads in time units, resolution to 0.1 μ sec Direct reading in degrees at 400 cps	\$750

*Rack mount instruments \$15 less. **Rack mount \$25 less. ***Rack mount \$5 more. †Power line time base; with optional crystal time base (0.01% accuracy) add \$100.

SOLID STATE INSTRUMENTS
Counter, Plug-in

Primary Uses

Frequency Range

Characteristics

Price

5211A Counter	Measure frequency, ratio, speed with proper transducers	300 kc maximum counting rate	4-digit resolution in neon columnar display; gate times 0.1 sec, 1 sec; power line time base (typically 0.1%)	\$750
5211B Counter	Measure frequency, ratio, speed with proper transducers	300 kc maximum counting rate	Same as 5211A, except offers additional gate time of 10 sec	\$825
5212A Counter	Measure frequency, period, multiple period average, ratio, multiple ratio	300 kc maximum counting rate	5-digit resolution in neon columnar display; stability 2/10 ⁶ /week	\$975
5214L Preset Counter	Measures rate, time, totalizes; measures normalized rate, normalized time, counts N events	300 kc maximum counting rate	Number N can be set 1 to 100,000, remotely programmed; preset at N and ratio functions by front-panel controls	\$1475
5223L Counter	Measure frequency, period, multiple period average, time interval, ratio, multiple ratio	300 kc	5-digit resolution in in-line display	\$1450
5232A Counter	Measure frequency, period, multiple period average, ratio, multiple ratio	1.2 mc maximum counting rate	6-digit resolution in neon columnar display; stability 2/10 ⁷ /week	\$1300
5233L Counter	Measure frequency, period, multiple period average, time interval, ratio, multiple ratio	2 mc maximum counting rate	6-digit resolution in in-line display	\$1850
5244L Counter	Measure frequency, period, multiple period average, ratio, multiples of ratio	dc to 50 mc	7-digit resolution with in-line display; stability 2 parts/10 ⁷ /month	\$2225
5245L Counter	Measure frequency, period, multiple period average, ratio, multiples of ratio, scaling to 10 ⁹	dc to 512 mc, time interval and 1 mv sensitivity with proper plug-ins, basic counting rate to 50 mc	8-digit resolution with in-line display; stability better than 3 parts/10 ⁹ /day; plug-in versatility	\$2950
5251A Plug-in	Frequency converter for 5243L, 5245L Counters	20 mc to 100 mc	Extends basic counting rate of counters, accuracy same as counter	\$300
5253B Plug-in	Frequency converter for 5243L, 5245L Counters	88 to 512 mc	Extends basic counting rate of counters, accuracy same as counter	\$500
5254A Plug-in	Frequency converter for 5245L Counter	300 to 3000 mc	Extends basic counting rate of counter into microwave range	\$825
5261A Plug-in	Video amplifier for 5243L, 5245L Counters	10 cps to 20 mc with 5243L, 10 cps to 50 mc with 5245L	Increases counter sensitivity to 1 mv rms, retains accuracy of counter; 1 megohm, 15 pf shunt input impedance	\$325
5262A Plug-in	Measure pulse length, spacing, time interval with 5243L, 5245L Counters	Time interval 1 μ sec to 10 ⁶ sec	Time interval unit providing counter with 0.1 μ sec resolution, retains accuracy of counter	\$300
5264A Plug-in	Preset unit for 5243L, 5245L Counters	Same as counter	Preset N from 1 to 100,000 normalize rate, ratio, count and time N events, divide input by N	\$650
5265A Plug-in	Digital voltmeter unit for 5243L, 5245L Counters	to 1000 v dc	Accuracy of $\pm 1\%$; 6-digit resolution	\$575
5275A Counter	Measure time interval with digital readout	10 nsec to 0.1 sec interval, counted frequency 100 mc from external 1 mc standard	10 nsec resolution, accuracy ± 10 nsec \pm time base (external) accuracy; hp 101A recommended	\$2750
5512A Counter	Measure frequency, period, multiple period average, ratio, multiple ratio	300 kc maximum counting rate	5-digit resolution with in-line display; stability 2/10 ⁶ /week	\$1175
5532A Counter	Measure frequency, period, multiple period average, ratio, multiple ratio	1.2 maximum counting rate	6-digit resolution with in-line display; stability 2/10 ⁷ /week	\$1550
2590A Converter	Measure microwave frequency with counter accuracy	0.5 to 15 gc (with 5243L, 5245L, 524C, or 524D counters)	Also measure drift, jitter, AM, FM and pulsed signals	\$1900

H-LAB, hp POWER SUPPLIES

Harrison Laboratories, Division of Hewlett-Packard Company, offers over fifty types of highly regulated dc power supplies. The seven major series of H-Lab power supplies are presented on this page, along with illustrations of typical models from each series. These seven series are the most advanced supplies offered by Harrison Laboratories, and new models are being added constantly. On the remaining three pages, other power supplies which comprise the full line are included. Brief specifications of all available instruments appear in chart form. More details and information can be obtained from your local hp sales office or from Harrison Laboratories, 100 Locust Ave., Berkeley Heights, New Jersey. The sales office will also have information on new power supplies introduced after this catalog was prepared.

LAB Series—Laboratory Bench Supplies. The nine instruments comprising this LAB Series are a new step forward in bench supplies. Unique construction and circuit features make these the most versatile highly-regulated dc power supplies available today. Some of these 3½" half-rack units are constant voltage/constant current units, some are constant voltage/current limiting units, and some are dual range supplies. They are available in dc output voltage ratings up to 160 volts, output current to 3 amps and output wattage to 32 watts. *LAB Series Models—6200A, 6201A, 6202A, 6203A, 6204A, 6204AM, 6206A, 6206AM, 6207A.*

LVR Series—Low Voltage Rack Supplies. The H-Lab LVR Series power supplies are versatile high performance instruments designed to meet both laboratory and systems applications. Each output rating is available in either a model having front panel controls, meters, and constant voltage/constant cur-

rent operation, or in a companion model with a single rear panel control, no meters, and constant voltage/current limiting operation. Output voltages up to 60 volts, currents to 20 amps and wattage ratings to 360 watts are available. *LVR Series Models—6263A, 6363A; 6264A, 6364A; 6265A, 6365A; 6266A, 6366A; 6267A, 6367A; 6271A, 6371A.*

MVR Series—Medium Voltage Rack Supplies. The MVR Series of three all-semiconductor medium voltage power supplies features a unique "piggy-back" circuit; low voltage series power transistors which are required to dissipate only a fraction of their power rating provide high regulation—yet the supplies can withstand a direct short circuit across the output terminals! *Model 890A* provides an output of 0-320 volts at 600 milliamps. *Model 895A* provides an output of 0-320 volts at 1.5 amperes. *Model 896A* has an output voltage rating of 75 to 160 volts at 2.5 amps.

MOD Series—Modular Supplies. The MOD Series of plug-in power supplies has been designed to meet the need for well-regulated chassis-mounting dc supplies of low and medium power ratings which can be efficiently grouped on a chassis or rack panel. The six models presently included in the MOD Series can be used as fixed or variable voltage supplies, and all input, output, and control connections are accomplished via the 11-pin plug located on one end of the supply. Output voltages up to 36 volts, currents to 2.5 amps, and wattage ratings to 54 watts are currently available. *MOD Series Models—6343A, 6344A, 6345A, 6346A, 6347A, 6348A.*

SCR-1 Series—Silicon-Controlled Rectifier Rack Supplies—Single-Phase Input. The SCR-1 Series consists of four compact, high current, regulated power supplies in-

tended for applications which require a fixed or continuously variable dc source with a moderate degree of regulation combined with high efficiency and reliability. In this series, silicon-controlled rectifiers perform simultaneously the rectifier and series regulating functions with resulting regulation of less than 0.5%. All units are short-circuit proof and feature constant voltage/current limiting operation. Output voltage ratings to 72 volts and current ratings to 45 amps are included in this series. *SCR-1 Series Models—505A, 510A, 520A, 6428A.*

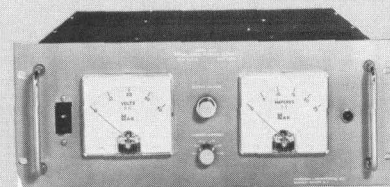
SCR-3 Series—Silicon-Controlled Rectifier Rack Supplies—3-Phase Input. The SCR-3 Series has four models with output voltage ratings to 64 volts and current ratings to 200 amps. Similar to the SCR-1 Series, this series also utilizes silicon-controlled rectifiers to perform the rectifying and series regulating functions. Resulting constant voltage regulation is less than 0.5%, and constant current regulation is less than 1%. All supplies are short circuit proof and feature automatic crossover between constant voltage and constant current operation. *SCR-3 Series Models—6453A, 6455A, 6456A, 6459A.*

HVR Series—High Voltage Rack Supplies. The HVR Series consists of three high voltage supplies utilizing all-semiconductor circuitry—not tubes. All three supplies are tightly regulated and provide 200 watts output, which is sufficient for many devices not capable of being powered with conventional low current, high voltage supplies. These supplies feature constant voltage/constant current operation with automatic crossover. They can withstand a direct short across the output of the power supply, and either side of the power supply can be floating up to 2 kilovolts above ground. *HVR Series Models—6521A, 6522A, 6525A.*

SEVEN MAJOR SERIES, OVER 50 TYPES OF SUPPLIES



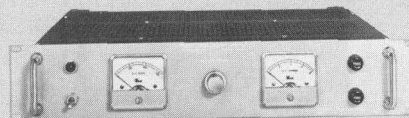
MOD Series



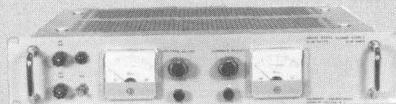
SCR-1 Series



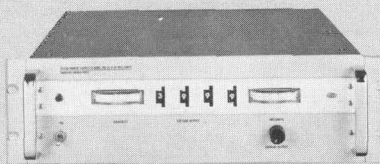
LAB Series



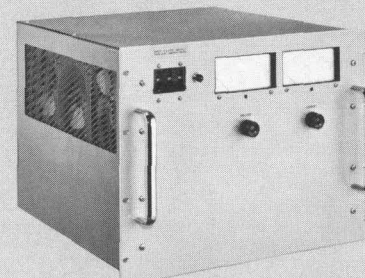
MVR Series



LVR Series



HVR Series



SCR-3 Series

SERIES	Model	Output Volts	Output Amps	Load Regulation* (mv)	Line Regulation* (mv)	Ripple (mv)	Remote Programming	Remote Sensing	Characteristics	Price
SCR-1	505A	0 to 72	0 to 5	0.5% combined		720	✓	✓	High efficiency, solid state rack mount supply with Auto-Series and Auto-Parallel capability, variable current limit	\$475¶
	510A	0 to 36	0 to 10	0.5% combined		360	✓	✓	Same as 505A except for output	\$450¶
	520A	0 to 36	0 to 25	0.5% combined		360	✓	✓	Same as 505A except for output	\$575¶
	711A 711AR	0 to 500	0 to 0.1	1000 or 0.5%	1000 or 0.5%	1			Two ranges on voltmeter and ammeter, 12.6 v ac ct auxiliary 3 a output; overload protection; vacuum tube cabinet model, 711A rack mount, 711AR	\$275 \$280
	712B 712BR	0 to +500 -300** 0 to -150	0 to 0.2 0 to 0.05 0 to 0.005	50 50 —	±100 ±100 ±100	0.5 — 0.5			Voltmeter can be switched to monitor any of three dc output voltages; 6.3 v ac ct auxiliary 10 a output; overload protection; 712B cabinet, 712BR rack mount, both vacuum tube models	\$490# \$475#
	715A	-250 to -400 0 to -900	0.03 to 0.05 0 to 10 (µa)	1% 1%	1% 1%	7 10			6.3 v ac 1.5 a output additional; direct reading calibrated voltage controls, choice of modulation signal, overload protection, vacuum tube bench model	\$365
	716B	-250 to -800 0 to -800 6.3 (adj.)	0 to 0.1 0 to 2	0.05% —	0.1% 0.05% 1%	1 0.5 2			Direct reading calibrated voltage controls, choice of internal and external modulation for unique versatility, sync input for internal modulation, diode protection circuit, vacuum tube bench or rack mount; relays disconnect the beam supply to prevent Klystron failure should the filament voltage drop below 1 volt or rise above 9 volts	\$875
	721A	0 to 30	0 to 0.15	30 or 0.3%	±15 or 0.3%	0.15			Six-position meter and four-position current limit switch, convection cooling, bench model	\$145
	723A	0 to 40	0 to 0.5	20	10	0.15	✓		Variable current limit; Auto-Series, Auto-Parallel operation, bench or rack mount in one instrument	\$240
	726AR	0 to 60	0 to 2	5	2.5	0.25	✓	✓	Variable current limit, rack mount, front and rear output terminals	\$595
	800A-2	0 to 36 DUAL	0 to 1.5	5	5	0.2			Two sides can be connected in series for 0 to 72 v at 0 to 1.5 a, bench supply with rack mounting panels available; dual outputs identical	\$580¶
	800B-2	0 to 36	0 to 2.5	10	5	0.25			Lab supply; rack mount panels available	\$339¶
	801C	0 to 25	0 to 0.2	2	2	0.1		✓	Strain gage supply; extremely compact, multiple shielding, rack mount	\$149¶
	802B	0 to 36 DUAL	0 to 1.5	3.6 or 0.01%	3.6 or 0.01%	0.2		✓	Twin supplies independent; two sides can be seriesed for 0 to 72 v at 0 to 1.5 a; output terminals front and rear; rack mount	\$580‡
	808A	0 to 36	0 to 5	3.6 or 0.01%	3.6 or 0.01%	0.5	✓	✓	Constant voltage/current limiting or constant current selectable by plug-in card; also Auto-Series, Auto-Parallel operation	\$475¶†
	809A	0 to 36	0 to 10	7.2 or 0.02%	7.2 or 0.02%	0.5	✓	✓		\$575¶†
	810B	0 to 60	0 to 7.5	10 or 0.02%	5 or 0.01%	1	✓	✓	Constant voltage/constant current supply, Auto-Series, Auto-Parallel operation	\$695¶†
	814A	0 to 36	0 to 25	10 or 0.03%	10 or 0.03%	1	✓	✓		\$775¶†

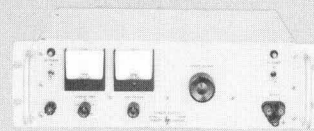
*Whichever is greater. **Output not continuously variable over entire range. †Optional chopped stabilization \$125 extra, add suffix X to model number, installed at factory on new instruments only.
 ‡115-volt, 60-cycle operation #Requires external step-down transformer for 230-volt operation.



