

ELECTRONIC TEST INSTRUMENTS

SHORT FORM CATALOG 1963/64



HEWLETT-PACKARD COMPANY
1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA
Area Code 415, 326-7000

HEWLETT-PACKARD

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BOONTON RADIO

Pages 24-25

HARRISON LABS

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DYMEC

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SANBORN

Pages 20-21

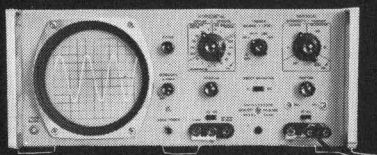
F. L. MOSELEY CO.

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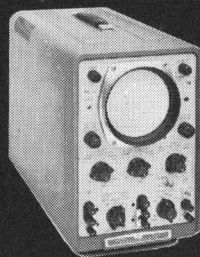
hp OSCILLOSCOPES, BANDWIDTHS TO

LOW FREQUENCY SCOPES

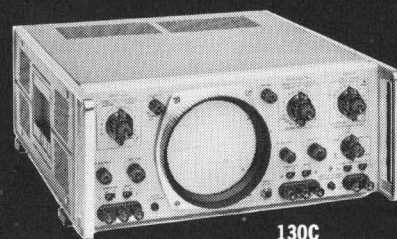
- Bandwidths to 500 kc, sensitivities to 200 $\mu\text{V}/\text{cm}$
- Single or dual channels
- Automatic triggering on all models, calibrated sweeps
- No-parallax, no-glare 10 x 10 crt's



120B



122A



130C

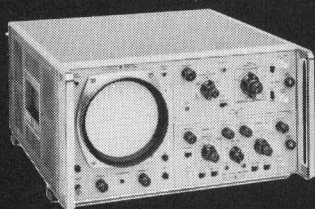
120B Scope DC to 450 KC—Four calibrated vertical ranges, 10 mv/cm to 10 v/cm: 15 calibrated sweeps from 1 $\mu\text{sec}/\text{cm}$ to 200 ms/cm, $\pm 5\%$; x5 sweep magnifier works on all ranges; horizontal amplifier has 3 calibrated steps 100 mv/cm to 10 v/cm. For x-y, phase shift between vertical 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 1 $\mu\text{sec}/\text{cm}$ 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 mv/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.

NEW 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 with 1401A and 1420A



1400A

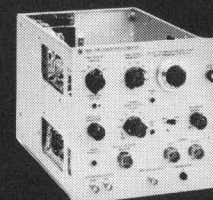
1421A



1402A



1403A



1415A

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 of 40 db.

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.

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 300 kc. Both upper and lower limits are selectable. Differential input with common mode rejection of 94 db. Noise, 20 μV p-p at full bandwidth.

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 ns/cm. Triggers internally to over 20 mc, single sweep.

1421A Time Base and Delay Generator—22 ranges 0.1 $\mu\text{s}/\text{cm}$ to 1 sec/cm $\pm 3\%$; x5 magnifier extends fastest sweep to 20 ns/cm. Triggers internally to over 20 mc; single sweep. Calibrated delay time 0.1 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 reflections from discontinuities in transmission systems. BW equivalent to 3500 mc. Reflection coefficients of 0.001 can be observed. Includes 90 ps rise time sampler and 50 ps rise time pulse generator. Sweeps 20 ns/cm to 200 ns/cm with x1 to x200 magnifier. 0 to 2000 ns delay for examining long transmission lines.

CAMERAS	Features	Price
196A	75mm, f1.9 lens, 3 1/4 x 4 1/4 Polaroid for std. crt's	\$395
196B	75mm, f1.9 lens, 3 1/4 x 4 1/4 Polaroid for std. and IG crt's	\$445
CURRENT PROBE AND AMPLIFIER		
1110A	Probe: 1 mv/ma, 1700 cps to 50 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.		

3500 MC, SENSITIVITIES TO 10 $\mu\text{V}/\text{CM}$

OSCILLOSCOPES
DC to 3500 MC

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 $\mu\text{s}/\text{cm}$ to 200 ms/cm	Beam finder, automatic sync	\$475
122A	Two	dc to 200 kc	10 mv/cm to 10 v/cm	1 $\mu\text{s}/\text{cm}$ to 200 ms/cm	Diff. input, automatic sync	\$695
130C	One	dc to 500 kc	200 $\mu\text{V}/\text{cm}$ to 20 v/cm	0.2 $\mu\text{s}/\text{cm}$ 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 $\mu\text{V}/\text{cm}$	From 20 ns/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 $\mu\text{V}/\text{cm}$ 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		Diff. input; A + B	\$550
1403A	One	0.1 cps to 300 kc	10 $\mu\text{V}/\text{cm}$ to 100 mv/cm		Diff. input, selectable bandwidth	\$350
Combination Plug-In	Description	Use		Features		Price
1415A	Time Domain Reflectometer	Analyze discontinuities in high frequency transmission systems		Pulse generator: rise time, approx. 50 ps; amplitude, 0.25 volts into 50 ohms Vertical amplifier: rise time, 90 ps; sensitivity, 1 mv/cm to 0.1 v/cm Time base: 20 ns/cm to 200 ns/cm, x1 to x200 magnifier		\$950
Horizontal Plug-Ins						
1420A	Time Base	Provides sweeps for 140A		0.5 $\mu\text{s}/\text{cm}$ to 5 sec/cm, x10 magnifier, automatic triggering		\$250
1421A	Time Base	Provides normal and delayed sweeps for 140A		0.1 $\mu\text{s}/\text{cm}$ to 1 sec/cm, x5 magnifier; delay time, 0.1 μsec to 10 sec		\$625
Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
175A*	Up to four	Up to 50 mc	Up to 5 mv/cm	10 ns/cm to 5 sec/cm	6 x 10 cm display, tunnel diode triggering	\$1325
Vertical Plug-Ins**						
1750A	Two	dc to 40 mc	50 mv/cm to 20 v/cm		Diff. input, 9 ns rise time	\$285
1751A	One	dc to 50 mc	50 mv/cm to 20 v/cm		7 ns 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 ns rise time	\$595
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, 1 μsec to 10 sec; jitter less than $\pm 0.002\%$; mixed sweep		\$375
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 $\pm 0.5\%$		\$130
SAMPLING OSCILLOSCOPES						
Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
185B	Up to two	Up to 100 ps rise time (3500 mc)	Up to 1 mv/cm	0.1 ns/cm to 10 $\mu\text{sec}/\text{cm}$	Sync to 1000 mc, beam finder	\$2300
Plug-Ins						
187B	Two	350 ps rise time	4 mv/cm to 200 mv/cm		100 k, 2 pf probes, diff. input	\$1000
188A	Two	100 ps rise time	1 mv/cm to 200 mv/cm		Feed thru 50 ohm input, diff. input	Price on Request
186A	One	0.5 ns rise time	4 mv/cm to 10 v/cm		1 ns, 20 v pulse generator, 2 power supplies	\$1500
Sampling Accessories	Description	Use		Features		Price
1100A	Delay Line	View signals where suitable triggers are not available		Includes delay line, sync take-off and load		\$300
1102A	Accessory Kit	Measure larger signals, reduce loading, sample 50 ohm systems		Includes dividers, blocking capacitors, and 50 ohm tee		\$300
MILITARIZED OSCILLOSCOPES						
Model	Channels	Bandwidth	Sensitivity	Sweep Range	Other Features	Price
H02-160B	Up to two	Up to 15 mc	Up to 5 mv/cm	20 ns/cm to 5 sec/cm	Meets rugged military environmental specifications	\$2250
H02-170A	Up to two	Up to 30 mc	Up to 5 mv/cm	20 ns/cm to 5 sec/cm		\$2350
Vertical Plug-Ins						
H02-162A	Two	160B-14 mc, 170A-22 mc	20 mv/cm to 20 v/cm		Diff. input	\$420
H02-162B	Two	160B-15 mc, 170A-30 mc	50 mv/cm to 20 v/cm		Diff. input	\$390
H02-162D	One	160B-14 mc, 170A-22 mc	5 mv/cm to 20 v/cm		Diff. input, 4 low ranges	\$260
H02-162F	One	160B-15 mc, 170A-30 mc	50 mv/cm to 20 v/cm		12 ns rise time with 170A	\$185
Horizontal Plug-Ins	Description	Use		Features		Price
H02-166A	Auxiliary	Allows 160B, 170A to perform standard functions		Normal or single sweeps		\$35
H02-166B	Time Mark Generator	Provides synchronized intensity modulated time markers		Range: 10, 1, 0.1 μsec ; accuracy: $\pm 0.5\%$		\$165
H02-166C	Display Scanner	Permits permanent recordings on x-y recorders of waveforms		20 mc bandwidth with 170A; internal or external scanning		\$300
H02-166D	Sweep Delay Generator	Allows detailed analysis of complex signals or pulses		Sweep delays, 1 μsec to 10 sec; mixed sweep		\$435

* Extra fast writing rate model also available for photographing high speed transients. Ask your field engineer about the hp H30-175A.
** Special plug-ins with 2.5 ns rise time also available. Ask your field engineer about the K01-1759A and K02-1759A.

hp 175A 50 MC UNIVERSAL OSCILLOSCOPE

- Bandwidth to 50 mc, sensitivities to 5 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 ns/cm. Preset internal triggering to over 50 mc. 1% calibrator.

VERTICAL PLUG-INS

1750A 40 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 40 mc (9 ns rise time). Differential input with common mode rejection of 40 db.

1751A 50 MC Single Channel—Nine calibrated sensitivities 50 mv/cm to 20 v/cm with 7 ns 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 of different levels.

1754A 40 MC Four Channel—Four traces presented in chopped or on alternate sweeps. Each channel has nine cali-

brated ranges 50 mv/cm to 20 v/cm with bandwidth dc to 40 mc (9 ns rise time). Has sync amplifier for triggering on any channel and trace identifier.

HORIZONTAL PLUG-INS

1780A Auxiliary—Allows 175A to perform all standard functions. Single sweep included with internal or external arming.

1781B Sweep Delay—Provides calibrated delay times from 1 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.

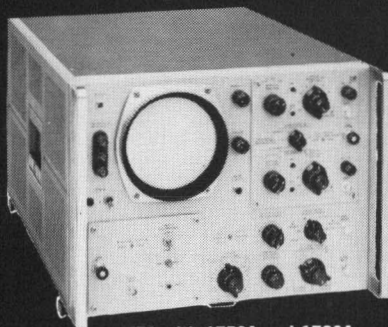
PROBES, ADAPTERS, AND VIEWING HOODS

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	10 pf	5'
10002B/D*	50:1	dc to 30 mc	9	20 pf	10'
10003A/B*	10:1	dc to 40 mc	10	10 pf	4'

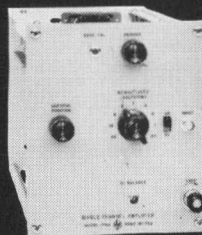
*These probes have black identification boots; the others have red. Price \$30 each.

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

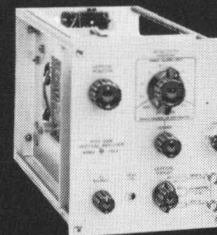
NEW INSTRUMENTS



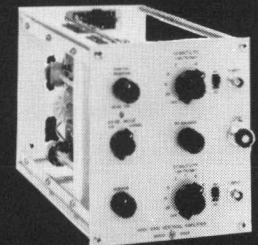
175A with 1750A and 1780A



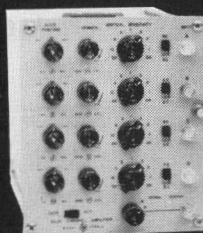
1751A



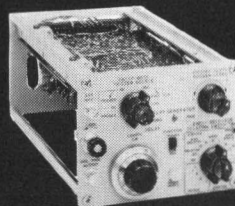
1752A



1752B



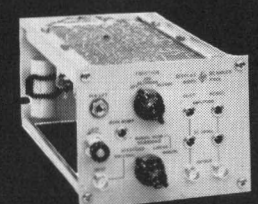
1754A



1781B



1783A



1782A

SAMPLING OSCILLOSCOPES

hp 185B SAMPLING OSCILLOSCOPE

- Bandwidth to 3500 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 ns/cm
- Complete line of accessories

185B Scope—Ten calibrated sweep ranges 10 ns/cm to 10 μ sec/cm $\pm 5\%$; x1 to x100 magnifier increases maximum sweep to 0.1 ns/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 ns rise time, 20 pulse generator, 0.5 ns 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.

187B 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 available for bridging 50-ohm transmission lines. Each channel has 5 calibrated ranges from 10 mv/cm to 200 mv/cm (4 mv/cm with vernier). Noise approximately 1 mv p-p. Differential input (A-B).

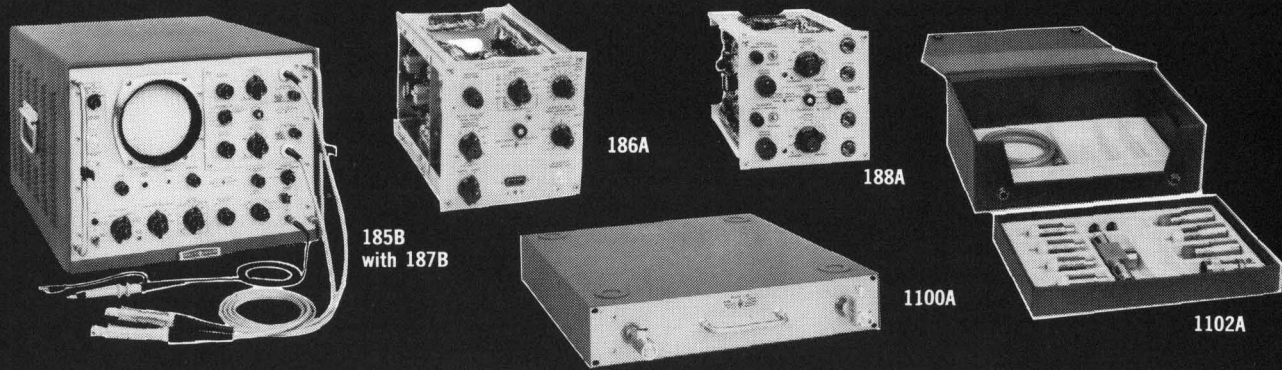
188A 0.1 NS Rise Time Dual Channel—Bridging sampler in 50 ohm line allows sig-

nals to be monitored without terminating unless desired. Each channel has 8 calibrated ranges 1 mv/cm to 200 mv/cm with 0.1 ns rise time (3.5 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 ohm; rise time, approximately 0.25 ns.

1102A Accessory Kit—Allows you to measure larger signals, sample 50 ohm systems, block dc and reduce circuit loading. Includes a 50-ohm termination, 50-ohm Tee, four resistive dividers with cable, two 10:1 probe dividers, and three blocking capacitors.



hp MIL SCOPES AND ACCESSORIES

H02-160B, dc to 15 mc and **H02-170A**, dc to 30 mc are militarized oscilloscopes offering rugged dependability under a wide range of environmental conditions. Eight plug-ins (described in the scope table) increase versatility.