711A



723A



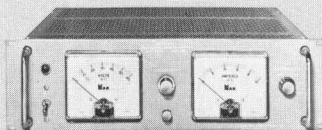
726AR



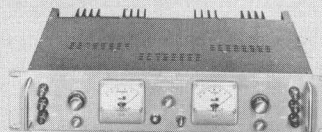
800A-2



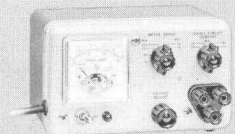
808A



810B



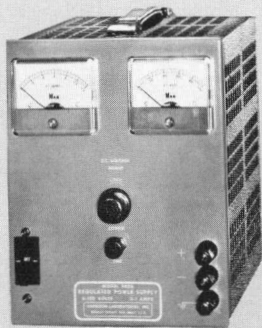
802B



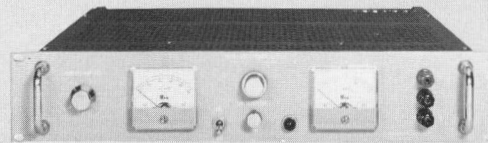
721A

H-LAB, hp POWER SUPPLIES

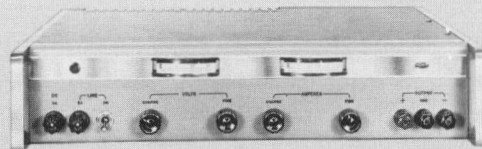
SERIES	Model	Output Volts	Output Amps	Load Regulation* (mv)	Line Regulation* (mv)	Ripple (mv)	Remote Programming	Remote Sensing	Characteristics	Price
SERIES	855B	0 to 18	0 to 1.5	5 or 0.05%	5 or 0.05%	0.2	✓	✓	Rack or bench mount Auto-Series, Auto-Parallel supply with adjustable voltage and current limit, front and rear output terminals	\$169
	865B	0 to 40	0 to 0.5	5 or 0.05%	5 or 0.05%	0.2	✓	✓	Similar to 855B except for output	\$169
	880	0 to 100	0 to 1	5 or 0.02%	5 or 0.05%	1			Bench instrument, rack mount panels available	\$375††
	881A	0 to 100	0 to 1	5 or 0.02%	5 or 0.05%	0.2	✓	✓	Auto-Series, Auto-Parallel operation; constant voltage-current limiting or constant current selectable by plug-in cord	\$475††
MVR	890A	0 to 320	0 to 0.6	20 or 0.007%	20 or 0.007%	2	✓	✓	Voltage continuously adjustable by ten-turn helipot; convection cooling; fully protected against all overloads	\$445††
	895A	0 to 320	0 to 1.5	20 or 0.007%	20 or 0.007%	2	✓	✓		\$625††
	896A	75 to 160	0 to 2.5	30 or 0.02%	30 or 0.02%	1	✓	✓		\$675††
LAB	6200A	0 to 20 or 0 to 40	0 to 1.5 0 to 0.75	0.03% or 3	0.03% or 3	0.2	✓	✓	Constant voltage, constant current, bench mount or 3½" half width rack mount; Auto-Series, Auto-Parallel with adjustable voltage and current limit, front and rear output terminals; pushbutton range selector	\$189‡
	6201A	0 to 20	0 to 1.5	0.03% or 3	0.03% or 3	0.2	✓	✓		\$159‡
	6202A	0 to 40	0 to 0.75	0.03% or 3	0.03% or 3	0.2	✓	✓		\$159‡
	6203A	0 to 7.5	0 to 3	0.03% or 3	0.03% or 3	0.2	✓	✓	Bench mount or 3½" half width rack mount; Auto-Series, Auto-Parallel with adjustable voltage and fixed current limit, front and rear output terminals; pushbutton range selector. Meters, \$20 extra	\$159†‡
	6204A	0 to 18 or 0 to 36	0 to 0.6 0 to 0.3	0.03% or 5	0.03% or 5	0.2	✓	✓		\$149†‡
	6206A	0 to 32 or 0 to 64	0 to 1 0 to 0.5	0.03% or 10	0.03% or 10	0.2	✓	✓		\$99†‡
	6207A	0 to 60	0 to 0.2	0.03% or 20	0.03% or 20	0.5	✓	✓		Same as 6202A except for output
6224A	0 to 18	0 to 3	2 or 0.03%	2 or 0.02%	0.5	✓	✓	Auto-Series, Auto-Parallel, front and rear output, bench and rack mounts	\$340	
6226A	0 to 36	0 to 1.5	2 or 0.02%	2 or 0.02%	0.5	✓	✓	Large-scale meters; mount up to 3 abreast on H-Lab rack panel or use as bench supply	\$325	
6242A	0 to 32 or 0 to 64	0 to 2 0 to 1	3 or 0.02%	5 or 0.03%	1	✓	✓	Constant voltage/constant current; dual range; output selectable by plug-in card; Auto-Series, Auto-Parallel operation	\$435†	
6244A	0 to 36	0 to 3	5 or 0.02%	2 or 0.01%	1	✓	✓	Constant voltage/constant current operation; Auto-Series, Auto-Parallel operation; variable current limit; rack and bench mount	\$460†	



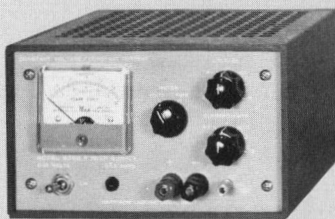
880A



881A



6242A



855B



6226A/6224A

Solid State Regulated DC Power Supplies. *H-Lab Models 855B, 865B, 6224A and 6226A* are four versatile supplies, each of which operates as either a constant voltage or a constant current dc source and automatically transfers from one mode to the other as the load resistance changes.

Low Voltage Supplies. These solid state instruments include two hp models—the 721A and 723A, plus *H-Lab Models 800A-2, 800B-2 and 880*. The compact and inexpensive 721A, which features a range-switchable output meter, is used extensively in semiconductor circuit design. The 723A is especially useful for systems, due to its cabinet design and remote programming features. The 800A-2 is a twin supply providing two identical outputs. The 800B-2 is a 2.5 amp bench supply with a continuously adjustable output, and the 880 is a compact 1 amp supply for bench applications where up to 100 volts may be required.

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

Constant Voltage/Constant Current Rack Mount Supplies. Seven H-Lab supplies provide rack mounted constant voltage/constant current instrumentation. Three use a plug-in card to determine the mode of operation (808A, 809A and 881A). Four provide automatic crossover between constant voltage and constant current operation (810B, 814A, 6242A and 6244A). The 6242A has two operating ranges selectable by a plug-in card.

Low Voltage Rack Supplies. The *H-Lab 802B* is a twin solid state instrument furnishing two independent outputs; it is a rack mounting instrument similar to the 800A-2. The *hp 726AR* features remote programming capability and a 2 amp current capacity.

Supplies for DC Applications over 100 Volts. The versatile *hp 711A* is a regulated supply for basic bench use, output 0-500 volts, 100 ma maximum load. The *hp 712B* furnishes four outputs—including 0-500 v dc, a regulated dc fixed

bias, a dc variable bias and unregulated 6.3 v ac.

Klystron Power Supplies. Two Klystron power supplies include the 716B which offers superior regulation, noise, ripple and hum characteristics, plus the broad capability of powering at least 250 types of Klystrons. The *hp 715A* is an economy model with high performance standards for low power Klystrons.

Special Instrumentation. The *H-Lab 801C* is a compact solid state strain gage power module whose design, construction and size permit extreme isolation from ground and the ac power line. The *H-Lab 6910A* dual crowbar protector provides two independent overvoltage protection circuits for protection of external load circuitry should built-in power supply overvoltage protectors fail. The *H-Lab 6920A* meter calibrator is a convenient instrument for calibrating voltmeters and ammeters, ac or dc, up to 1000 volts and up to 5 amps.

SERIES	Model	Output Volts	Output Amps	Load Regulation* (mv)	Line Regulation* (mv)	Ripple (mv)	Remote Programming	Remote Sensing	Characteristics	Price
LVR	6263A	0 to 18	0 to 10	1 or 0.01%	1 or 0.01%	0.5	✓	✓	Constant voltage and constant current with automatic crossover; coarse and fine controls; meters on front panel; silicon differential amplifiers, Auto-Series, Auto-Parallel operation	\$435†
	6264A	0 to 18	0 to 20	0 or 0.01%	1 or 0.01%	1.0	✓	✓		\$5259†
	6265A	0 to 36	0 to 3	1 or 0.01%	1 or 0.01%	0.5	✓	✓		\$350†
	6266A	0 to 36	0 to 5	1 or 0.01%	1 or 0.01%	0.5	✓	✓		\$435†
	6267A	0 to 36	0 to 10	1 or 0.01%	1 or 0.01%	0.5	✓	✓		\$525†
	6271A	0 to 60	0 to 3	3 or 0.01%	3 or 0.01%	0.5	✓	✓		\$435†
MOD	6343A	0 to 18	0 to 0.3	3 or 0.03%	3 or 0.03%	1	✓	✓	All input and output connectors via 11-pin plug; other pins on plug terminals to permit remote programming of output control, Auto-Series, Auto-Parallel operation, remote sensing; units can be plugged directly into any chassis fitted with 11-pin socket, alternatively, modular dimensions permit efficient grouping of like or mixed rack mount assemblies	\$120‡
	6344A	0 to 18	0 to 1	3 or 0.03%	3 or 0.03%	1	✓	✓		\$165‡
	6345A	0 to 18	0 to 2.5	3 or 0.03%	3 or 0.03%	1	✓	✓		\$225‡
	6346A	0 to 36	0 to 0.15	3 or 0.02%	3 or 0.02%	1	✓	✓		\$120‡
	6347A	0 to 36	0 to 0.5	3 or 0.02%	3 or 0.02%	1	✓	✓		\$165‡
	6348A	0 to 36	0 to 1.5	3 or 0.02%	3 or 0.02%	1	✓	✓		\$225‡
LVR	6363A	0 to 18	0 to 10	1 or 0.01%	1 or 0.01%	0.5	✓	✓	Constant voltage/current limiting; no meters; voltage control mounted on rear of unit; Auto-Series, Auto-Parallel operation	\$359¶
	6364A	0 to 18	0 to 20	1 or 0.01%	1 or 0.01%	1.0	✓	✓		\$450¶
	6365A	0 to 36	0 to 3	1 or 0.01%	1 or 0.01%	0.5	✓	✓		\$279¶
	6366A	0 to 36	0 to 5	1 or 0.01%	1 or 0.01%	0.5	✓	✓		\$359¶
	6367A	0 to 36	0 to 10	1 or 0.01%	1 or 0.01%	0.5	✓	✓		\$450¶
	6371A	0 to 60	0 to 3	3 or 0.01%	3 or 0.01%	0.5	✓	✓		\$359¶
SCR-1	6428A	0 to 18	0 to 45	0.25% combined		90			High efficiency, constant voltage/constant current	\$550¶
SCR-3	6453A	0 to 15	0 to 200	0.25% combined		150	✓	✓	Constant voltage/constant current with automatic crossover; Auto-Series, Auto-Parallel; input 208, 230, 460 volt, 3-phase (6455A, 208-230 only)	\$1395¶
	6455A	0 to 36	0 to 75	0.5% combined		180	✓	✓		\$1450¶
	6456A	0 to 32	0 to 100	0.25% combined		160	✓	✓		\$1250¶
	6459A	0 to 64	0 to 50	0.25% combined		320	✓	✓		\$1250¶
HVR	6521A	0 to 1000	0 to 0.2	20 or 0.005%	20 or 0.005%	1			Constant voltage/constant current with automatic crossover. All solid state circuitry, three decade switching with vernier control, short circuit proof	\$695¶
	6522A	0 to 200	0 to 0.1	20 or 0.005%	20 or 0.005%	1				\$695¶
	6525A	0 to 4000	0 to 0.05	20 or 0.005%	20 or 0.005%	1				\$695¶

*Whichever is greater. †Optional chopped stabilization \$125 extra, adds suffix X to model number, installed at factory on new instruments only. ‡115-volt, 60-cycle operation. ‡Slight additional charge for 230-volt, 50-cycle operation.

hp OSCILLATORS

Oscillators—Hewlett-Packard oscillators are easy to use even by inexperienced personnel because controls are few and no zero-setting is required. Output frequencies are accurate and easily read from large clearly marked dials. In addition, frequency response is flat and frequency and amplitude stability are high so that controls often need not be reset when making tests at various frequencies. Distortion, hum, noise and other spurious output voltages have been kept low so that reliable measurements and tests may be made by operators with a minimum of experience and skill. For instance, most of the oscillators' characteristics are essentially independent of load, and the dial accuracy specification typically includes warm-up drift.

Most hp oscillators fall into two broad categories. One category includes instruments with output monitors and attenuators for tests and measurements where it is desirable to set a known output level quickly and to vary output in accurate increments without any other equipment. The other category includes low cost oscillators for general-purpose production line and laboratory tests where a known output voltage is of secondary importance.

General Purpose Oscillators—Models 200AB, 200CD, 200J, 200S, 200T, 201C and 202C are basically similar instruments differing primarily in frequency range and power output as shown in the table. They have but three controls: a range selector, a frequency dial and an output level control.

Model 204B Portable Oscillator is similar to the oscillators above, but is completely solid state and battery operated (ac operation optional) to be completely portable and free from power-line limitations. Its floating output makes it suitable for driving loads referenced above ground and for avoiding ground loops. Because its frequency and amplitude stability are excellent, Model 204B is also useful for making long-term drift measurements on amplifiers, etc.

Oscillators with Calibrated Output—Model 205AG Audio Signal Generator combines several units into one instrument for measuring characteristics of amplifiers, filters and other devices conveniently. With this one instrument you

may measure gain, attenuation and frequency response of audio devices since it includes an output monitor and attenuator so that you can set the input to a device to a known level. A second independent voltmeter measures the output of the device being tested. In addition, Model 205AG provides 5 watts of audio power into various impedances, making it useful for tests on loudspeakers, other transducers or for providing driving power to audio bridges. Up to 158 volts rms are available from its high-impedance output.

Model 206A Audio Signal Generator is designed for tests on quality audio amplifiers where low distortion and known output level are particularly important. Its 111 db output attenuator makes it simple to set a desired level or to determine the dynamic range and linearity of amplifiers.

Models 208A and 208A (option 01.) are particularly useful for field measurements because they operate from their internal rechargeable batteries. Being independent of power lines, they are also useful for tests where ground loops and hum could cause erroneous measurements. Frequency stability is typically 5 parts in 10^6 . The output monitor and attenuator of the 208A are calibrated in volts; those of the 208A (option 01.) in dbm.

Model 650A Oscillator brings audio frequency speed, accuracy and ease of operation to higher frequency fields. Its wide frequency range, 10 cps to 10 mc, makes it ideal for a wide variety of measurements.

Model 651A Test Oscillator is ideal for wide-range measurements from audio to rf frequencies. Covering the spectrum from 10 cps to 10 mc on six continuously-variable ranges, this solid-state oscillator has exceptional amplitude stability (typically $\pm 0.1\%$). Frequency response is better than $\pm 4\%$ over the entire frequency range. The 651A output monitor is calibrated to read dbm for 50 ohms. Two outputs deliver 200 mw into 50 ohms or 16 mw into 600 ohms. $\pm 1\%$ output attenuator provides 90 db range in 10 db steps with a vernier. The 651A (option 01.) is calibrated to read dbm for 600 ohms.

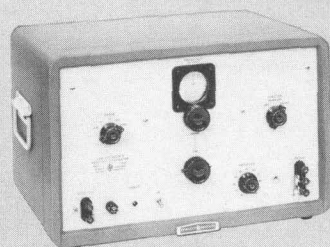
Special-Purpose Oscillators — **Model 202A Function Generator** is designed for low frequency tests in geophysical and medical equipment and for simulating certain mechanical phenomena. Its constant output vs. frequency characteristic (<0.2 db) also makes the hp 202A extremely useful for determining the low frequency response of ac voltmeters. **Model 207A Audio Sweep Oscillator** covers the frequencies of the audio spectrum with one sweep of the dial. Since output is constant within ± 1 db over the entire range, the 207A is particularly suited for rapid determination of the frequency response of audio devices such as amplifiers, transformers, tape recorders and equalization networks. Versions are available with an x-axis output for graphic recorders and with a motor drive for semi-automatic operation.

Model 203A Variable Phase Function Generator provides two transient-free low distortion square and sinusoidal test signals useful for a wide variety of low frequency applications, including servo, geophysical and medical research and testing. The 203A has four output circuits with individual 40 db continuously variable attenuators. Outputs consist of a reference sine and square wave and a variable phase sine and square wave. The two sine and square wave outputs are electrically identical except that one sine and square wave output contains a 0 to 360 degree phase shifter. These four signals (two reference phase and two variable phase) are available simultaneously from the 203A. Frequency range of 0.005 to 60 kc is covered in seven overlapping bands ($\pm 1\%$ accuracy). Two additional ranges are available on special order, offering frequency range to 0.00005 cps.