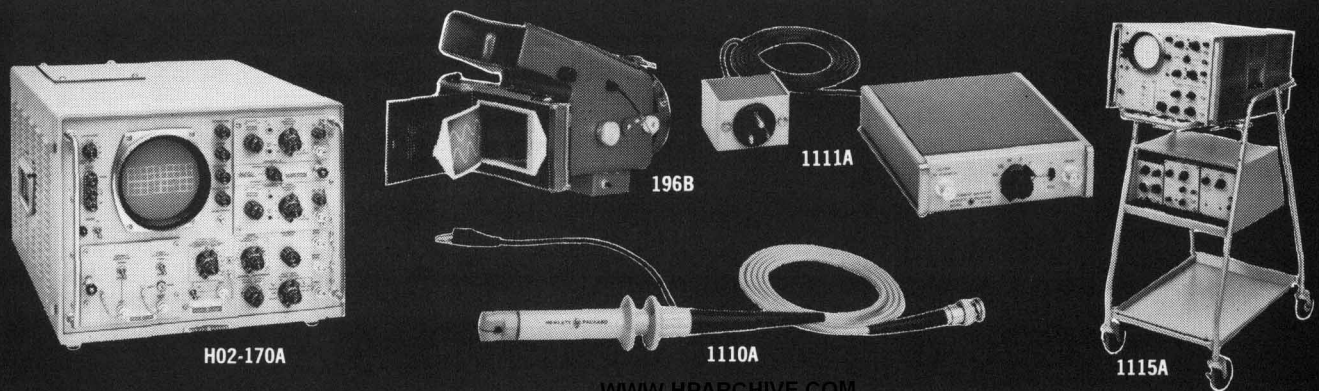
The **hp 196B** is designed specifically for photographing no parallax internal graticule crt's. It features a black light for illuminating the graticule,

f/1.9 lens, shutter speeds 1/100 to 1 sec (plus T & B) and a detented moving lens for multiple exposures.

The **hp 1110A Probe** and **1111A Current Amplifier** permits 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 **hp 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.



hp VOLTMETERS, AMMETERS, OHMMETERS, AMPLIFIERS,



Basic electronic measurements are easy, fast and accurate with Hewlett-Packard instruments, including voltmeters, ammeters, ohmmeters, amplifiers, and distortion and waveform analyzers.

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 $\pm 1\%$ to 1 mc, $\pm 5\%$ to 2 mc. The *hp 3400A* provides true rms readings of ac voltages having crest factors of 8:1 at full scale (higher for down scale readings) over the frequency range 50 cps to 3 mc with 1% accuracy and 10 cps to 8 mc with 5% accuracy. New all solid state *3440A Digital Voltmeter* features 4-digit readout with storage, printer output and plug-in flexibility. Accuracy on dc, 0.05% of reading. Especially useful for low-level measurements is the *Dymec DY-2401A Integrating Digital Voltmeter* whose floating and guarded input permits accurate measurement even in the presence of high common mode or spurious noise. *Dymec DY-2410A AC/Ohms Converter* expands *DY-2401A* capability to include floated and guarded wideband, 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 Millivoltmeter* is a highly sensitive instrument for measurement to 1 gc. Versatility is a major advantage of the *hp 412A Precision Volt-Ohm-Ammeter*, which provides accuracy of $\pm 1\%$ on voltage measurements and $\pm 2\%$ on 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 428A,B Clip-on DC Milliammeters* permit measurement without breaking leads, making dc connections or loading circuits under test. These instruments, which differ primarily in range, also use the *hp 3528A Clip-on Current Probe* and the *3529A Magnetometer Probe*, 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 *hp 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 and the 412A, described above.

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.

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 EEM Section 3000).

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 analyzers 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.

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

AUDIO-VIDEO INSTRUMENTATION

DISTORTION AND WAVEFORM ANALYZERS

Instrument	Primary Uses	Frequency Range	Voltage or 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	\$2000
330B	Measure total audio distortion; includes input amplifier, vtvm	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	0.03 v to 300 v full scale, 10 cps to 60 kc	Distortion Meter, 200 K; voltmeter, 1 megohm	\$575†
400D	Wide range ac measurements, high sensitivity	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	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	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
3400A	True rms readings of complex ac waveforms	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	dc	0.001 v to 1000 v (accuracy $\pm 0.05\%$ of reading ± 1 count)	10.2 megohms to dc	\$1160
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	\$300 \$350**
411A	Millivolt, db readings to gigacycle 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 as 100 db amplifier	10 μ v to 1 v full scale, 10 μ a to 3 ma full scale	1 megohm $\pm 3\%$	\$500*
428A	Clip-on milliammeter eliminates direct connection, circuit loading	dc	3 ma to 1 amp full scale, 6 ranges	—	\$500*
428B	Similar to 428A, 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
DY-2401A	Integrating digital voltmeter; measure voltage in presence of high common mode noise	dc	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-2410A	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**
3528A	Current measurements in large conductors	dc (with 428A); dc to 300 cps (with 428B)	3 ma to 1 amp (with 428A) 1 ma to 10 amps (with 428B)	—	\$450
3529A	Magnetic field measurements	dc (with 428A); dc to 80 cps (with 428B)	3 mgauss to 1 gauss (428A) 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	\$990

*Cabinet price, rack mount instruments \$5 additional. †Cabinet price, rack mount instruments \$15 less. ‡\$375 for 230 volt operation.
With hp 11036A ac probe. *Ac only \$1850, ohms only \$1650.

Amplifiers	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
466A	General purpose ac lab amplifier	10 cps to 1 mc	20, 40 db gain, frequency response ± 0.5 db	\$165
DY-2411A	Permits 10 mv full scale measurements with DY-2401A	dc	Guarded, programmable, $+1$ and $+10$ gain, 10,000 meg input resistance	\$1150
DY-2460A	High reliability for low-level signal amplification	dc	All solid state, photoconductive chopper; four versatile plug-ins for system and bench applications; Drift < 1 μ v/week, noise < 4 μ v	\$395*

* Plug-ins from \$35 to \$125.

NEW INSTRUMENTS

hp OSCILLATORS, PULSE, SQUARE WAVE,

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 is 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-DB 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 is calibrated in volts; those of the 208A-DB in dbm.

Model 650A Test Oscillator is ideal for wide range measurements from audio to low rf frequencies. With it you can make measurements on video amplifiers and tape recorders, on audio and ultrasonic devices or on receivers operating in the commercial broadcast band.

Model 233A Audio Oscillator is specifically designed for testing carrier current systems. It provides a balanced monitored 3-watt signal, enough output for testing loops over 100 miles long. Provision is made so that this output may be voice modulated to facilitate tests. A second single-ended low level output is also provided.

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 ($<2.3\%$) 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 2% (<0.2 db) over the entire range, *Model*

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 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 0.2%. Because its output level is constant within 2%, it is usually unnecessary to reset level when the frequency is changed.

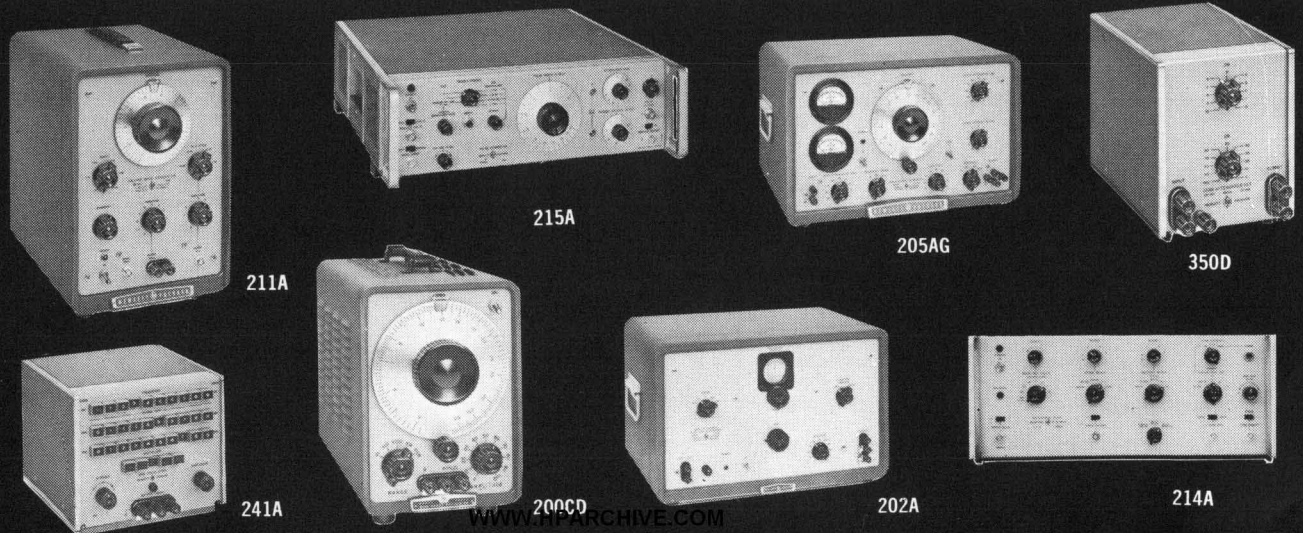
Pulse and Square Wave Generators—*Model 211A Square Wave Generator* is designed for testing video and audio amplifiers, networks, for modulating signal generators and driving externally-triggered equipment. Frequency range is 1 cps to 1 mc with 20 ns rise time.