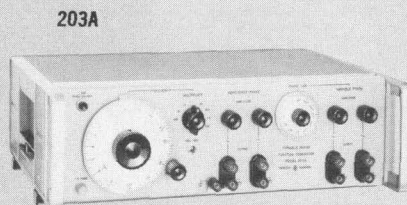
Model 241A Pushbutton Oscillator is ideal for making repetitive measurements at various frequencies. Output frequencies are selected by pushbuttons so that frequencies are selected quickly and may be returned to easily and with confidence after other frequencies have been used. Repeatability is typically within 0.1%. Because its output level is constant within 2%, it is usually unnecessary to reset level when the frequency is changed.

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

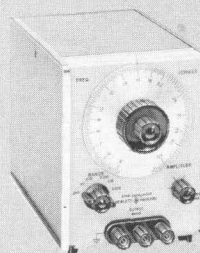
GENERAL PURPOSE, CALIBRATED-OUTPUT, SPECIAL-PURPOSE OSCILLATORS



202A



203A



204B



200CD

OSCILLATORS

Model	Frequency Range	Frequency Response	Dial Accuracy	Description, Features	Output	Price
200AB	20 cps to 40 kc, 4 ranges	± 1 db	±2%	Ideal for amplifier testing, modulating signal generators, testing transmitter modulator response; balanced output	1 watt (24.5 v/600 ohms)	\$165*
200CD	5 cps to 600 kc, 5 ranges	± 1 db	±2%	Subsonic to radio frequencies, useful for testing servo and vibration systems, medical and geophysical equipment, audio amplifiers, video frequency circuits; low distortion independent of load	160 mw (10 v/600 ohms)	\$195*
200J	6 cps to 6 kc, 6 ranges	± 1 db	±1%	Ideal for frequency measurements; <0.5% distortion	160 mw (10 v/600 ohms)	\$350*
200S	5 cps to 600 kc, 5 ranges	± 1 db	±2%	Frequency response testing	3 v/50 ohms	\$225*
200T	250 cps to 100 kc, 5 ranges	± 1 db	±1%	Telemetry, carrier current tests; excellent frequency and amplitude stability	160 mw (10 v/600 ohms)	\$500*
201C	20 cps to 20 kc, 3 ranges	± 1 db	±1%	High power, designed for testing amplifiers, speakers, crossover networks; 40 db attenuator in 10 db steps	3 watts (42.5 v/600 ohms)	\$250*
202A	0.008 to 1200 cps, 5 ranges	±0.2 db	±1%	Source of continually variable, transient-free sine, square, triangular waves for electrically simulating mechanical, physical, medical phenomena; ±1% stability	28 mw (30 v p-p/4000 ohms)	\$550**
202C	1 cps to 100 kc, 5 ranges	± 1 db	±2%	Ideal for subsonic, audio, ultrasonic applications such as vibration, electro-cardiograph, electro-encephalograph; <0.5% distortion and <0.1% hum; recovery time <5 sec at 1 cps output	160 mw (10 v/600 ohms)	\$325*
203A	0.005 cps to 60 kc; two lower ranges of 0.0005 and 0.00005 cps are available on special order.	±1%	±1%	Function generator has four simultaneous outputs with variable phase sine and square waves; one square and sine wave adjustable over a 360° range; sine wave distortion <0.06%; rise and fall time of square wave <200 μsec; amplitude stability ±0.1 db; each output has an attenuator (cont. variable over 40 db) ideal for subsonic, audio and phase shift measurements	Max output voltage 30 v p-p open circuit for all outputs; output power is at least 40 mw (5 v rms into 600 ohms)	\$1200
204B	5 cps to 560 kc, 5 ranges	±3%	±3%	Solid state, portable, battery or optional ac operation; output fully floating, will drive balanced and unbalanced loads referenced above or below ground; highly stable; distortion <1%	10 mw (2.5 v/600 ohms)	\$315***
205AG	20 cps to 20 kc, 3 ranges	±1 db	±2%	A single instrument for making high power audio tests, gain and frequency response measurements; two VM's measure input and output of device under test	5 watts adjustable/50, 200, 600, 5000 ohms	\$600**
206A	20 cps to 20 kc, 3 ranges	±0.2 db	±2%	Distortion <0.1%; ideal for testing FM broadcasting units, high fidelity audio systems; metered output, variable in 0.1, 1, and 10 db steps to 111 db	+15 dbm/50, 150, 200 ohms	\$900**
207A	20 cps to 20 kc, 1 range	±1 db	±4%	Covers 20 cps to 20 kc in one sweep of the dial; versions available with x-axis and/or motor drive at extra cost	160 mw (10 v/600 ohms)	\$425*
208A 208A (option 01.)	50 cps to 560 kc, 5 ranges	±3%	±3%	Excellent frequency response and stability; output monitored by VM with 2% accuracy; 208A is calibrated in volts; 208A (option 01.) is calibrated in db	10 mw (+10 dbm) (2.5 v/600 ohms)	\$525 \$535
241A	10 cps to 1 mc	±2%	±1%	Pushbutton selection of frequency for repetitive, production testing	10 mw (2.5 v/600 ohms)	\$490
650A	10 cps to 10 mc, 6 ranges	±1 db	±2%	Ideal for measurements in audio, supersonic, video, rf ranges; metered output flat within 1 db; distortion <1%, 20 cps to 100 kc; less than 2%, 100 kc to 1 mc; approx. 5% at 10 mc; 50 db attenuator, 10 db steps	15 mw (3 v/600 ohms)	\$550**
651A	10 cps to 10 mc, 6 ranges	±2%	±2%, 100 cps ±3%, 10 cps to 10 mc	Ideal for measurements in audio and communication frequencies, television frequencies; meter output flat within ±2%; typical amplitude stability 0.1% 90 db attenuator, 10 db steps; two outputs 50 and 600 ohms	200 mw (3.16 v into 50 ohms) 16 mw (3.16 v into 600 ohms)	\$590

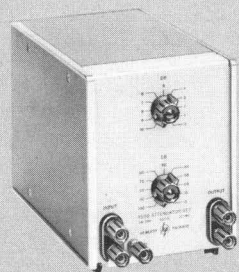
ATTENUATORS

350C/D	dc to 1 mc	350C, 500 ohms 5 watts; 350D, 600 ohms 5 watts	dc to 100 kc, 0.125 db; 100 kc to 1 mc, ±.25 db	Two attenuator sections in cascade make up the attenuators: one section is a 100 db attenuator, adjustable in 10 db steps; the other is a 10 db attenuator, adjustable in 1 db steps; frequency response is flat to 1 mc; ideal for ultrasonic and other work involving measurements above the range of conventional audio frequency attenuators	350C-500 ohms 350D-600 ohms	\$125
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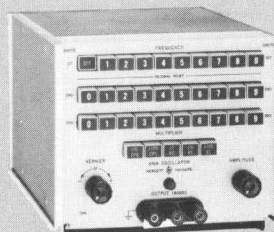
*Cabinet models; rack mount models \$5 additional **Cabinet models; rack mount models \$15 less ***AC operation optional, \$35 extra



208A



350D



241A



651A

hp GENERAL-PURPOSE GENERATORS

Model 211A Square Wave Generator is designed for testing video and audio amplifiers, networks, for modulating signal generators and driving externally triggered equipment. Frequency range is 1 cps to 1 mc with 20 nsec rise time.

Model 213B Pulse Generator is ideal for testing the 185A,B Sampling Oscilloscopes and for time domain reflectometry application. Rise time less than 0.1 nsec.

Model 214A Pulse Generator provides

200 watts pulse power with 15 nsec rise time for testing magnetic devices, high power semiconductors, radar and other general purpose circuitry. A 50-ohm source impedance eliminates errors caused by reflections from the generator. Pulse characteristics are carefully controlled for meaningful measurements.

Model 215A Pulse Generator combines less than 1 nsec rise and fall pulse with a nearly ideal pulse shape, calibrated pulse width and delay, adjustable pulse amplitude, rep rates to 1 mc and a true

50-ohm source impedance for fast pulse testing. These characteristics make the 215A particularly useful for measuring parameters of semiconductors logic circuits.

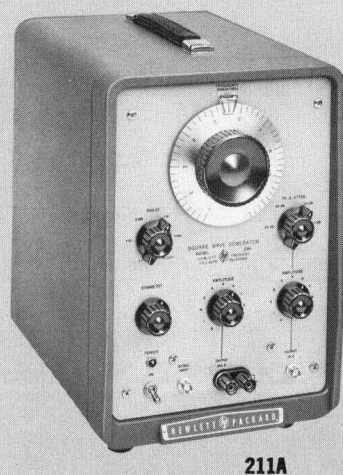
Model 218AR Digital Delay Generator, with plug-in versatility is ideally suited for pulse simulation and time measurements and for applications such as radar, Loran and pulse code systems. It provides two precision time intervals or pulse delays independently adjustable from 1 μ sec to 9,999 μ sec in 1 μ sec steps.

Model	Rep Rate	Rise Time	Amplitude	Pulse Width	Other Features	Price
211A Square Wave Generator	1 cps to 1 mc	<20 nsec <100 nsec	-3.5 v/75 ohms, -27 v/600 ohms adjustable		Symmetry control permits exact square wave balance. Sync input	\$350*
212A Pulse Generator	50 to 5000 pps	20	± 50 v/50 ohms, adjustable	0.07 to 10 μ sec	External triggering, sync; pulse position adj. from 10 μ sec advance to 100 μ sec delay (respect to sync out pulse)	\$600**
213B Pulse Generator	Approx. 100 kc	<0.1 nsec	± 175 mv/50 ohms	Flat for 100 nsec (2 μ sec total)	May be externally triggered from 0 to 100 kc, 50-ohm source	\$215
214A Pulse Generator	10 cps to 1 mc	<13 nsec (15 nsec at 100 v)	± 100 v/50 ohms adjustable	0.05 μ sec to 10 msec	External triggering with selectable trigger point; pulse position adj. to 10 msec in advance or delay of sync out pulse; single, gated or double pulses, 50-ohm source	\$875
215A Pulse Generator	100 cps to 1 mc	<1 nsec	± 10 v/50 ohms	Continuously adj. to 100 nsec	External triggering with selectable trigger point; output trigger from 140 nsec advance to 10 nsec delay (respect to sync out); single and gated pulses, 50-ohm source	\$1875
218AR Digital Delay Generator	10 cps to 10 kc		See 219 series plug-ins		Two independent time delays from 1 to 9,999 μ sec using internal Xtal or 1 to 10,000 periods of ext. time base; sync out pulse at beginning or end of time intervals; output pulses generated in 219 series plug-ins	\$2000 (rack)
219A Dual Trigger Unit	(See 218AR)	0.1 μ sec	+25 v/50 ohms	>1.5 μ sec	One pulse is available at the beginning of the time intervals or at the end of one time interval; second pulse occurs at end of other time interval	\$125
219B Dual Pulse Unit	(See 218AR)	60 nsec	± 25 v/50 ohms (adjustable)	0.2 to 5 μ sec		\$490
219C Digital Pulse Duration Unit	(See 218AR)	30 nsec (90 ohms)	-7.5 v/90 ohms or -45 v/500 ohms (adjustable)	1 to 10,000 μ sec (total of width + delay)	Positive excursions of pulses clamped to chassis; positive- and negative-going pulses available simultaneously; pulse may be delayed up to 9,999 μ sec	\$375

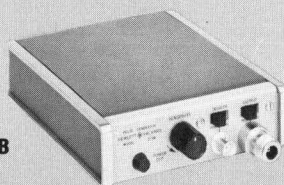
*Cabinet models; rack mount models \$5 additional. **Cabinet models; rack mount models \$15 less.

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SQUARE WAVE, PULSE, DIGITAL DELAY SOURCES



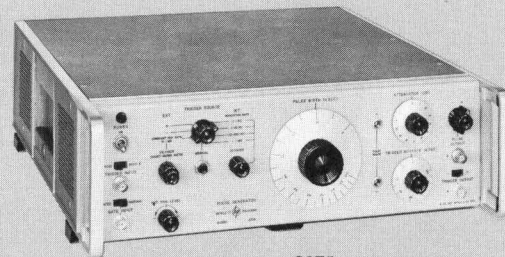
213B



214A



215A



SANBORN SIGNAL-CONDITIONING & RECORDING INSTRUMENTS

On this and the next two pages are shown versatile, reliable and easily operated Sanborn instruments for measuring, amplifying, storing and graphically recording information on numerous physical and electrical variables—ranging from force, flow, rpm, vibration and velocity to ac and dc voltages, currents, power, servo error signals and frequencies. **S a n b o r n** transducers

translate physical quantities into proportional electrical signals; amplifiers provide the necessary gain and precise control over the signals; magnetic tape recorders economically and conveniently store the signals in their original form and permit playback with the original time interval compressed or expanded, and oscillographic recorders make a permanent, written record or

graphic analog of the variable (or several variables simultaneously) on a moving strip chart.

Sanborn invites your inquiry regarding specific measurement or instrumentation needs: your nearby hp field engineering office can supply detailed data on any of these products—or write Sanborn directly in Waltham, Mass.

MAGNETIC RECORDING SYSTEMS

<p>2004: 4-track, 4-speed, 1/4" tape 3907A: 7-track, 6-speed, 1/2" tape 3914A: 14-track, 6-speed, 1" tape</p>	<p>Completely new 7- and 14-track systems feature new Hewlett-Packard transport, achieving instrumentation performance at substantially lower cost; 6 electrical speeds (1 7/8 to 60 ips) with no capstan change; extra edge track for monitoring, 40 db or better signal-to-noise ratio, 0.2% p-p flutter, IRIG compatibility; reduced crosstalk by unique magnetic shielding, built-in footage counter with 99.95% accuracy. Solid state direct, FM or pulse record/reproduce electronics on plug-in cards. Direct record bandwidth 100 to 100,000 cps; FM 0 to 10 KC. Wideband systems available soon (250 kc direct, 20 kc FM). Model 2004 4-track, 4-speed system uses same electronics, has flutter compensation, footage counter, is compatible with Sanborn preamps and recorders</p>	<p>Typical 7-channel system complete for FM recording/reproducing, with filters for 3 speeds, in cabinet: \$8900. Same system, for 14-channels: \$13,370. 4-channel system complete for FM recording at 4 speeds: \$4690.</p>
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EVENT RECORDERS

<p>361, 30 channels 360, up to 120 channels</p>	<p>Sharp, clear traces of events as short as 1.3 msec, on dry, electro-sensitive charts; pulsed writing; systems meet MIL-1-26600/2 Class 1B RFI Spec.; seven solid state, plug-in writing control cards available for fixed variable logic levels, low level signals, etc.; Model 361 occupies only 8 3/4" panel space, has 4 speeds; Model 360 takes 14", has 9 standard speeds</p>	<p>361, \$2250 (with +6 to -40 v writing control) 360, \$3900 (without writing control)</p>
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DATA AMPLIFIERS

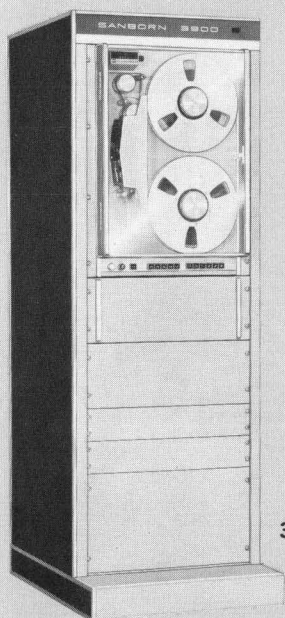
<p>860-4000 860-4200 860-4300</p>	<p>Specialized, all solid state dc data amplifiers for driving digital voltmeters, tape systems, analog-digital converters, etc.; each has 2" x 7" panel; packaging in portable case, 2-unit or 8-unit rack mounting modules; Model 860-4000 FIFO has 10 kc bandwidth, floating input isolated from floating output, gain of 1000, ±0.1% linearity; Model 860-4200 is a dc-50 kc 3 terminal floating amplifier with gain of 1000, ±0.01% linearity; Model 860-4300 has floating input isolated from floating output, dc-100 cps bandwidth, ±0.05% linearity</p>	<p>4000, \$825 4200, \$600 4300, \$425</p>
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TRANSDUCERS

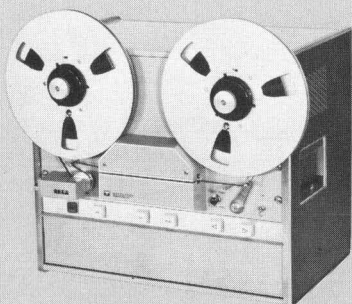
<p>For linear displacement, velocity and acceleration; gas and fluid pressures; low forces.</p>	<p>LVsyn's for linear velocities at strokes to 22", need no excitation, \$40 to \$120; Linearsyn's for linear displacements of ±0.01" to ±1", \$15 to \$60; 580, 581 probes for f.s. recording of ±0.050" displacements, \$125 to \$185; Series 7 DCDT's for ±0.05" to ±3" displacements with 6 v dc excitation, dc output, \$99 to \$162; Series 267, 268 for liquid or gas pressures, -100 to +100 mm Hg, -40 to +40 mm Hg, \$225 and \$250; Model 270 for bi-directional, differential gas pressures, +400 to -400 mm H₂O, \$295; FTA Series Microforce for bi-directional forces ±1 to ±100 grams, \$175 to \$200; Models 311 (\$425) and 312 (\$300) Transducer Amplifier-Indicators for excitation and output display on meter, with strain gage bridges, LVDT's, etc. Note: More "specials" of different ratings quickly available; consult Transducer Division</p>	<p>(See Features at left)</p>
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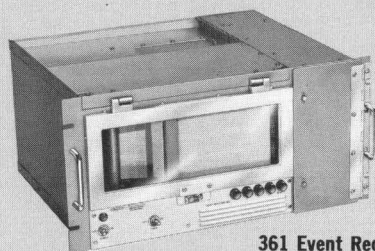
RECORDERS, AMPLIFIERS AND TRANSDUCERS



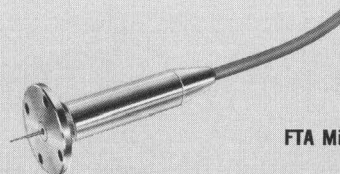
3907A System



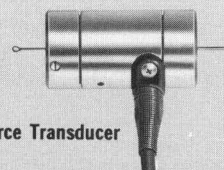
2004 System



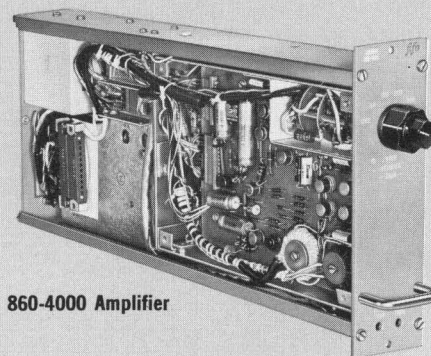
361 Event Recorder



580 Displacement Probe



FTA Microforce Transducer

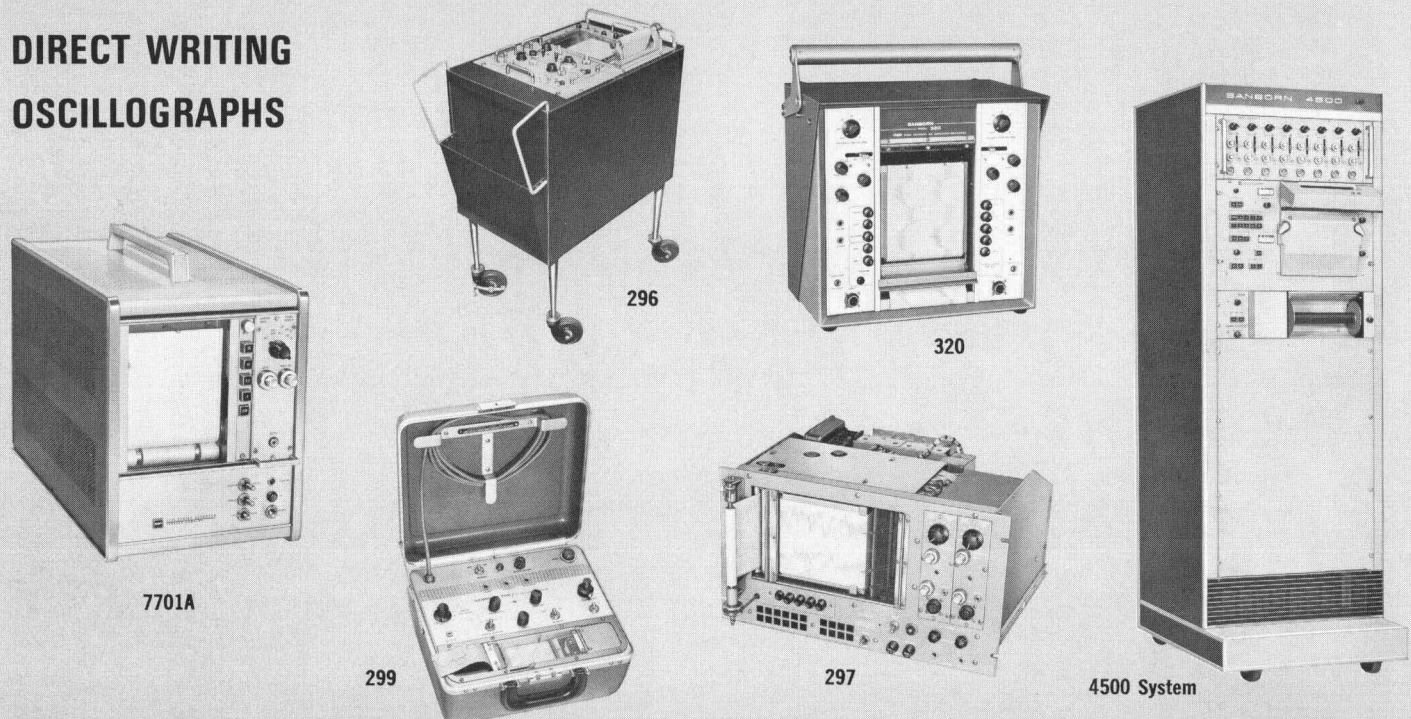


860-4000 Amplifier

SANBORN SIGNAL-CONDITIONING & RECORDING INSTRUMENTS

SINGLE-CHANNEL DIRECT WRITING OSCILLOGRAPHS						
Model	Features	Response (at 10 div p-p)	Sensitivity	Non- Linearity	Speeds	Price
7701A	Wide chart (100 mm) recorder for greater trace resolution; uses "8800" solid state preamps; ideal bench or field unit; size 1 cu. ft., weighs 40 lbs.	dc to 30 cps within 3 db (full scale 100 mm)	1 μ v/div to 5 mv/div, depending on "8800" preamp used	Max. 0.5%	0.5, 2.5, 10 and 50 mm/sec (Optional: 0.5 to 50 mm/min.)	\$1075 without preamp or case
299	Compact, portable, 7" x 10 1/2" x 12" wide; event marker, cal. zero suppression; bal. input, 5 meg. each side	dc to 100 cps within 3 db	10 mv/div to 10 v/div (10-pos.)	Max. 0.625%	5 mm/sec 50 mm/sec	\$700
301	Carrier-type amplifier and phase-sensitive demodulator for inductive transducers, strain gages; completely transistorized; carrier freq., 2400 cps @ 5 v rms (internal)	dc to 100 cps within 3 db	10 μ v rms/div to 2 mv/div (8-pos.)	Max. 0.625%	5 mm/sec 50 mm/sec	\$850
302	Phase-sensitive demodulator recorder; recording proportional to level of in-phase or 180° out-of-phase ac signal component with respect to reference	dc to 100 cps within 3 db	0.5mv rms/div to 500 mv/div (10-pos.)	Max. 0.625%	5 mm/sec 50 mm/sec	\$750
DUAL-CHANNEL DIRECT WRITING OSCILLOGRAPHS						
Model	Features	Response (at 10 div p-p)	Sensitivity	Non- Linearity	Speeds	Price
296	Versatility and performance of larger systems; uses two 350 preamps; transistorized current feedback power amp, two 50-mm channels, paper take-up, 14" x 19" panel, rack mounted or portable	dc to 125 cps within 3 db	2 μ v to 5 v/mm depending on preamps	Max. 0.5%	Four, pushbutton-selected: 1, 5, 20 and 100 mm/sec	\$1575 (plus preamps)
297	Same as 296 except uses miniaturized 850 preamps; 10 1/2" x 19" panel, rack mounted or portable	(Same as 296)	10 μ v to 5 v/mm depending on preamps	Max 0.5%	(Same as 296)	\$1675 (plus preamps)
320	Solid state; floating and guarded inputs; common mode rejection 140 db min. at dc; operates in any position, rack mounted or portable	(Same as 296)	0.5 to 20 mv/mm and v/cm (12-pos.)	Max. 0.5%	(Same as 296)	\$1650 (port. case) \$1800 (rack)
321	Similar to 320, except provides excitation for and records outputs of ac-excited transducers, etc.; rack mounted or portable	(Same as 296)	10 μ v rms/mm to 2 mv/mm (8-pos.)	Max. 0.5%	(Same as 296)	\$1650 (port. case) \$1800 (rack)
322	Moderate gain, tube-transistor direct-coupled amplifiers; common mode rejection 50:1; has zero suppression; rack mounted or portable	(Same as 296)	10 mv to 10 v/mm (10-pos.)	Max. 0.5%	(Same as 296)	\$1395 (port. case) \$1545 (rack) \$22A without (zero sup., \$100 less than above)
1 TO 24 CHANNEL OPTICAL DIRECT WRITING OSCILLOGRAPHS						
Model	Features	Response (at 10 div p-p)	Sensitivity	Non- Linearity	Speeds	Price
4500 Series	Optical 1 to 24 channel system with response to 5 kc over 4" amplitudes, with single set of galvanometers; choice of carrier, high, medium or low gain 8 channel amplifiers; 8" ultra-violet self-develop; charts, traces immediately visible, can overlap to occupy 8" amplitude	dc to 5 kc within 3 db at 4" p-p; to 3 kc at 8" p-p	0.5 mv rms to 20 v/inch, depending on which of 4 amplifiers is used	Max. 1.5%	Nine: 0.25 to 100 inches/sec, pushbutton-selected	8-channel recorder with galvanometer \$4200; 8-channel, amps, \$2200 to \$3900

DIRECT WRITING OSCILLOGRAPHS



350 SERIES

850 SERIES

7700 SERIES**

950 SERIES

Features	350 SERIES	850 SERIES	7700 SERIES**	950 SERIES
Response (10 div p-p)	dc to 150 cps within 3 db	dc to 150 cps within 3 db	dc to 150 cps within 3 db	dc to 150 cps within 3 db
Sensitivity	0.1 v/div, without preamps 2 μ v/div to 5 v/div, depending on pre-amp	10 μ v/div to 5 v/div, depending on preamp	1 μ v/div to 5 v/div, depending on preamp	10 μ v/div to 5 v/div, depending on 950 amplifier module used
Non-Linearity	Max. 0.5%	Max. 0.5%	Max. 0.5%	Max. 0.5%
Speeds	Nine: 0.25 to 100 mm/sec (nine more optional, mm/min) push-button-selected	Same as 350 Series	Same as 350 Series	Same as 350 Series

Basic Assemblies

Note: Add to basic assembly price the total price of preamps desired, for total system price (without preamps)

4 channel
6 channel
8 channel
12 to 16 channel\$3985
\$5215
\$6270\$3350
\$4650
\$5325
Price on request—
\$4820
\$5495
Price on request—
\$3000
\$3300
Price on request

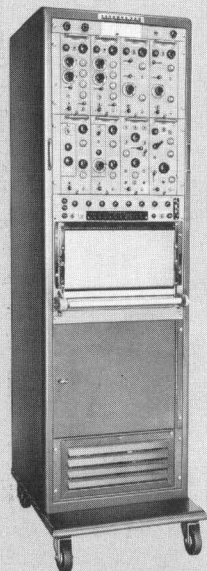
Preamplifiers (add Series No. prefix)	Single-Channel Plug-In (4 3/16" w. x 10 1/2"h.)	Single-Channel Plug-In (2 1/16" w. x 7"h.)	Single-Channel Plug-In (2 1/16" w. x 7"h.)	8-Channel Module (19" w. x 7"h.)
1000 DC	\$325*	\$275*	(8802A) \$325*	
1100 Carrier	\$425*	\$365, \$500*	(8805A) \$400	\$3500*
1200 Phase-Sens. Demod.	\$400	\$250	(8806A) \$575	
1300 DC Coupling	\$250*	\$185, \$225*	(8801A) \$275*	
1400 Logarithmic	\$475			
1500 Low Level	\$600, \$690*	\$435	(8803A) \$600*	\$3800
1800 Stabilized DC	\$550*	\$375*		
2000 Low Gain				\$1700
2300 AC Wattmeter	\$850			
2500 RMS Volt/Am.	\$600			
2600 Freq. Deviation	\$525	\$400		
2800 Freq. Meter	\$415	\$425		
2900 Med. Low Gain				\$2500*
3400 Med. Gain				\$3500
3900 Accelerometer	\$600			

*With zero suppression

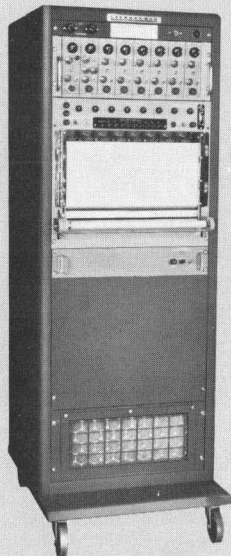
**Uses "8800" Preamplifiers

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

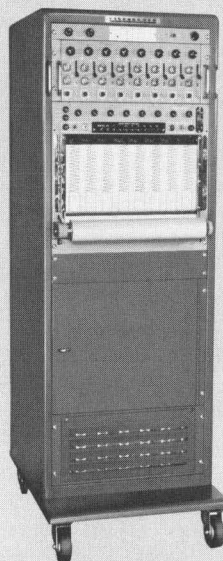
OSCILLOGRAPHIC RECORDING SYSTEMS



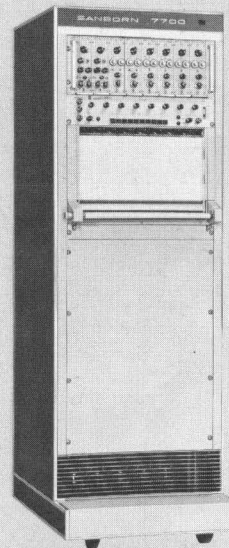
350 SYSTEM



850 SYSTEM



950 SYSTEM



7700 SYSTEM

MOSELEY X-Y and STRIP CHART RECORDERS

F. L. Moseley Co. manufactures a complete line of x-y and strip chart recorders with complementary accessories which include program controllers, analog converters, digital keyboards and line followers. A detailed catalog with complete descriptions and specifications of each instrument is available from your local hp sales/service organization, or by writing direct to F. L. Moseley Co., 433 N. Fair Oaks Ave., Pasadena California.