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 ns.

Model 214A Pulse Generator provides 200 watts pulse power with 15 ns 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 1 ns 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 and thin film memory units.

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 10,000 μ sec in 1 μ sec steps.



DIGITAL DELAY GENERATORS, ATTENUATORS

OSCILLATORS
PULSE GENERATORS

OSCILLATORS				Description, Features	Output	Price
Model	Frequency Range	Frequency Response	Dial Accuracy			
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 nets; 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/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)	\$300°
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	(10 v/600 ohms) 160 mw	\$375°
208A 208A-DB	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-DB is calibrated in db	10 mw (+10 dbm) (2.5 v/600 ohms)	\$525 \$535
233A	5 kc to 500 kc, 4 ranges	±1 db	±1%	Designed for carrier current system measurement; second output (50 cps to 500 kc, 6 ohm source also provided)	3 watts (42.5 v/600 ohms)	\$650 (cabinet)
241A	10 cps to 1 mc	±2%	±1%	Pushbutton selection of frequency for repetitive, production testing	10 mw (2.5 v/600 ohms)	\$425
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**

SQUARE WAVE AND PULSE GENERATORS						
Model	Rep Rate	Rise Time	Amplitude	Pulse Width	Other Features	Price
211A Square Wave Generator	1 cps to 1 mc	20 ns	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 ns	±50 v/50 ohms, adjustable	0.07 to 10 μs	External triggering, sync; pulse position adj. from 10 μs advance to 100 μs delay (respect to sync out pulse)	\$600**
213B Pulse Generator	Approx. 100 kc	0.1 ns	175 mv/50 ohms	Flat for 100 ns (2 μs total)	May be externally triggered from 0 to 100 kc, 50-ohm source	\$215
214A Pulse Generator	10 cps to 1 mc	13 ns	±100 v/50 ohms adjustable	0.05 μs to 10 ms	External triggering with selectable trigger point; pulse position adj. to 10 ms 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 ns	±10 v/50 ohms	Continuously adj. to 100 ns	External triggering with selectable trigger point; output trigger from 140 ns advance to 10 ns 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 10,000 μs 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 μs	+25 v/50 ohms	>1.5 μs	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 ns	±25 v/50 ohms (adjustable)	0.2 to 5 μs		\$490
219C Digital Pulse Duration Unit	See 218AR	30 ns (90 ohms)	-7.5 v/90 ohms or -45 v/500 ohms (adjustable)	1 to 10,000 μs (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 μs	\$375

*Cabinet models; rack mount models \$5 additional. **Cabinet models; rack mount models \$15 less. ***AC operation optional, \$25 extra.

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

NEW INSTRUMENTS

hp SOLID STATE, VACUUM TUBE

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 $+65^\circ$ 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, 100 mc and 512 mc with plug-in converters. Other plug-ins are provided for time interval measurements and for amplifying low level signals.

The *hp* 5243L is identical to the 5245L but measures directly to 20 mc. It accepts the same plug-ins as the 5245L.

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.

The *hp* 5232A and 5532A Counters are identical 1.2 mc instruments, except for readout. Both offer 6-digit resolution, the 5232A in improved neon columns and the 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* 5242L and 5244L have respective counting rates of 20 mc and 50 mc, offer 7-digit resolution with rectangular, closely spaced digital indicator tubes. They are similar to the 5245L and 5243L except for time base stability and plug-in versatility.

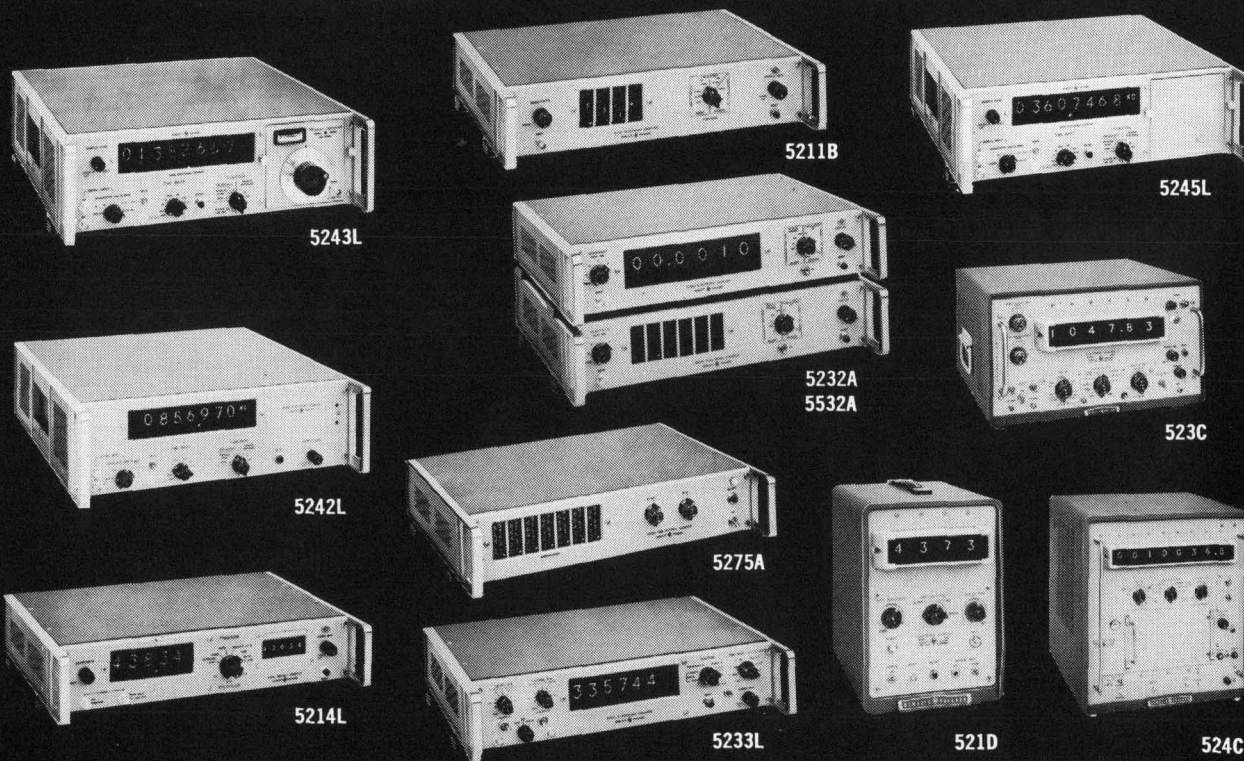
The *hp* 5275A Counter measures time intervals from 10 nsec to 0.1 sec by counting a 100 mc sine wave. This 100 mc sine wave is generated by a multiplying circuit that is driven from an external 1

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, time and totalizing, and also measures normalized rate; measures ratio; measures normalized ratio; measures 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.

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 μ sec 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.