MOSELEY X-Y Recorders Include models with recording areas of 7" x 10", 10" x 15" and 30" x 30"; a 10" x 10" model with automatic frame advance; two-pen models.

MOSELEY Strip Chart Recorders include 5" and 10" models featuring instant chart speed selection with single and multiple input ranges.

Most recorder series provide a choice of bench or rack type mounting, English or metric scaling, 115 or 230 volt, 50 or 60 cycle power requirement.

Model 135 Series, 136A, 7030A X-Y Recorders are the most compact 8½" x 11" recorders available. Unique design makes possible use on bench, in rack, or as hand carried portable. 135 series, and 7030A are single pen, 136A two-pen.

One megohm input resistance and zener diode controlled reference supplies are major features. 7030A has automatic resettable time sweep and adjustable sweep lengths on both axes, Autogrip* electric paper holddown.

Model 7000A Series are high sensitivity 11" x 17" x-y recorders offered in a variety of rack and bench models. Features included on all models are ac or dc inputs, one megohm input resistance, automatic resettable time sweep and adjustable sweep lengths on both axes, Autogrip* electric paper holddown, English or metric scaling.

Model 2D Series, 2FRA are 11" x 17" x-y recorders offered in a variety of rack and bench models for general and special applications. Choice of features on different models include one megohm input resistance, time base on one axis, computer reference, vacuum paper holddown, remote pen control, English or metric scaling, Model 2FRA is a two-pen version.

Model 680 Series offers wide variety of modular constructed 5" servo type strip chart recorders. These feature two or eight instantly selectable chart speeds, ten input ranges, all solid state circuitry, choice of factory installed accessories including retransmitting potenti-

ometers, event markers, limit switches and encoders. Also available with English or metric scaling; single voltage, current, or cold junction compensated temperature ranges.

Model 7100A Series are newest 10" dual channel strip chart recorders featuring twelve instantly selectable chart speeds, ten input ranges with one megohm input resistance. Optional features include remote 10 to 1 chart speed reducer, event markers and five times full scale zero suppression. *Model 7101A* is a single channel recorder.

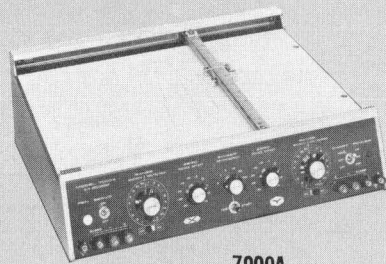
Model 22 Servo Voltmeter is a high accuracy, servo-operated indicating instrument featuring a fourteen inch, mirror backed scale with 11 ranges from 1 mv to 300 volts, full scale and ±0.2% accuracy.

Model 7500A Series are optical line follower systems adaptable to 680 or 2D (with Q-3) recorders for use as chart readers or transport delay simulators.

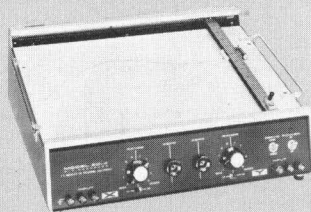
MOSELEY Accessories are available for adaptation of the recorders to a wide variety of applications including ac and dc conversion, logarithmic plotting, optical line following, oscilloscope waveform translation, digital plotting with keyboards and character printers.

Data subject to change without notice. Prices f.o.b. factory. *Trademark, pat. pending

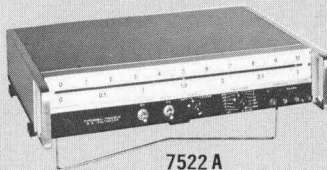
WIDE VARIETY OF RECORDERS, COMPLETE LINE OF ACCESSORIES



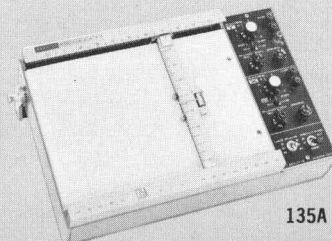
7000A



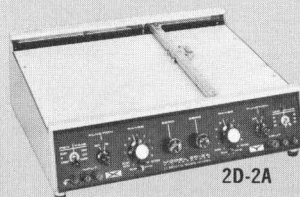
2D-4



7522 A

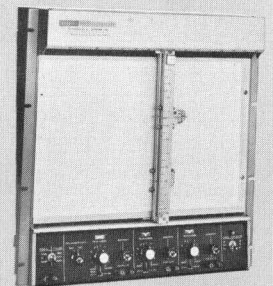
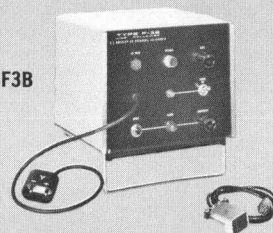


135A

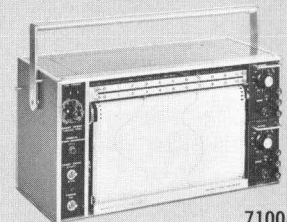


2D-2A

Type F3B



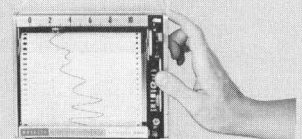
2 FRA



7100A



Type 101



680



60D

X-Y RECORDER

Model	Characteristics	Recording Size (in.)	Slewing Speed	Input Ranges	Accuracy	Price
7030A	X-Y recorder, compact portable or rack mount, Autogrip® holddown, 1 megohm input impedance all ranges	8½ x 11	20 in/sec each axis	17 dc ranges, 0.1 mv/in to 20 v/in	0.2% of full scale	\$1795
7050A	X-Y basic systems recorder, single range, all solid state	8½ x 11	Less than 1 sec full scale	Single range 1 v full scale	0.1% of full scale	\$975
135	Compact portable, desk or rack mount x-y recorder,	8½ x 11	20 in/sec each axis	16 ranges each axis, 0.5 mv/in to 50 v/in**	Better than 0.2% of full scale	\$1650
135A	Similar to 135, but has one megohm input resistance on all 11 ranges	8½ x 11	20 in/sec each axis	11 ranges each axis, 0.5 mv/in to 50 v/in**		\$1650
135C	X-Y recorder, dc input, 10 ranges and variable range each channel	8½ x 11	15 in/sec each axis	10 ranges on each axis, 0.5 mv/inch to 50 v/inch**	0.1% F. S. on basic range; 1% attenuator	\$1190
136A	Two-pen version of Model 135A X-Y Recorder, similar characteristics (x-y ₂)	8½ x 11	20 in/sec each axis			\$2650
7000A	X-Y recorder, accepts ac or dc inputs on each axis, built-in resettable time sweep, Autogrip® holddown, 1 megohm input resistance on all ranges	11 x 17	20 in/sec each axis	17 dc ranges: 0.1 mv/in to 20 v/in; 12 ac ranges: 5 mv/in to 20 v/in**	dc, 0.2% full scale; ac, 0.5% full scale (20 cps to 100 kc)	\$2575
7590A	X-Y data plotting system, built-in null detector, character printer, mechanical paper holddown	11 x 17	15 in/sec	10 ranges, 0.5 mv/in to 10 v/in**	0.1% of full scale on most sensitive range	\$1985
2D-2 (bench) 2DR-2 (rack)	X-Y recorder, accepts dc inputs on each axis, built-in time sweep, solid state	11 x 17	20 in/sec each axis	Each axis: dc, 16 ranges 0.5 mv/in to 50 v/in	Better than 0.2% of full scale 0.1% resettability	\$1950
2D-2A (bench) 2DR-2A (rack)	Similar to 2D-2, except provides one megohm input resistance on all 11 ranges	11 x 17	20 in/sec each axis	Metric scaling optional (2D-2AM) & (2DR-2AM) 11 ranges	Better than 0.2% of full scale 0.1% resettability	\$1950
2D-3 (bench) 2DR-3 (rack)	Similar to 2D-2, omits built-in time base designed for computer use, will accept ±100 v computer reference	11 x 17	20 in/sec each axis	Metric scaling optional 16 ranges	Better than 0.2% of full scale 0.1% resettability	\$2050
2D-4 (bench) 2DR-4 (rack)	X-Y recorder, dc input, 10 ranges and variable range control on each axis; mechanical paper hold-down	11 x 17	15 in/sec each axis	10 ranges on each axis, 0.5 mv/inch to 10 v/in; metric scaling optional	0.1% F. S. on basic range; 1% attenuator	\$1490
2FRA	Two-pen x-y ₂ recorder, built-in time base on x-axis	11 x 17	1.5 sec or less each axis for full scale pen travel	11 ranges each axis, 0.5 mv to 50 v/division (inch)**	Better than 0.2% of full scale	\$3575
6SA	Rack mount x-y recorder with automatic chart advance, up to 120 charts on single roll, one megohm input on 11 ranges	10 x 10	1 sec each axis for full scale pen travel	11 ranges each axis, 0.5 mv/in to 50 v/in	Better than 0.2% of full scale	\$3150‡
7	Large x-y recorder ideal as plotting table; horizontal or vertical mounting	32 x 32	20 in/sec max. pen speed each axis	13 ranges, 1 mv/in to 10 v/in	Better than 0.2% of full scale	\$3950

STRIP CHART RECORDERS

680	Solid state 6" strip-chart recorder; eight chart speeds; continuous zero set, zener reference	6" chart to 100' long	8 chart speed ranges, 1 to 8 in/min, 1 to 8 in/hr	10 ranges, 5 mv to 100 v full scale**	Better than 0.2% of full scale	\$750‡
681	Similar to 680, except dual speed, single range	6" chart to 100' long	Customer specifies speeds in 60:1 ratio, generally any speed up to 8 in/min	Selected by customer, 5 mv to 100 v**	Better than 0.2% of full scale	\$625‡
682	Similar to 681, except for temperature recording					\$675
683	Similar to 681, except for current recording			5 µa maximum		\$625
7100A	General purpose two pen laboratory strip chart, one megohm input on ten ranges each channel, 12 chart speeds	10" chart to 120 ft long	0.5 sec for full scale pen travel, 12 chart speeds 1 in/hr to 2 in/sec	10 ranges 5 mv to 100 v full scale each channel	±0.2% of full scale	\$1800
7101A	Similar to 7100A, single channel only	10" chart				\$1390

SERVO VOLTMETER

22	DC Servo Voltmeter, 11 ranges, 3 mv to 300 v full scale, linear scale, zener reference					\$595‡
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ACCESSORIES

7500A	Line follower system, available for 2D, 680 series recorders; 2D also requires Q-3					\$1650 for 2D \$2100 for 680
17002A	Inverter power supply; 11 to 32 v dc input range, constant 115 or 230 v ac out; 50 or 60 cps models, up to 45 volt-amps capacity					\$350
60D	Logarithmic Converter, converts dc or ac to dc proportional to the log of the positive peak amplitude of the input**					\$575
Type A-1	Dual channel ac/dc converter, permits plotting of ac signals, 20 to 200 kc, on dc recorders; eight ranges each channel, 0.1 v/div to 20 v/div					\$585‡
Type F-3B	Optical line follower permits optical tracking of almost any high contrast line; permits pre-recorded curves to 120 feet to be read out from Model 2D Series Recorders					\$795‡ plus installation
Type 101	This waveform translator permits plotting of repetitive oscillator traces on x-y recorder					\$675‡

‡Slight additional charge for 115/230 volt, 50 cps operation.

*Trademark, pat. pending

**Metric scaling optional

hp MICROWAVE TEST EQUIPMENT, SIGNAL GENERATORS

Hewlett-Packard and its Dymec and Boonton Radio divisions manufacture an extensive line of general and special purpose signal generators covering 50 kc to 40 gc. Models in the opposite table prefixed "DY" are manufactured by Dymec, and Boonton products are described in another section.

LF to UHF Signal Generators—These signal generators, including *hp 606A, 608C, 608D* and *612A*, collectively cover frequencies from 50 kc to 1.23 gc and they are characterized by extremely low drift and incidental frequency modulation. All may be amplitude (sine, square, pulse) modulated. A feedback loop in the 606A keeps its output and percent modulation constant as frequency is varied. For very high on-off ratios, pulses may be applied directly to the oscillator of the 612A, which also may be used to simulate positive or negative tv transmissions.

UHF to SHF Signal Generators and Sources—This group of instruments, covering 800 mc to 21 gc, features extremely simple operation. The *614A, 616B, 618B, 620A, 626A* and *628A Signal Generators* provide large, direct-reading frequency and attenuator dials. They may be pulse, square-wave and frequency modulated. Their versatility makes them useful for measuring signal-noise ratio, receiver sensitivity, swr and transmission line characteristics.

The *hp 8614A* and *8616A Signal Generators* are particularly easy to use. Frequency and attenuation are set on direct-reading digital dials, and push-buttons permit fast, easy selection of function (cw, leveled output, square-wave modulation or external amplitude, pulse or frequency modulation). In addition, each unit contains a unique PIN diode modulator which permits such a wide range of amplitude modulation

that remote control of output level or precise leveling with external equipment is possible.

The *8614B* and *8616B Signal Sources* can be used in many applications previously requiring signal generators. The sources have precision attenuators for relative measurements such as insertion loss, and they have pulse and square wave capability.

Related Test Equipment: Each of the *DY-623B, 5636, and 624C Test Sets* consists of a signal generator, frequency meter and power meter. Thus, a complete testing system is available in one unit for checking communication and radar systems.

The *DY-2650A Oscillator Synchronizer* and *DY-2654A Frequency Standard Synchronizer*, which are fully compatible with the *8614A,B* and *8616A,B*, provide absolute control of reflex klystron oscillator frequencies over the range of 1 to 12.4 gc by phase locking the klystron signal to a crystal reference; thus crystal oscillator stability is extended easily into the microwave region for use in doppler systems, microwave frequency standards and parametric amplifier pumps.

Sinusoidal and complex modulation of microwave signals is possible with the *8730 Series PIN Modulators*. Utilizing PIN diodes, the modulators present a good match and virtually eliminate frequency pulling. The *8403A Modulator* is intended for driving the 8730's, providing the specially shaped signals required for fast rise times (typically 30 nsec). The 8403A can also drive standard signal sources.

Sweep Oscillators—The *hp 690 Sweep Oscillators* combine unique features to make them the most flexible and most accurate sweepers available. They provide calibrated broad and narrow

sweeps, and markers which amplitude modulate the rf may be used on either. The markers also may be used as end points of a second broad sweep. Manual sweep reduces x-y recorder setup time, and pushbuttons greatly simplify operation. Both external and internal leveling are available.

Frequency Doublers—Broadband frequency doublers, *hp 938A* and *940A*, provide low cost signal generator capability in the 18 to 40 gc range. Designed to be driven by signal sources in the 9 to 20 gc range, the frequency doublers preserve the versatility and stability of the driving source. Thus, the signals may be cw, pulsed or swept. An output monitor and precision attenuator provide a metered output, even though the input signal is uncalibrated.

Other Test Equipment—In addition to signal generators and sweep oscillators, Hewlett-Packard offers today's most complete line of coaxial and waveguide test equipment to help you make microwave measurements easier, faster and more accurately. Much of the waveguide equipment is available in several frequency bands. The frequency range and designation of each band are listed below.

Waveguide Band	Frequency (gc)
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

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

SIGNAL GENERATORS TO 40 GC, COAXIAL AND WAVEGUIDE TEST EQUIPMENT



Signal Generators	Frequency Range	Characteristics	Price
606A Signal Generator	50 kc to 65 mc	Output 3 v to 0.1 μ v, mod. BW dc to 20 kc, low drift and noise, low incidental FM, low distortion	\$1350**
608C Signal Generator	10 to 480 mc	Output 1 v to 0.1 μ v, into 50-ohm load; AM, pulse modulation, direct calibration	\$1200*
608D Signal Generator	10 to 420 mc	Output 0.5 v to 0.1 μ v into 50 ohms, amplitude, pulse mod., direct calib., low incidental FM and drift	\$1300*
612A Signal Generator	450 mc to 1.23 gc	Output 0.5 v to 0.1 μ v into 50-ohm load; AM, pulse or square wave modulation, direct calibration	\$1400*
614A Signal Generator	800 mc to 2.1 gc	Output at least 1/2 mv to -127 dbm (0.1 μ v) into 50 ohms, pulse or FM mod., direct calibration	\$1950*
8614A Signal Generator	800 mc to 2.4 gc	Output +10 to -127 dbm into 50 ohms, leveled below 0 dbm; internal sq. wave, external pulse, AM & FM	\$2100
8614B Signal Source	800 mc to 2.4 gc	Output 15 mw to -127 dbm into 50 ohms; internal square wave, external pulse and FM	\$1450
616B Signal Generator	1.8 to 4.2 gc	Output 1 mw to -127 dbm (0.1 μ v) into 50-ohm load, pulse or FM modulation, direct calibration	\$1950*
8616A Signal Generator	1.8 to 4.5 gc	Output +3 to -127 dbm into 50 ohms, leveled below 0 dbm; internal sq. wave, external pulse, AM & FM	\$2100
8616B Signal Source	1.8 to 4.5 gc	Output 3 mw to -127 dbm into 50 ohms; internal square wave, external pulse and FM	\$1450
618B Signal Generator	3.8 to 7.6 gc	Output 1 mw to -127 dbm (0.1 μ v) into 50 ohms, pulse, FM or square wave mod., direct calibration	\$2250*
DY-623B SHF Test Set	5.925 to 7.725 gc†	Output 0 dbm to -70 dbm; external pulse, FM or square wave modulation; internal FM	\$2265***
620A Signal Generator	7 to 11 gc	Output 1 mw to -127 dbm (0.1 μ v) into 50 ohms, pulse, FM or square wave mod., direct calibration	\$2250*
DY-5636 Test Set	7.1 to 8.5 gc	Output +15 dbm to -85 dbm; external pulse, FM or square wave modulation; internal FM	\$3800***
DY-624C X-Band Test Set	8.5 to 10 gc	Output 0 dbm to -100 dbm; external pulse, FM or square wave modulation; internal pulse, FM	\$2265**
626A Signal Generator	10 to 15.5 gc	Output +10 dbm to -90 dbm; pulse, FM or square wave modulation, direct calibration	\$3400*
628A Signal Generator	15 to 21 gc	Output +10 dbm to -90 dbm; pulse, FM or square wave modulation, direct calibration	\$3400*
938A Frequency Doubler	18 to 26.5 gc	Driven by 9 to 13.25 gc source, hp 626A, 694A,B or klystrons	\$1500****
940A Frequency Doubler	26.5 to 40 gc	Driven by 13.25 to 20 gc source, hp 628A, 695A or klystrons	\$1500****

Sweep Oscillators

691A Sweep Oscillator	1 to 2 gc	Output 100 mw, accuracy \pm 1%	\$3200
691B Sweep Oscillator	1 to 2 gc	Output 60 mw, accuracy \pm 10 mc	\$3550
692A Sweep Oscillator	2 to 4 gc	Output 70 mw, accuracy \pm 1%	\$3000
692B Sweep Oscillator	2 to 4 gc	Output 40 mw, accuracy \pm 10 mc	\$3350
693A Sweep Oscillator	4 to 8 gc	Output 20 mw, accuracy \pm 1%	\$3000
693B Sweep Oscillator	4 to 8 gc	Output 15 mw, accuracy \pm 20 mc	\$3350
694A Sweep Oscillator	8 to 12.4 gc	Output 20 mw, accuracy \pm 1%	\$3100
694B Sweep Oscillator	8 to 12.4 gc	Output 10 mw, accuracy \pm 30 mc	\$3450
695A Sweep Oscillator	12.4 to 18 gc	Output 10 mw, accuracy \pm 1%	\$3500
696A Sweep Oscillator	18 to 26.5 gc	Output 10 mw, accuracy \pm 1%	\$4500
697A Sweep Oscillator	26.5 to 40 gc	Output 5 mw, accuracy \pm 1%	\$6500

Electronic or manual sweep; variable sweep rate and width; external leveling \pm 0.1 db plus coupler and detector variation; internal leveling available (Option 01.); square wave, frequency, and amplitude modulation.

Note: This applies to all

Modulators

8403A Modulator		Drives 8730 series or signal sources directly; square wave, pulse and amplitude modulation	\$700
8730 Series PIN Modulators	0.8 to 12.4 gc	Absorption type modulator; 30 db dynamic range for "A" models, 80 db for "B" models; fast rise time	\$300 to \$500

*Cabinet price, rack mount \$20 additional.

**Cabinet price, rack mount \$15 less.

***Transit case only.

****Cabinet price, rack mount \$15 additional.

†3 klystrons required to cover frequency range.

Waveguide Equip.

Description

Frequency Range, Price

281A	Waveguide-to-coax adapters	S281A, \$50; G281A, \$40; J281A, \$35; H281A, \$30; X281A, \$25
292A,B	Waveguide-to-waveguide adapters	HX292B, \$25; MX292B, \$40; MP292B, \$40; NP292A, \$40; NK292A, \$40
370A,B,C,D	Attenuators, fixed, 3, 6, 10, 20 db	S370, \$100; G370, \$95; J370, \$85; H370, \$75; X370, \$65; P370, \$80; K370*, \$115; R370*, \$125
372C,D	Precision Attenuators, fixed	S372, \$425; G372, \$300; J372, \$190; H372, \$135; X372, \$110; P372, \$125; K372*, \$240; R372*, \$275
375A	Flap Attenuators, 20 db maximum	S375A, \$165; G375A, \$145; J375A, \$135; H375A, \$125; X375A, \$100; M375A, \$190; P375A, \$135; K375A*, \$185; R375A*, \$200
382A	Precision Var. Atten. 50 db range	G382A, \$500; J382A, \$375; H382A, \$350; X382A, \$275; M382A, \$650; P382A, \$300; K382A*, \$475; R382A*, \$500
S382B,C	Precision Var. Atten. 60 db range	S382B, calibrated in 0.1° increments, \$600; S382C, calibrated in 0.01° increments, \$650
424A, 422A	Detector Mounts	S424A, \$175; G424A, \$165; J424A, \$165; H424A, \$155; X424A, \$135; M424A, \$250; P424A, \$175; K422A*, \$250; R422A*, \$250
532A	Frequency Meters, direct reading	G532A, \$375; J532A, \$350; H532A, \$300; X532B, \$200; M532A, \$300; P532A, \$275; K532A*, \$350; R532A*, \$400
750	Dir. Couplers, x-guide, 20, 30 db	S750, \$150; G750, \$120; J750, \$100; H750, \$75; X750, \$60
752	Directional Couplers, multi-hole, 3, 10, 20 db	S752, \$400; G752, \$300; J752, \$190; H752, \$135; X752, \$110; M752, \$175; P752, \$125; K752*, \$200; R752*, \$250
810A,B	Slotted Sections for 809B Carriage	S810A†, \$450; G810B, \$125; J810B, \$110; H810B, \$110; X810B, \$90; M810B, \$175; P810B, \$110
815B	Slotted Sections for 814B Carriage	K815B*, \$265; R815B*, \$265
870A	Slide Screw Tuners	S870A, \$250; G870A, \$200; J870A, \$165; H870A, \$140; X870A, \$130; M870A, \$170; P870A, \$140; K870A*, \$250; R870A*, \$300
880A,B	E-H Tuners	X880A, \$130; P880B, \$150
885A	Waveguide Phase Shifters	J885A, \$550; X885A, \$425; P885A, \$600
910A,B	Terminations, low power	S910A, \$75; G910A, \$65; J910A, \$55; H910A, \$45; X910B, \$35; P910A, \$40
S912A, X913A	Terminations, high power	S912A, \$200; X913A, \$100
914A,B	Moving Loads	S914A, \$125; G914A, \$95; J914A, \$85; H914A, \$70; X914B, \$60; M914A, \$85; P914A, \$70; K914B*, \$250; R914B*, \$250
916	Standard Reflection	X916, \$125
920A,B	Adjustable Shorts	S920A, \$150; G920A, \$125; J920A, \$100; H920A, \$85; X920A, \$75; M920A, \$125; P920B, \$125; K920B*, \$155; R920B*, \$155
930A	Waveguide Shorting Switch	X930A, \$160
932A	Harmonic Mixer	P932A, \$250
446B	Broad Band Probe, untuned mounts in 814B Carriage	446B, \$145, 18 to 40 gc

*Circular flange adapters: K-band (UH-425/U), hp 11515A, \$35 ea.; R-band (UG-381/U), hp 11516A, \$40 ea.

†Complete assembly including carriage.

Coaxial Equipment

Description, Features

Price

355C,D	VHF Attenuators, dc to 1000 mc, attenuation 12 db in 1 db steps (355C), dc to 1000 mc, attenuation 120 db in 10 db steps (355D)	\$140
393A	Variable Attenuator, 0.5 to 1 gc, direct reading, capacity to 200 watts average	\$525
394A	Variable Attenuator, 1 to 2 gc, direct reading, capacity to 200 watts average	\$550
420A	Crystal Detector, 10 mc to 12.4 gc; maximum swr 3; sensitivity 0.1 v dc/ μ w cw	\$50
420B	Coaxial Reflectometer Crystal Mount, similar to 420A but improved square-law characteristics: (Matched pair, \$170)	\$75
423A	Crystal Detector, 10 mc to 12.4 gc; maximum swr 1.5; sensitivity 0.4 mv dc/ μ w cw; frequency response \pm 0.5 db	\$125
536A	Coaxial Frequency Meter, direct reading, 960 mc to 4.2 gc	\$500
786D/787D	Directional Detectors, 0.96 to 2.11 gc (786D) and 1.9 to 4.1 gc (787D); frequency response \pm 0.2 db; sensitivity 4 μ v/ μ w; high directivity	\$275
796D/797D	Directional Couplers, 0.96 to 2.11 gc (796D) and 1.9 to 4.1 gc (797D); coupling 20 db; coupling variation \pm 0.2 db; high directivity	\$200
906A	Sliding Coaxial Termination, permits measurements of residual swr of slotted lines, directivity of directional couplers	\$325
908A	50-ohm Coaxial Termination, swr less than 1.05, dc to 4 gc	\$35
934A	Harmonic Mixer, 2 to 12.4 gc	\$150

DY-2650A	Phase locks klystron oscillator signals, 1 to 40 gc, to internal crystal for frequency control	\$1450
DY-2654A	Phase locks klystron signals, 1 to 12.4 gc, to quartz oscillator for frequency control	\$1750

hp MICROWAVE INSTRUMENTATION

Spectrum Analysis—The new Hewlett-Packard 8551A/851A *Spectrum Analyzer* is truly an advance in the state of the art. It provides a 60 db dynamic range, flat response over spectrum widths from 100 kc to 2 gc, and images are 4 gc apart. The controls are calibrated, as are the linear, log and square displays. Thus, quantitative measurements can be made and test conditions easily repeated. A unique signal identifier permits easy identification of all signals on the display. Frequency range is 10 mc to 40 gc.

Power Measurement—Hewlett-Packard bolometric and calorimetric bridges and bolometer mounts measure power from dc to 40 gc.

Model 430C, a low cost automatic self-balancing bridge with full scale ranges from 0.1 to 10 mw, is used with *hp Models 477B* and *487 Thermistor Mounts* for measurements from 10 mc to 40 gc. *Model 430C* may be used with barretter or thermistor mounts and supplies up to 16 ma bias.

Model 431B Microwave Power Meter is particularly well suited for standards measurements because it may be used with precise dc-substitution techniques as well as for direct power measurements. It uses temperature compensated thermistor mounts, making it insensitive to ambient temperature changes, and a recorder output makes the 431B highly useful for drift measurements. *Model 431B* has full scale ranges from 10 μ w to 10 mw and is designed to be used with *hp Model 478A Coaxial Thermistor Mount* (10 mc to 10 gc) and the *486A Waveguide Thermistor Mounts* (2.6 to 40 gc).

Model 434A Calorimetric Power Meter provides a fast, easy method for measuring power accurately from 10 mw to 10 w, a range not covered by bolometer bridges or conventional calorimeters. Power to be measured is connected

directly to the input of the 434A; no external bolometers are needed.

Microwave Amplifiers—Hewlett-Packard manufactures a series of broadband microwave amplifiers. *Models 489A, 491C, 493A, and 495A Microwave Amplifiers* cover the frequency spectrum from 1 to 12.4 gc and provide 1 watt or more output for an input signal of 1 mw. Amplitude modulation circuitry with a passband from dc to >100 kc provides on-off ratios >20 db and power leveling facilities. These amplifiers are light and compact because the TWT's use PPM focusing. The same instrument may be used on the bench or mounted in a 19" equipment rack.

SWR and Impedance Measurement—Impedance measurement in microwave frequencies is simplified with the *hp 415D SWR Meter*, a high gain, low noise, tuned-amplifier type voltmeter calibrated for square law detectors. Each 2.5 db portion of the range may be expanded to full scale for measurements which require high resolution. An optional rechargeable battery pack is available for field measurements.

The low-cost *hp 415B Standing Wave Indicator* provides readings in swr or db for all waveguide and coaxial slotted sections.

Forward and reverse signals are combined and their ratios displayed directly by the *hp 416B Ratio Meter* which operates automatically, irrespective of common amplitude variations in the signals. Suitable for single and swept frequency operation.

Slotted Lines and Carriages—*Models 809B and 814B Universal Probe Carriages* are precision mechanical assemblies operating respectively with *hp 810B and 815B Slotted Sections*. Slotted Sections can be interchanged on the carriages in seconds. The 809B, which also accepts the *806B Coaxial Slotted Section* (3 to

12 gc), has a vernier scale and is equipped for dial gauge mounting. The 814B has a direct reading dial.

Models 805C and 805D Slotted Lines, 500 to 4000 mc, include probe carriage and detector. *Model 805C* is used in type N systems; *Model 805D* in $\frac{7}{8}$ " rigid coax systems.

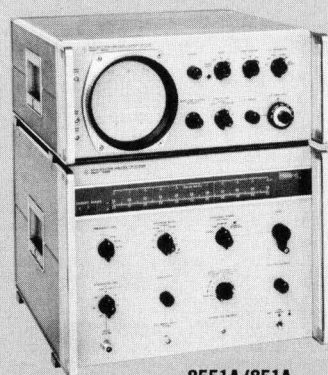
At frequencies below 500 mc, where slotted lines are long and cumbersome, *Model 803A VHF Bridge* measures impedance simply and directly. *Model 803A* measures impedance magnitude from 2 ohms to 2000 ohms over the entire frequency range of 55 to 500 mc and phase angle to 90° lead or lag even at minimum rated frequency. The usable frequency range of the vhf bridge is 5 mc to 1 gc.

Noise Figure Measurements—Noise Figure measurements in microwave receivers are possible with hp noise figure meters and noise sources covering IF through waveguide ranges. The *hp 344A Noise Figure Meter* is usable with radar receivers in any rf range for which noise sources are available. Continuous display of noise figure permits optimizing this noise figure during operation. High sensitivity of the 344A permits decoupling the noise source up to 20 db from the main transmitter line. It is designed for pulse radars with 90 to 500 pps repetition rates. Receiver and component alignment is simplified with the *hp 340B and 342B Noise Figure Meters*, which measure and continuously display IF or rf amplifier noise figures. Four noise sources are available for use with hp noise figure meters.