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



ELECTRONIC COUNTERS

ELECTRONIC COUNTERS, ACCESSORIES

Vacuum Tube 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 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
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
5242L Counter	Measure frequency, period, multiple period average, ratio, multiples of ratio	dc to 20 mc	7-digit resolution with in-line display; stability 2 parts/10 ⁷ /month	\$2225
5243L Counter	Measure frequency, period, multiple period average, ratio, multiples of ratio, scaling to 10 ⁸	dc to 512 mc, time interval and 1 mv sensitivity with proper plug-ins, basic counting rate to 20 mc	8-digit resolution with in-line display; stability better than 3 parts/10 ⁶ /day; plug-in versatility	\$2950
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	\$2450
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 ⁶ /day; plug-in versatility	\$3250
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
5253A Plug-in	Frequency converter for 5243L, 5245L Counters	88 to 512 mc	Extends basic counting rate of counters, accuracy same as counter	\$500
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 ⁸ sec	Time interval unit providing counter with 0.1 μ sec resolution, retains accuracy of counter	\$300
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 mc maximum counting rate	6-digit resolution with in-line display; stability 2/10 ⁷ /week	\$1550

NEW INSTRUMENTS

hp RECORDERS, FREQUENCY/TIME INSTRUMENTS

This precision instrumentation from Hewlett-Packard includes the new 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 0.01 cps 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 is the same as the frequency standard used as the prime driver (± 3 parts in 10^6 per day with the internal standard).

Frequency/Time Standards—These instruments range from highly accurate quartz oscillators to complete frequency and time systems. Included are the hp 100E Frequency Standard and a series of oscillators ranging from the hp 101A, designed specifically as a time base for the hp 5275A Counter, to the hp 103AR and 104AR Quartz Oscillators, which offer outputs of 1 mc and 100 kc. Model 104AR also provides a high purity 5 mc signal for multiplication to microwave frequencies. 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. Also available for systems use are 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 the 560A, 561B, 562A Digital Recorders; the 565A Digital Printer; 570A and 571B and H03-571B Digital Clocks, and 580A and 581A Digital-to-Analog Converters.

Instrument	Description, Characteristics	Price
100E	Frequency standard, $5/10^6$ 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/ 10^6 output at least 1 v into 50-ohm load	\$500
103AR	Quartz oscillator for primary frequency/time standard system; stability $5/10^6$ /day; two sinusoidal outputs, 1 mc and 100 kc, plus 100 kc for driving 115BR	\$1900 ^{**}
104AR	Identical to hp 103AR, with additional 5 mc output of extreme spectral purity	\$2300 ^{**}
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 ^{**}
5100A	Provide digitally selected frequencies from 0.01 cps to 50 mc in 0.01 cps steps which retain stability of 1-mc driving signal ($\pm 3 \times 10^{-6}$ /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	\$10250
5110A		\$5000
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‡
H03-571B	Digital clock, similar to 570A, for 562A	Price on request
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.

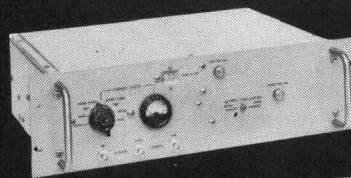
†Rack mount \$15 less.

‡Slight additional charge for 230-volt, 50-cycle operation.

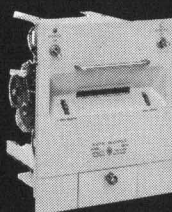
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Prices f.o.b. factory.

NEW INSTRUMENTS



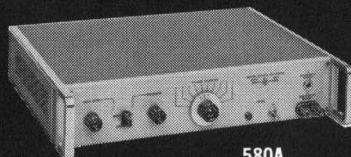
104AR



565A

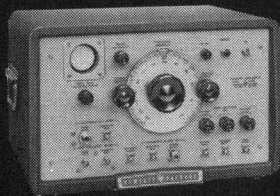


114BR

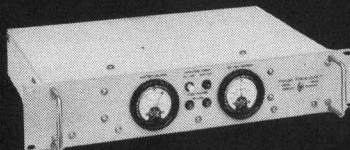


580A

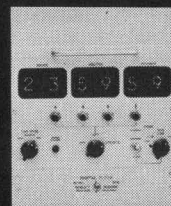
115BR



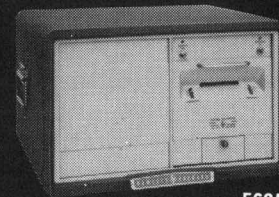
540B



725AR



571B



562A

H Lab, hp POWER SUPPLIES

Harrison Laboratories Division of Hewlett-Packard offers over 40 different models of highly regulated dc power supplies. Brief specifications of available instruments appear on these catalog pages. All supplies are described in detail in the *hp* product catalog, or information may be obtained from your local field sales office or Harrison Laboratories, 45 Industrial Road, Berkeley Heights, New Jersey. Your field sales office will also have information on other power supplies introduced since this catalog was prepared.

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 constant current supply and automatically transfers from one mode to the other as the load resistance changes.

Bench and Rack Supplies—*H-Lab 6200A, 6201A, 6202A, 6204A, 6204AM, 6206A, and 6206AM* are designed as a family and are mechanically and electrically compatible. Three units feature constant voltage/constant current. Three units feature dual output ranges and are competitively priced with single output range instruments.

Low Voltage Lab Supplies—These solid state instruments include two *hp* models, the *721A* and *723A*, plus *H Lab 800A-2, 800B-2* and *880*. The inexpensive *721A* is ideal for R&D work, particularly in semiconductor circuit design. The *723A* is especially useful for systems use where a number of tests are made automatically at different voltages. 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 are required.

Constant Voltage, Constant Current Rack Mount Supplies—Seven H Lab supplies provide full range coverage in rack mount constant voltage, constant current instrumentation. Three use a plug-in card to determine the mode of operation. They are the *808A, 809A* and *881A*. Seven provide an automatic crossover between constant voltage and constant current operation. They are the *810B, 814A, 6242A, 6244A, 6263A, 6266A, and 6267A*.

Constant Voltage, Current Limiting Rack Mount Supplies—The *H-Lab 6363A, 6366A, and 6367A* have no meters and have voltage control in rear. They can be Auto Seriesed, Auto Paralleled, and remote programmed. The *H-Lab 802B* is a twin solid state instrument furnishing two independent outputs. The *hp 726A* features remote programming capability and a 2 amp current capacity.

Modular Plug-in Supplies—The *H Lab 6340 Series* dc supplies offer a well regulated chassis-mounting power source at modest cost. In addition this line of supplies of low to moderate power ratings is capable of being efficiently grouped on rack panels. The *6343A* and *6346A* are 2½" high, 8" deep, 3" wide. The *6344A* and *6347A* are 5" high, 9" deep and 3" wide. The *6345A* and *6348A* are 5" high, 9" deep and 6¼" wide.

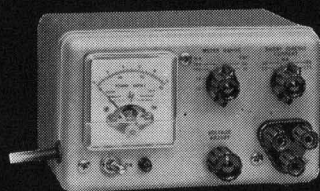
Rugged SCR Supplies—Four H Lab SCR supplies, the *505A, 510A, 520A* and *6455A*, offer high efficiency and relia-

bility, plus fixed or continuously variable dc power with 0.5% regulation.

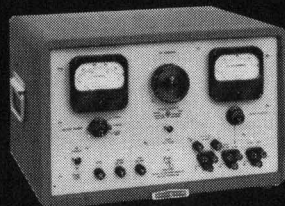
Supplies for DC Applications Over 100 V, less than 1000 V—The versatile *hp 711* is a highly regulated supply ideal for basic bench use, output 0 to 500 v, 100 ma maximum load. The *hp 712B* furnishes four outputs, including dc 0 to 500 v, a regulated dc fixed bias, a dc variable bias and unregulated 6.3 v ac. *H Lab 890A* provides an output of 0 to 320 v at 0 to 0.6 a. The *H Lab 895A* provides the same voltage output as the *890A* but at 0 to 1.5 a. In addition to these supplies, H Lab offers its *200D* and *200DX*, plug-in vacuum tube instruments with similar characteristics, but with voltage output adjustable over limited spans.

Klystron Power Supplies—Two klystron power supplies include the *716A*, which offers superior regulation, noise, ripple and hum characteristics, giving 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 6920A Meter Calibrator* is a convenient instrument for calibrating voltmeters, ac or dc, up to 1000 volts and up to 5 amps. The *H Lab 6910A Dual Crowbar Protector* provides two independent overvoltage protection circuits for protection of external circuitry, should built-in power supply overload protectors fail. Specifications of the *6920A* and *6910A* are available from H Lab.



721A



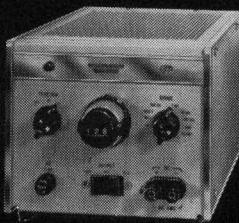
712B



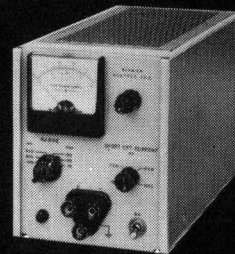
865B



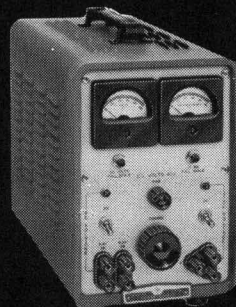
800B-2



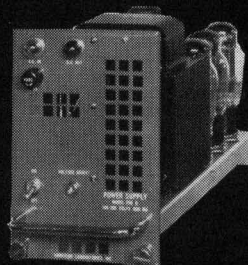
6920A



723A



711A



200D



880

Model	Output Volts	Output Amps	Load Regulation* (mv)	Line Regulation* (mv)	Ripple (mv)	Remote Programming	Remote Sensing	Optional Chopper Stabilization	Characteristics	Price
200D**	150 to 315	0 to 0.8	30	±60	1, 5				Complete vacuum tube supply in one plug-in module for use in rack mounting case	\$275†
200DX**	100 to 260	0 to 0.8	30	±60	1, 5				Similar to 200D; differs only in output voltage capability	\$295†
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	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	\$250
711AR										\$255
712B	0 to +500 -300**	0 to 0.2 0 to 0.05	50 50	±100 ±100	0.5				Voltmeter can be switched to monitor any of three output voltages; 6.3 v ac ct auxiliary 10 a output; overload protection; 712B cabinet, 712BR rack mount, both vacuum tube models	\$390#
712BR	0 to -150	0 to 0.005	—	±100	0.5					\$375#
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	\$325
716A	-250 to -800 0 to -800 6.3 (adj.)	0 to 0.1 0 to 2	0.05% —	0.1% 1%	1 0.5 15				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	\$775
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	\$225
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	✓	✓	✓	Auto Series, Auto Parallel operation, variable current limit, rack mount	\$475†
809A	0 to 36	0 to 10	7.2 or 0.02%	7.2 or 0.02%	0.5	✓	✓	✓	Similar to 808A, except for current output, regulation	\$575†
810B	0 to 60	0 to 7.5	10 or 0.02%	5 or 0.01%	1	✓	✓	✓	Similar to 808A, except for voltage and current output, regulation	\$695†
814A	0 to 36	0 to 25	10 or 0.03%	10 or 0.03%	1	✓	✓	✓	Auto Series, Auto Parallel operation, rack mount, variable current limit	\$775†
855B	0 to 18	0 to 1.5	5 or 0.03%	5 or 0.03%	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	4 or 0.01%	4 or 0.01%	0.2	✓	✓		Similar to 855B except for output	\$169
880	0 to 100	0 to 1	5 or 0.02%	5 or 0.05%	0.5				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, variable current limit, rack mount	\$475†
890A	0 to 320	0 to 0.6	20 or 0.007%	20 or 0.007%	2	✓	✓	✓	Convection cooling, no moving parts, fuse protects against severe overloads, rack mount	\$445†
895A	0 to 320	0 to 1.5	20 or 0.007%	20 or 0.007%	2	✓	✓	✓	Similar to 890A except for current output and regulation	\$625†
896A	75 to 160	0 to 2.5	30 or 0.02%	30 or 0.02%	1	✓	✓	✓	Similar to 890A except for output and regulation	\$675†
6200A	0 to 20 or 0 to 40	0 to 1.5 0 to 0.75	0.03% or 5 mv	0.03% or 5 mv	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 5 mv	0.03% or 5 mv	0.2	✓	✓			\$159
6202A	0 to 40	0 to 0.75	0.03% or 5 mv	0.03% or 5 mv	0.2	✓	✓			\$159
6204A	0 to 18 or 0 to 36	0 to 0.6 0 to 0.3	Less than 10 mv	Less than 10 mv	0.5	✓	✓		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	\$99*†
6206A	0 to 32 or 0 to 64	0 to 1 0 to 0.5	Less than 10 mv	Less than 10 mv	0.5	✓	✓			\$149*†
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 or 0 to 1	3 or 0.02%	5 or 0.03%	1	✓	✓	✓	Variable current limit in rack and bench supplies with Auto Series, Auto Parallel operation, two output ranges	\$435
6244A	0 to 36	0 to 3	5 or 0.02%	2 or 0.01%	1	✓	✓	✓	Auto Series, Auto Parallel operation, variable current limit, replaceable subassemblies, rack and bench mount	\$460
6263A	0 to 18	0 to 10	1 or 0.01%	1 or 0.01%	1	✓	✓	✓	Constant current / constant voltage supplies. Auto Series, Auto Parallel	\$435
6266A	0 to 36	0 to 5	1 or 0.01%	1 or 0.01%	1	✓	✓	✓		\$435
6267A	0 to 36	0 to 10	2 or 0.02%	2 or 0.02%	2	✓	✓	✓		\$525

*Whichever is greater. **Output not continuously variable over entire voltage range. †\$125 extra, add 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. #Requires external step-down transformer for 230-volt operation. Data subject to change without notice. Prices f.o.b. factory.

H LAB, hp POWER SUPPLIES ARE COMPLETELY SOLID STATE, EXCEPT WHERE OTHERWISE NOTED

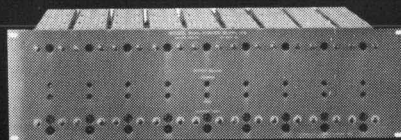
NEW INSTRUMENTS

WWW.HPARCHIVE.COM

POWER SUPPLIES

POWER SUPPLIES

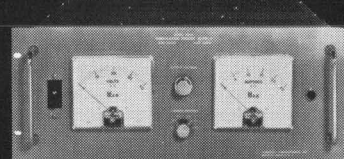
Model	Output Volts	Output Amps	Load Regulation* (mv)	Line Regulation* (mv)	Ripple (mv)	Remote Programming	Remote Sensing	Optional Cropper Stabilization†	Characteristics	Price
6343A	0 to 18	0 to 0.3	3 or 0.02%	3 or 0.02%	1	✓	✓		All input and output connectors via 11-pin plug; other pins on plug terminals 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 0.02%	3 or 0.02%	1	✓	✓	\$165		
6345A	0 to 18	0 to 2.5	3 or 0.02%	3 or 0.02%	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		
6363A	0 to 18	0 to 10	3 or 0.02%	3 or 0.02%	1	✓	✓	Constant voltage, current limiting supplies. No front panel meters. Voltage adjust in rear. Auto Series, Auto Parallel	\$359	
6366A	0 to 36	0 to 5	3 or 0.02%	3 or 0.02%	1	✓	✓		\$359	
6367A	0 to 36	0 to 10	5 or 0.03%	5 or 0.03%	2	✓	✓		\$450	
6455A	0 to 36	0 to 75	0.5% combined		180	✓	✓		High efficiency, rack mount supply; variable current limit, Auto Series, Auto Parallel operation	\$1450