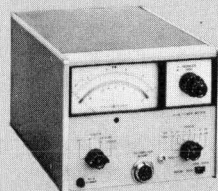
Additional Information—Data on the broad line of Hewlett-Packard microwave instrumentation is available from your nearest Hewlett-Packard field sales office.

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

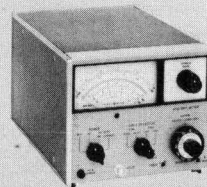
INSTRUMENTS FOR MICROWAVE SPECTRUM ANALYSIS AND POWER, IMPEDANCE AND NOISE FIGURE MEASURING



8551A/851A



431B



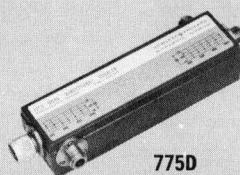
415D



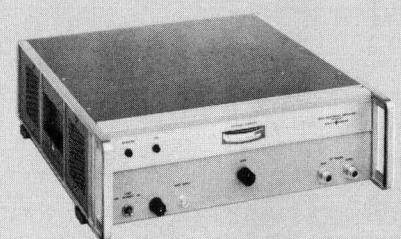
486A



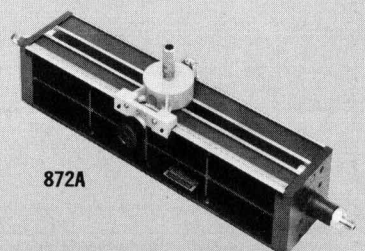
478A



775D



495A



872A

Spectrum Analysis	Primary Uses	Frequency Ranges	Characteristics	Price
851A Display Section	Adjustment of signal sources, detection of spurious signals, observation of side bands, spectrum signature work, EMC-RFI work, calibration of attenuators and wave meters, adjustments of harmonic generators	Determined by rf section	Calibrated IF attenuator, IF bandwidth, sweep rate and vertical display (linear, square, log); 60 db dynamic range; manual or automatic bandwidth selection Spectrum widths, 100 kc to 2 gc; frequency response, ± 5 db over 2 gc, ± 2 db over 200 mc; image separation, 4 gc; sensitivity, -80 dbm (coax), -65 dbm (waveguide)	\$2400
8551A RF Section		Coaxial input: 10 mc to 10 gc; waveguide input: 8.2 to 40 gc (accessory mixers and taper sections required)		\$7100
Power Measurement	Primary Uses	Frequency Range	Characteristics	Price
430C Microwave Power Meter	Measure rf power 0.02 to 10 mw	10 mc to 40 gc, depending on bolometer mount	Accuracy $\pm 5\%$, direct readings in dbm or mw	\$250*
431B Microwave Power Meter	Measure rf power 1 μ w to 10 mw	10 mc to 40 gc, depending on thermistor mount	Accuracy $\pm 3\%$, direct readings, temperature compensated	\$450
434A Calorimetric Power Meter	Measure rf power 10 mw to 10 watts (full scale)	dc to 12.4 gc	Accuracy within 5% full scale; response less than 5 sec.	\$1600**
477B Coaxial Thermistor Mount	Use with 430C for power measurement	10 mc to 10 gc	swr less than 1.5, no tuning required	\$75
478A Coaxial Thermistor Mount	Use with 431B for power measurement	10 mc to 10 gc	Low drift, swr less than 1.5	\$155
486A Thermistor Mounts	Use with 431B for power measurement	2.6 to 40 gc, 9 models, S- through R-Bands	Temperature compensated, swr less than 1.5, except K,R, 2.0	\$145 to \$375
487B,C Broadband Waveguide Thermistor Mounts	Use with 430C for power measurement	2.6 to 40 gc, 9 models	Full coverage, no tuning; swr 1.5 except K487C, R487B, 2.0	\$75 to \$275
Microwave Amplifiers	Primary Uses	Frequency Range	Characteristics	Price
489A Microwave Amplifier	Medium power L-Band amplification	1 to 2 gc	30 db gain, 1 watt output	\$2300
491C Microwave Amplifier	Medium power S-Band amplification	2 to 4 gc	30 db gain, 1 watt output	\$2300
493A Microwave Amplifier	Medium power G- and J-Band amplification	4 to 8 gc	30 db gain, 1 watt output	\$2900
495A Microwave Amplifier	Medium power X-Band amplification	7 to 12.4 gc	30 db gain, 1 watt output	\$2900
Impedance Measurement	Primary Uses	Frequency Range	Characteristics	Price
774D-777D Dual Directional Couplers	Reflectometer and rf power measurements	215 to 4000 mc; each covers full octave	Coupling attenuation 20 db, high directivity***	\$200 each
360A-D Low Pass Filters	Eliminate harmonic voltages from uhf systems	Cut-off frequencies: A-700 mc, B-1200 mc, C-2200 mc, D-4100 mc	50 db rejection at 1.25 cut-off frequency	A-\$70 B-\$60 C-\$50 D-\$50
362A Low Pass Filters	Suppress harmonics for slotted section measurements, etc.	8.2 to 40 gc, six models	Rejection at least 40 db in stop band (>35 db for R362A); low insertion loss	\$325 to \$385
415B Standing Wave Indicator	swr or null indicator	1000 cps $\pm 2\%$ (tuned frequency)	0 to 70 db attenuation, maximum sensitivity 0.1 μ v	\$225*
415D SWR Meter	swr or null indicator, high gain tuned amplifier	1000 cps $\pm 5\%$; bandwidth, 13 to 130 cps (tuned frequency)	0 to 70 db full scale expansion for any 2.5 db increment, maximum sensitivity 0.04 μ v	\$350
416B Ratio Meter	Reflectometer measurements	1000 cps $\pm 4\%$ (tuned frequency)	Continuous swept frequency presentation, accuracy $\pm 3\%$	\$590**
417A VHF Detector	vhf bridge detector hp 803A	10 to 500 mc	Approximately 5 μ v sensitivity	\$550
440A Detector Mount	Use with 809B and 442B	2.6 to 12.4 gc	Detect rf energy in coax or slotted waveguide systems	\$85
442B Broadband Probe	Use with 809B Carriage, 806B,810B Slotted Sections	2.6 to 12.4 gc	rf output appears at female Type N	\$50
444A Untuned Probe	Use with 809B Carriage, 806B,810B Slotted Sections	2.6 to 18 gc	Broadband detector	\$55
446B Untuned Probe	Use with 814B Carriage, 815B Slotted Sections	18 to 40 gc	Broadband detector	\$145
476A Bolometer Mount	Use with 415B, 416B for square-law detection	10 mc to 1 gc	swr less than 1.25, no tuning required	\$85
485B Waveguide Detector Mounts	Reflectometer measurements	3.95 to 12.4 gc	Full coverage of waveguide band	\$75 to \$100
803A VHF Bridge	Measure vhf impedance, swr	55 to 500 mc	2 to 2000 ohms impedance, -90° to +90° phase angle	\$1250
805C Coaxial Slotted Section	Measure swr	500 to 4000 mc	Type N Connectors, flexible cables	\$525
805D Coaxial Slotted Section	Measure swr	500 to 4000 mc	For rigid 1/8" RG44/U line	\$600
806B Coaxial Slotted Section	Measure swr	3 to 12 gc	Type N Connectors, mounts in 809B	\$200
809B Universal Probe Carriage	For 806B, also supports G, C, J, H, X, M and P810B Waveguide Sections		Accepts 442B, 444A Probes	\$175
810B Waveguide Slotted Sections	Use with 809B Universal Probe Carriage	3.95 to 18 gc	Slot reflection less than 1.01 swr	\$90 to \$175
814B Universal Probe Carriage	Supports K and R815B Waveguide Slotted Sections		Accepts 446B Untuned Probe	\$225
815B Waveguide Slotted Sections	For use with 814B Carriage	K-18 to 26.5 gc R-26.5 to 40 gc	Maximum swr, 1.01	\$265
872A Coaxial Slide Screw Tuner	Correcting discontinuities, matching coax systems	500 to 4000 mc	Correctable swr, 5; insertion loss, 0.5 db or less	\$525
Noise Figure Measurement	Primary Uses	Frequency Range	Characteristics	Price
340B Noise Figure Meter	Fast alignment of receivers and components	Depends on noise source, 10 mc to 18 gc	IF input range 30 or 60 mc, others available on order	\$715***
342A Noise Figure Meter	Noise figure measurement on receivers, components	Depends on noise source, 10 mc to 18 gc	Operates on 30, 60, 70, 105, 200 mc; other frequencies on special order	\$815***
343A VHF Noise Source	Broadband noise source	10 to 600 mc	5.2 db excess noise, 50 ohm source	\$100
344A Noise Figure Meter	Measure NF on radars	IF range: 15 to 100 mc, specify	Useful with radars	\$1650‡
344A-78G Modulator	Fires noise sources for 344A		Included with 344A Noise Figure Meter	\$250
345B IF Noise Source	5.2 db source for IF noise measurement	30 or 60 mc, others available	Matches 50, 100, 200, 400 ohms	\$100
347A Waveguide Noise Sources	Gas discharge sources	S, G, J, H, X, P-Bands 2.6 to 18 gc	Nominal excess noise 15.1 to 16 db, depending upon frequency	\$225 to \$390
349A UHF Noise Source	Gas discharge source (coax.)	400 to 4000 mc	Nominal excess noise 15.1 to 16 db, depending upon frequency	\$325

*Price for cabinet model, rack mount \$5 more. **Price for cabinet model, rack mount \$15 less.

***Power handling capacity of all 770 series couplers 50 watts cw, 10 kw peak. ‡Approximately, depends on options, modulations. ■ Not available in Europe.

BOONTON MEASURING INSTRUMENTS

Boonton Radio Company, division of Hewlett-Packard, produces three general types of precision electronic laboratory instruments: Impedance measuring instruments, including Q meters, rf bridges, production Q comparators and transistor test equipment in the 1 kc to 600 mc range; FM-AM signal generators and accessory equipment, including sweep signal generators, power amplifiers, FM stereo modulators and signal generator calibrators in the 1 kc to 500 mc range and specialized signal generators for the testing and calibration of aircraft VOR, ILS, DME and ATC beacon systems.

Q Meters, which measure the Q or "figure of merit" of coils, are flexible, broadly general purpose instruments useful in the measurement of components and systems in a wide range of applications. The Q meter consists of a self-contained, continuously variable, stable oscillator, whose controlled and measured output is applied to a calibrated, series-tuned resonant circuit. In the *Boonton 260A* and *190A*, a high-impedance vtvm is connected across the internal variable capacitor portion of the tuned circuit to measure the reactive voltage in terms of circuit Q. Q meters are useful for measurement of coils, capacitors, resistors and dielectric materials.

250A RX Meter, is a self-contained ex-

tremely wide-range rf bridge for use in measuring the equivalent parallel resistance and capacitance of two terminal networks. It includes an accurate, continuously tuned oscillator, high-frequency bridge, amplifier-detector and null indicating meter.

265A Q Comparator, essentially a "production Q meter," is designed for rapid inspection of coils, capacitors, resistors and other components for both Q and L-C. It consists of a swept-frequency oscillator, Q meter-type measuring circuit with detector and a crt indicator which reads out percentage of departure from a standard.

275A Transistor Test Set, is a completely self-contained instrument, including continuously variable bias supplies, for the precision measurement of basic transistor parameters, as well as the characteristics of diodes and other semiconductor devices. It provides direct-reading measurement of alpha, beta and input resistance and, when used in conjunction with the *250A RX Meter*, will predict transistor characteristics up to several gc.

FM-AM Signal Generators include *Type 202H* for testing and calibrating FM receiving systems in broadcast FM, vhf-tv and mobile communications,

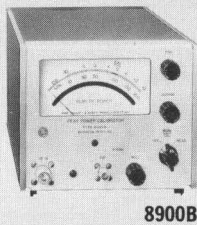
and *Type 202J*, specifically designed for coverage of the vhf telemetering band. *207H Accessory Univerter*, provides IF coverage when used with either the *202H* or *202J*. Others are the *Type 225A*, a high-stability, general purpose model, and the *Type 240A*, a sweep signal generator for visual alignment of broad-band circuits and its accessory Univerter, *Type 203B*, extending the lower limit of basic frequency coverage.

219A FM Stereo Modulator provides a multiplex output signal for the recently approved FM stereo broadcast system in accordance with FCC Docket 13506. The output of the *219A* may be used directly for the test and alignment of base-band circuits or may be used to modulate the *202H Signal Generator* providing a complete stereo signal at rf.

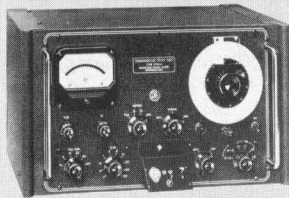
230A Signal Generator Power Amplifier, when driven with a conventional signal generator, provides high-level rf power for use in receiver testing, voltmeter and wattmeter calibration, attenuation measurements, and antenna, filter, and component testing. Because of its excellent noise figure, the *230A* is also well suited to low-level applications, including receiver pre-selection, tuned selective filtering, harmonic amplification and pre-amplification for electronic frequency counters.

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

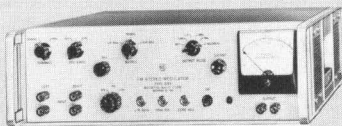
IMPEDANCE-MEASURING, FM-AM SIGNAL GENERATORS, VOR/ILS/DME TEST EQUIPMENT



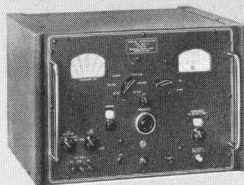
8900B



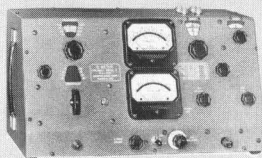
275A



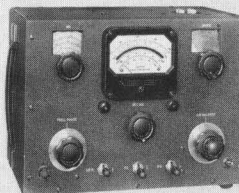
219A



225A



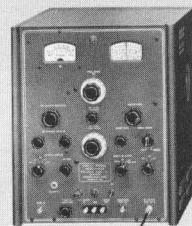
260A



190A



245C



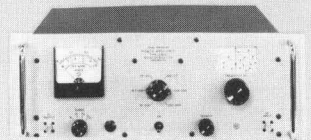
240A



211A



207H



230A

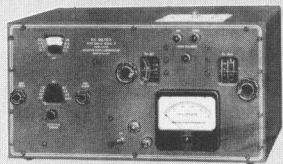
245C,D Signal Generator Calibrators provide a rapid and convenient means for checking and calibrating the rf output and amplitude modulation of signal generators. They also provide calibrated rf levels in the microvolt range for the precision measurement of receiver sensitivity.

8900B Peak Power Calibrator provides a convenient means of directly reading the peak rf power of pulses. The power level, indicated directly on the panel meter, is completely independent of duty cycle. The instrument consists of a precision terminated input circuit, diode detector, dc reference supply and a chopped video output system. May be readily standardized against external bolometer or calorimeter.

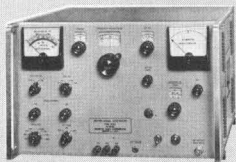
Aircraft VOR/ILS/DME/ATC Beacon Test Equipment includes specialized signal generators for the testing and calibration of aircraft systems. *Crystal Monitored Signal Generator Type 211A* provides coverage for VOR and ILS localizer, as well as VHF communications; *Glide Slope Signal Generator Type 232A* provides coverage for ILS glide slope; *DME/ATC Test Set Type 8925A* provides complete facilities for DME and the ATC Beacon.