801C



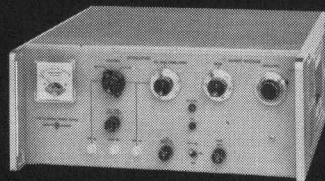
802B



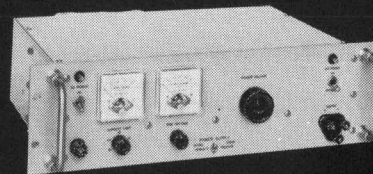
520A



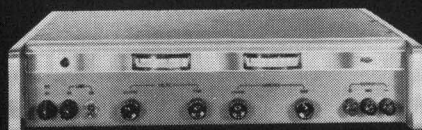
809A



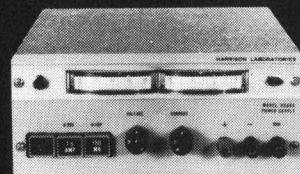
716A



726AR



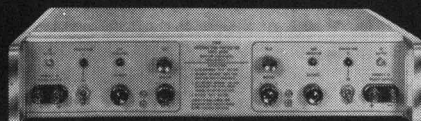
6242A



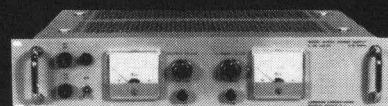
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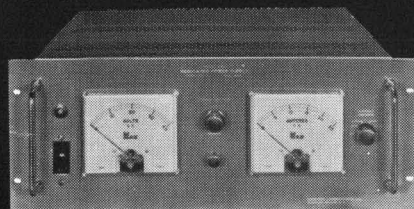
890A



6910A



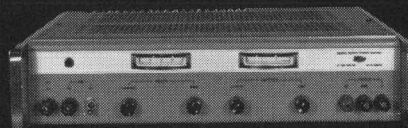
6266A



814A



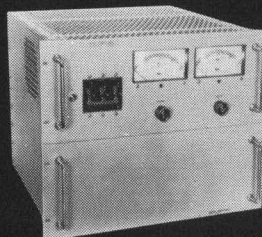
505A



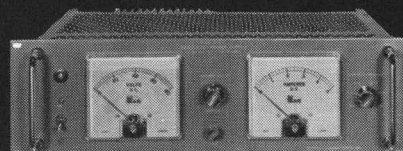
6244A



808A



6455A



810B

hp MICROWAVE TEST EQUIPMENT

Hewlett-Packard and its Dymec and Boonton Radio Co. 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 on page 27.

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, since modulation may be either up or down from (as well as symmetrical about) the cw level.

UHF to SHF Signal Generators—Most of the models manufactured by Hewlett-Packard and Dymec are included in this group, covering 800 mc to 21 gc and featuring extremely simple operation. Models *614A, 616B, 618B, 620A, 626A* and *628A* provide large, direct-reading frequency dials and require no voltage adjustment during tuning. They may be pulse, square-wave and frequency modulated. Their versatility makes them extremely useful for making measurements such as signal-noise ratio, receiver sensitivity, standing wave ratio and transmission line characteristics. The new *hp 8614A Signal Generator* is particularly easy to use. Frequency and

attenuation are set on direct-reading digital dials, and pushbuttons permit fast, easy selection of function (cw, leveled output, square-wave modulation or external amplitude or pulse frequency modulation). In addition, the 8614A 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.

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-2650 Oscillator Synchronizer*, which is fully compatible with the *hp 8614A*, provides absolute control of reflex klystron oscillator frequencies over the range 1 to 12.4 gc by phase locking the klystron signal to a crystal reference. Crystal oscillator stability is thereby extended into the microwave region with unprecedented ease and convenience. The stabilized signals are suitable for use in doppler systems, radio astronomy receivers, microwave spectroscopy measurements, microwave frequency standards and parametric amplifier pumps.

Sweep Oscillators—The *hp 680 Series Sweep Oscillators* provide flexibility, simplicity and convenience for obtaining swept rf frequencies over the 1 to 18 gc range. Voltage tuned, these oscillators are specifically designed for fast, comprehensive, full-range testing techniques. An auxiliary output, proportional to frequency, may be used for oscillographic or x-y recording. Open

loop levelers compensate for major variations in the rf output.

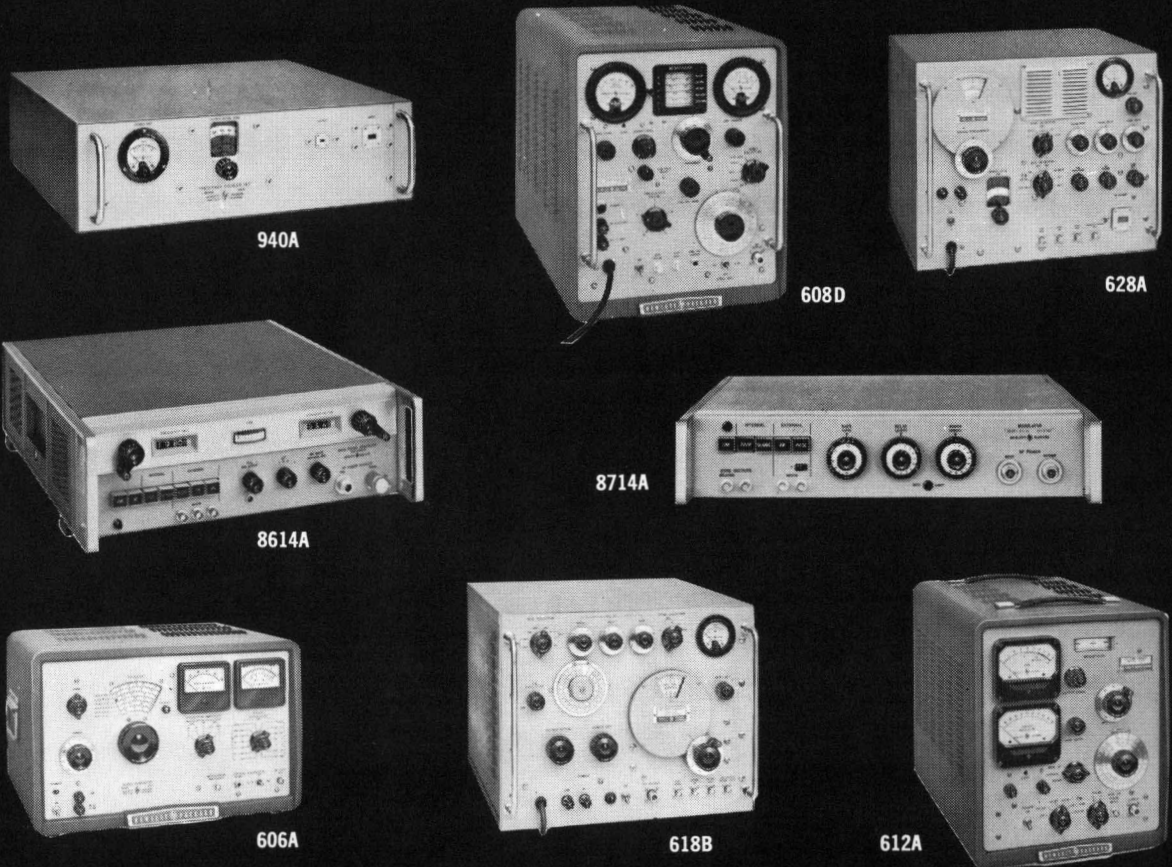
Frequency Doublers—Broadband frequency doublers, *hp 938A* and *940A*, provide low cost signal generator capability in the 18 to 40 gc range. Designed to be driven by the *hp 626A*, or *628A* Signal Generators, *686C* or *687C* Sweep Oscillators or other sources in the 9 to 20 gc range, the frequency 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, *hp* offers today's most complete line of coaxial and waveguide test equipment. This instrumentation, listed on the opposite page, is designed to help you make microwave measurements easier, faster and more accurately. Much of the waveguide equipment is available in several frequency bands. The chart below lists the frequency range and designation of each band.

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.