Q METERS							
Type	RF Range	Total Q Range	Res. C Range	L Range	Price		
260A 190A	50 kc to 50 mc 20 mc to 260·mc	10 to 625 5 to 1200	30 to 460 pf 7.5 to 100 pf	0.09 μh to 130 mh 4 mμh to 8.5 μh	\$990 \$995		
RX METER							
Type	RF Range	Resistance Range	Capacitance Range	Inductance Range	Measurement Voltage Level	Price	
250A	500 kc to 250 mc	15 to 100,000 ohms	0 to 20 pf (to 120 pf with auxiliary coils)	0.001 μh to 100 mh (depends on freq.)	0.05 to 0.75 v (may be reduced to 20 mv)	\$1695	
Q COMPARATOR							
Type	RF Range	Q Range	% Q Range	L Range	C Range	% L-C Range	Price
265A	200 kc to 70 mc	30 to 500	±25%	0.15 μh to 15 mh (depends on freq.)	5 pf to 0.01 μf	±5% or ±20% of standard, full scale	\$975
TRANSISTOR TEST SET							
Type	Alpha Range	Beta Range	Input Resistance Range	Test Oscillator Frequency	Collector V Range	Emitter I Range	Price
275A	0.1 to 0.9999	7 to 200	0.30 to 3000 ohms	1000 cps	0 to 100 v dc	0 to 100 ma (0 to 5 a external)	\$975
FM-AM SIGNAL GENERATORS							
Type	RF Range	RF Output	FM Dev.	AM Range	Price		
202H	54 mc to 216 mc	0.1 μv to 0.2 v	0 to 250 kc	0 to 100%	\$1365		
202J	195 mc to 270 mc	0.1 μv to 0.2 v	0 to 300 kc	0 to 100%	\$1475		
225A	10 mc to 500 mc	0.1 μv to 0.1 v	0 to 60 kc	0 to 30%	\$1050		
240A	4.5 mc to 120 mc	1 μv to 0.3 v	±1% to ±30%	30%	\$1995		
UNIVERTERS							
Type	RF Range	Accessory To	RF Output Range	Price			
203B	100 kc to 25 mc	240A 202H,J	1 μv to 2 v	\$445			
207H	100 kc to 55 mc		1 μv to >1 v	\$525			
SIGNAL GENERATOR POWER AMPLIFIER							
Type	RF Range	RF Output	RF Gain	RF Bandwidth	Price		
230A	10 to 500 mc	0 to 15 v across external 50-ohm load	30 db (10 to 125 mc) 27 db (125 to 250 mc) 24 db (250 to 500 mc)	>700 kc (10 to 150 mc) >1.4 mc (150 to 500 mc)	\$1200		
FM STEREO MODULATOR							
Type	(L) and (R) Freq. Range	SCA Freq. Range	Internal Oscillator Freq.	Output Level	Residual Hum, Noise	Crosstalk	Price
219A	50 cps to 15 kc	20 to 75 kc	1 kc	0 to 7.5 v pk.	>60 db below 100% output	>40 db below 100% output	\$975
SIGNAL GENERATOR CALIBRATORS							
Type	RF Range	RF Input Voltage Measurement Levels	RF Output Voltage	AM Range	Price		
245C	500 kc to 1000 mc	0.025, 0.05, 0.1 v	5, 10, 20 μv	10 to 100%	\$460		
245D	500 kc to 1000 mc	0.025, 0.05, 0.1 v	0.5, 1, 2 μv	10 to 100%	\$455		
PEAK POWER CALIBRATOR							
Type	RF Range	RF Power Range	RF Power Accuracy	RF Pulse Width	RF Repetition Rate	Price	
8900B	50 mc to 2000 mc	200 mw peak f. s.	±1.5 db*	>0.25 μsec	1.5 mc max.	\$485	
AIRCRAFT SIGNAL GENERATORS							
Type	RF Range	RF Output Range	Calibrates	Price			
211A	88 mc to 140 mc	0.1 μv to 0.2 v	VOR, ILS Localizer	\$1990			
232A	329.3 mc to 335 mc	1 μv to 0.2 v	ILS Glide Slope	\$2175			
8925A	950 mc to 1250 mc	-10 to -120 dbm	DME & ATC Transponder	\$12,115			

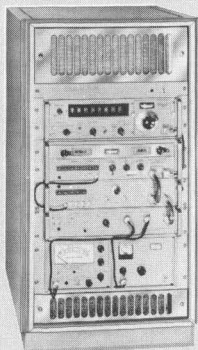
*±0.6 db with custom calibration curve, add \$75.



250A



202J



8925A

DYMEC DIGITAL INSTRUMENTATION

Dymec Division of Hewlett-Packard offers instruments for digital data acquisition and rf measurement and control. Dymec also offers complete systems, engineered and tested for maximum performance and reliability and available at low cost and with minimum delivery delay. Dymec digital systems and instruments are defined on these pages; RF instrumentation is covered on pages 24 and 25.

Data Acquisition Systems from Dymec include two basic series of versatile standard packages engineered for a variety of input and output situations. The *DY-2010 Series* of systems measures dc voltage and frequency. Optional equipment permits measurement of ac voltage, 50 cps to 100 kc; resistance, 100 ohms to 10 megohms full scale, and dc measurements of ± 10 mv full scale. Programmable high-low limit comparison can be accomplished on any of the above parameters. System operation can be controlled by either pinboard or punched-tape programming. In this series the measuring element is the floated and guarded *DY-2401B Integrating Digital Voltmeter*, which permits accurate low-level measurement

even in the presence of severe common mode and superimposed noise. The *DY-2013 Series*, which incorporates the hp 3440A Digital Voltmeter as its measuring device, provides multiple-point scanning capability with output on a variety of media, at an economical price.

Data Plotting Instrumentation systems produce graphical plots from digital information stored in punched cards, perforated tape or magnetic tape. The *DY-2030* accepts data directly from perforated tape or operates from a punched card reader. Data also can be entered manually. A paper tape editor provides direct x-y graphical output of data recorded digitally on punched tape. No other equipment or intermediate steps are required.

Dymec Input Scanners permit multiple signals to be measured with one measuring instrument or system. Operating modes include a continuous-scan, single-scan and single-step, with manual or remote control capability. The *DY-2900* scans up to 50 1-wire or 25 2-wire inputs. The *DY-2901* scans 25 3-wire inputs and programs all functions of the associated measuring instrument. *DY-2911* is a 600-point guarded cross-

bar scanner designed for low-level dc voltage scanning.

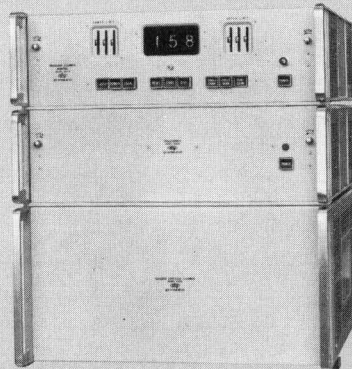
Signal Conditioning Devices translate the analog signal to a form acceptable by the analog-to-digital converter. Included are the *DY 2411A Guarded Data Amplifier* and the *DY-2410B AC/Ohms Converter*. Both instruments are fully programmable and compatible with the *DY-2401B Integrating Digital Voltmeter*.

Analog-to-Digital Converters include Dymec voltage-to-frequency converters and integrating digital voltmeter. The *voltage-to-frequency converters, Models DY-2210, DY-2211A,B, DY-5207-1*, permit voltage to be measured with an electronic counter by converting the signal to a proportional pulse rate. The floated and guarded *DY-2401B Integrating Digital Voltmeter* permits accurate low-level voltage measurements even in the presence of severe common mode noise. Completely programmable for systems use.

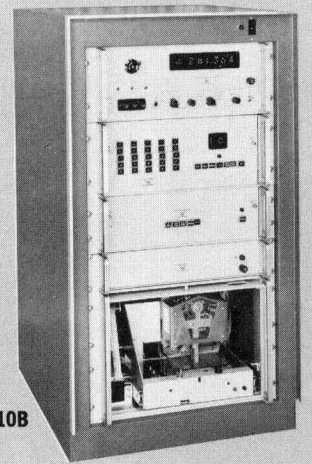
Output Couplers transfer and translate data from digital voltmeters, counters and digital clocks to digital recording devices and comparators. Standard input is 4-2-2-1 BCD.

INSTRUMENTS, SYSTEMS FOR DATA ACQUISITION, DATA PLOTTING

DY-2911A,B,C

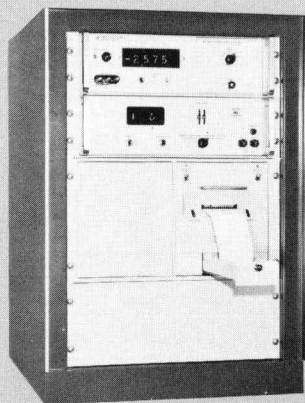
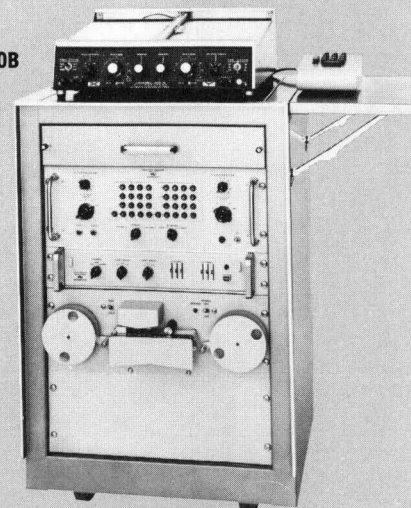


DY-2010B

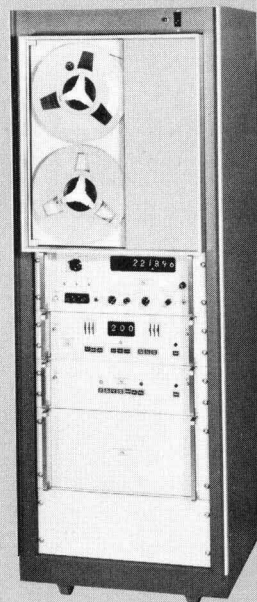


D-2401B

DY-2030B



DY-2013A



DY-2010J

Data Acquisition Systems	DY-2010A	DY-2010B	DY-2010E	DY-2010H	DY-2010C	DY-2010D	DY-2010F	DY-2010J	
Scanner input	Up to 25 3-wire signal sources; to 100 channels with slave scanners; programming capacity permits measurement of mixed types and levels of signals				Up to 200 guarded 3-wire inputs; to 600 non-guarded 1-wire inputs				
Voltage ranges	100 mv to 1000 v full scale; overranging to $\pm 300\%$ of full scale on four most sensitive ranges; 0.01% stability on four highest ranges								
Frequency ranges	10 cps to 300 kc; sample period 0.01, 0.1 or 1 sec								
Display	5 digits of data (optional 6), range, function (polarity), channel number, all included in readout and output recording								
Measurement speed	5 channels/sec	10 channels/sec	1 channel/sec	10 channels/sec	5 channels/sec	10 channels/sec	1 channel/sec	10 channels/sec	
Effective common mode rejection	105 db				130 db				
Output	Printed paper tape	Perforated tape	Punched card (IBM 526)	Magnetic tape	Printed paper tape	Perforated tape	Punched card (IBM 526)	Magnetic tape	
Price	\$8675‡	\$10,800‡	\$9885	\$15,365‡	\$10,965‡	\$12,850‡	\$12,175‡	\$17,415‡	
Options	Time of day, ac voltage and resistance measurements, 10 mv full-scale sensitivity, automatic limit comparison, high-speed printer, cabinet								

	DY-2013A	DY-2013B	DY-2013C	DY-2013D	DY-2013E	DY-2013J	DY-2013K	DY-2013L	DY-2013M	DY-2013N
Scanner input	25 2-wire or 50 1-wire, single-ended inputs; upper limit scan selection					Up to 25 3-wire signal sources; to 100 channels with slave scanners, single-ended inputs; channels individually selected				
Display	4 digits of data, range, polarity all included in readout and output recording									
Speed	100 channels/min	60 channels/min	40 channels/min	40 channels/min	100 channels/min	100 channels/min	60 channels/min	40 channels/min	40 channels/min	100 channels/min
Output	Printed paper tape	Perforated tape	Typewritten sheet	Punched card (IBM 024, IBM 026)	Punched card (IBM 526)	Printed paper tape	Perforated tape	Typewritten sheet	Punched card (IBM 024, IBM 026)	Punched card (IBM 526)
Price	\$4330‡	\$4985	\$5930	\$4190	\$5660	\$4960‡	\$5590	\$5995	\$4795	\$6225
Options	Time of day, ac voltage measurements, automatic ranging, cabinet									

Data Plotting Systems	Features	Input	Plot	Price
DY-2030A DY-2030B DY-2030C DY-2030D	Accepts data directly from perforated tape, punched card reader or, manually, from 10-digit keyboard; plots graphic recording of data; 4-digit resolution both axes, plotting speed 50 points/min for punched cards, 120 points/min for perforated tape; plot accuracy better than 0.15% of full scale	Cards Tape Cards Tape	11" x 17" 11" x 17" 30" x 30" 30" x 30"	\$6975 ■ \$7975 ■ \$11,360 ■ \$12,360 ■
DY-2734A	Tape editor provides interface between data acquisition and data plotting; permits DY-2030B and D systems to produce x-y plots from data acquired by DY-2010, DY-2013 and other systems producing perforated tape output			\$2900

Input Scanners	Features	Price
DY-2900B	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	\$1180
DY-2901A	Scans 25 3-wire inputs, programs all functions of associated system; pushbutton selection of channels to be scanned; pin-board inside scanner programs each channel for system functions and measurement delay; expandable in 25-channel increments with slave scanners	\$1950 slaves; \$1750
DY-2911	Crossbar switch is guarded for rejection of common mode noise, scans 600 1-wire, 300 2-wire, 200 3-wire, 100 6-wire inputs; lower and upper scan limits selectable at front panel, with random access to any channel; monitored channel indicated by in-line display and 4-2-2-1 BCD output; an optional programmer, DY-2911C, permits mixing types and levels of inputs and skipping random channels	\$4650

Signal Conditioners	Features	Price
DY-2410B	Permits floated and guarded, broadband low-level ac voltage measurements, 50 cps to 100 kc, 100 mv to 750 v full scale, and fast resistance measurements, 100 ohms to 10 megohms full scale; the converter is fully programmable; optional auto-ranging and 6-digit readout available	\$2250*‡
DY-2411A	Amplifier; Expands DY-2401B capability down to ± 10 mv full scale, with db common mode rejection; features 10,000 megohm input resistance, fast overload recovery and rapid rise time design, full programmability	\$1150

Integrating Digital Voltmeter	Features	Price
DY-2401B	Voltage ranges, frequency measuring ranges and display listed in "DY-2010" section above; accurate measurement of low-level signals in the presence of high common mode noise, accomplished by floated and guarded measuring circuitry and average-reading characteristics; effective common mode rejection 140 db at all noise frequencies; fully programmable	\$3950

Output Couplers	Features	Price
DY-2526	Couples DY-2401B or electronic counter to IBM 526 Card Punch; standard model accepts 10 input digits in BCD form and features data storage for high-speed operation; all solid state	\$3100 ■
DY-2540	Operates with serial-entry tape punches, card punches, typewriters, Flexowriters; up to 25 input characters standard, to 50 optional; max. recording speed, 20 character/sec	Typically, \$1200 to \$2500 ■
DY-2545	Operates with Teletype BRPE 11 Tape Punch, records at 110 characters/sec; standard model accepts 10 input digits in BCD form, from DY-2401B or electronic counter, produces IBM 8-level code; up to 16 input characters and other 5- to 8-level output codes optional; all solid state, features data storage for high-speed operation	\$3900 including tape punch
DY-2546A	Operates with Cook Model 150 Incremental Tape Recorder, records at 150 characters per second, standard model accepts output format for maximum computer-compatibility; all solid state, features data storage	\$8565, including magnetic tape transport

‡Slight additional charge for 115/230 volt, 50-cycle operation. *AC only, \$1850; Ohms only, \$1650. ■ Available in U.S.A. and Canada only.

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