MICROWAVE INSTRUMENTATION

SIGNAL GENERATORS

MICROWAVE INSTRUMENTATION

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 mw to -127 dbm (0.1 μ v) 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	\$1650
616B Signal Generator	1.8 to 4.2 gc	Output 0.5 v to 0.1 μ v into 50-ohm load, pulse or FM modulation, direct calibration	\$1950*
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	\$2100***
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, 686C or klystrons	\$1500****
940A Frequency Doubler	26.5 to 40 gc	Driven by 13.25 to 20 gc source, hp 628A, 687C or klystrons	\$1500****

Sweep Oscillators				
682C Sweep Oscillator	1 to 2 gc	Output 50 mw	Electronically swept; variable sweep rate, width; swr 3 or less; pulse, square wave, frequency, amplitude modulation; all models offer leveled output	\$3090**
683C Sweep Oscillator	2 to 4 gc	Output 30 mw		\$3000**
684C Sweep Oscillator	4 to 8.1 gc	Output 10 mw		\$2900**
H01-686C Sweep Oscillator	7 to 11 gc	Output 10 mw		\$3000**
686C Sweep Oscillator	8.2 to 12.4 gc	Output 10 mw		\$2900**
687C Sweep Oscillator	12.4 to 18 gc	Output 10 mw		\$3400**

Modulator			
8714A PIN Modulator	800 mc to 2.4 gc	Up to 1 watt input, 80 db on-off ratio, 20 nsec rise time	\$850

*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
290A	Cover-to-choke flanges	S290A, \$65; G290A, \$55; J290A, \$40; H290A, \$35; X290A, \$20; P290A, \$30
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	S372A, \$165; G375A, \$145; J375A, \$135; H375A, \$125; X375A, \$100; M375A, \$190; P375A, \$135; K375A**, \$185; R375A**, \$200
382A	Attenuators, calibrated, precision, 50 db range (10 db for 380A)	G382A, \$500; J382A, \$375; H382A, \$350; X382A, \$275; M382A, \$400; P382A, \$300; K382A**, \$475; R382A**, \$500
S382B,C	Precision Variable Attenuators, 60 db range	S382B, calibrated in 0.1° increments, \$600; S382C, calibrated in 0.01° increments, \$650
421A, 422A	Detector Mounts	H421A, \$95; X421A, \$75; M421A, \$175; P421A, \$150; K422, \$200; R422, \$200
532A	Frequency Meters, direct reading	G532A, \$375; J532A, \$350; H532A, \$300; X532B, \$200; M532A, \$300; P532A, \$275; K532A**, \$350; R532A**, \$400
750	Directional Couplers, cross 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, waveguide 810B's mount in 809B Carriage	S810A†, \$450; G810B, \$125; J810B, \$110; H810B, \$110; X810B, \$90; M810B, \$175; P810B, \$110
815B	Slotted Sections, waveguide 815's mount in 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

*Includes barretter; checked for square law characteristics. **Circular flange adapters: K-band (UH-425/U), hp 11515A, \$35 ea.; R-band (UG-381/U), hp 11516A, \$40 ea.
 †Includes thermistor installed. ‡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)	\$125
393A	Variable Attenuator, 0.5 to 1 gc, direct reading, capacity to 200 watts average	\$420
394A	Variable Attenuator, 1 to 2 gc, direct reading, capacity to 200 watts average	\$420
420A	Crystal Detector, 10 mc to 12.4 gc; maximum swr 3; sensitivity 0.1 v dc/mw 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
906A	Sliding Coaxial Termination, permits measurements of residual swr of slotted lines, directivity of directional couplers	\$250
908A	50-ohm Coaxial Termination, swr less than 1.05, dc to 4 gc	\$35
934A	Harmonic Mixer, 2 to 12.4 gc	\$150

hp MICROWAVE POWER, IMPEDANCE, NOISE

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 *486 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. Only two controls are needed for the 434A, a range selector and a zero set. Power to be measured is connected directly to the input of the 434A and dissipated in its internal 50-ohm load. No external bolometers are needed.

Microwave Amplifiers—Hewlett-Packard manufactures two series of broadband microwave amplifiers. One series, the *Models 489A, 491C, 493A, and 495A Microwave Amplifiers*, covers the frequency spectrum from 1 to 12.4 gc, and provides 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.

Models 490B, 492A, and 494A Low Power TWT Amplifiers cover 2 to 12.4 gc. They may be phase or frequency modulated as well as amplitude modulated. These units are especially well suited to the phase modulation techniques employed in Serrodyne and Homodyne systems.

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 1/8" rigid coax systems.

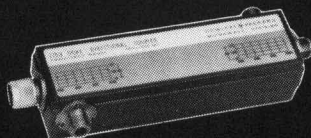
At frequencies below 500 mc, where slotted lines are long and cumbersome, *Model 803A VHF Bridge* measures impedance simply and directly. *Model 803A* measures impedance magnitude from 2 ohms to 2000 ohms over the entire frequency range of 55 to 500 mc and phase angle to 90° lead or lag even at minimum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

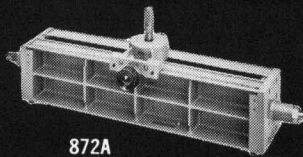
Additional Information—Data on the broad line of Hewlett-Packard microwave instrumentation is available from your nearest Hewlett-Packard field sales office.

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

MICROWAVE INSTRUMENTATION



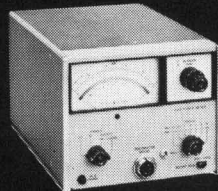
775D



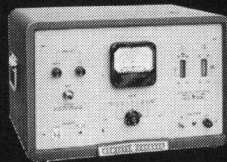
872A



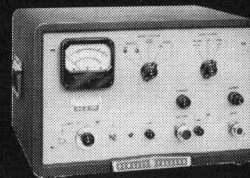
495A



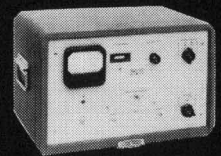
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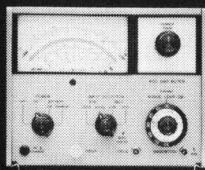
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342A



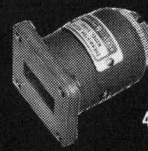
416B



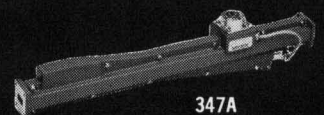
415D



478A



486A



347A

FIGURE MEASURING INSTRUMENTATION

MICROWAVE INSTRUMENTATION

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	\$425
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**
476A Bolometer Mount	Use with 415B, 416B or 430C for square-law detection	10 mc to 1 gc	swr less than 1.25, no tuning required	\$85
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	\$145
485A,B,D Waveguide Detector Mounts	Power, reflectometer measurements	2.6 to 12.4 gc	Full coverage of waveguide band	\$75 to \$185
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 application	1 to 2 gc	30 db gain, nsec rise time, 1 watt output	\$2300
490B Microwave Amplifier	Amplification through S-Band	2 to 4 gc	30 db gain, 10 mw output, helix modulation	\$1500#
491C Microwave Amplifier	Medium power S-Band amplification	2 to 4 gc	30 db gain, 1 watt output	\$2300
492A Microwave Amplifier	Amplification through most of G- and J-Bands	4 to 8 gc	30 db gain, 20 mw output, helix modulation	\$2000#
493A Microwave Amplifier	Medium power G- and J-Band amplification	4 to 8 gc	30 db gain, 1 watt output	\$2900
494A Microwave Amplifier	Amplification through X-Band	7 to 12.4 gc	30 db gain, 20 mw output, helix modulation	\$2000#
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, 12 to 130 cps (tuned frequency)	0 to 70 db full scale expansion for any 2.5 db increment, maximum sensitivity 0.04 μ v	\$325
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 for hp 803A	10 to 500 mc	Approximately 5 μ v sensitivity	\$475
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	Broad band detector	\$55
446B Untuned Probe	Use with 814B Carriage, 815B slotted sections	18 to 40 gc	Broad band detector	\$145
803A VHF Bridge	Measure vhf impedance, swr	55 to 500 mc	2 to 2000 ohms impedance, -90° to $+90^\circ$ phase angle	\$1000
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 7/8" 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	Broad band 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	Excess noise 15.2 ± 0.5 , all models	\$200 to \$360
349A UHF Noise Source	Gas discharge source (coax.)	400 to 4000 mc	Excess noise 15.2 db ± 0.5 db	\$325

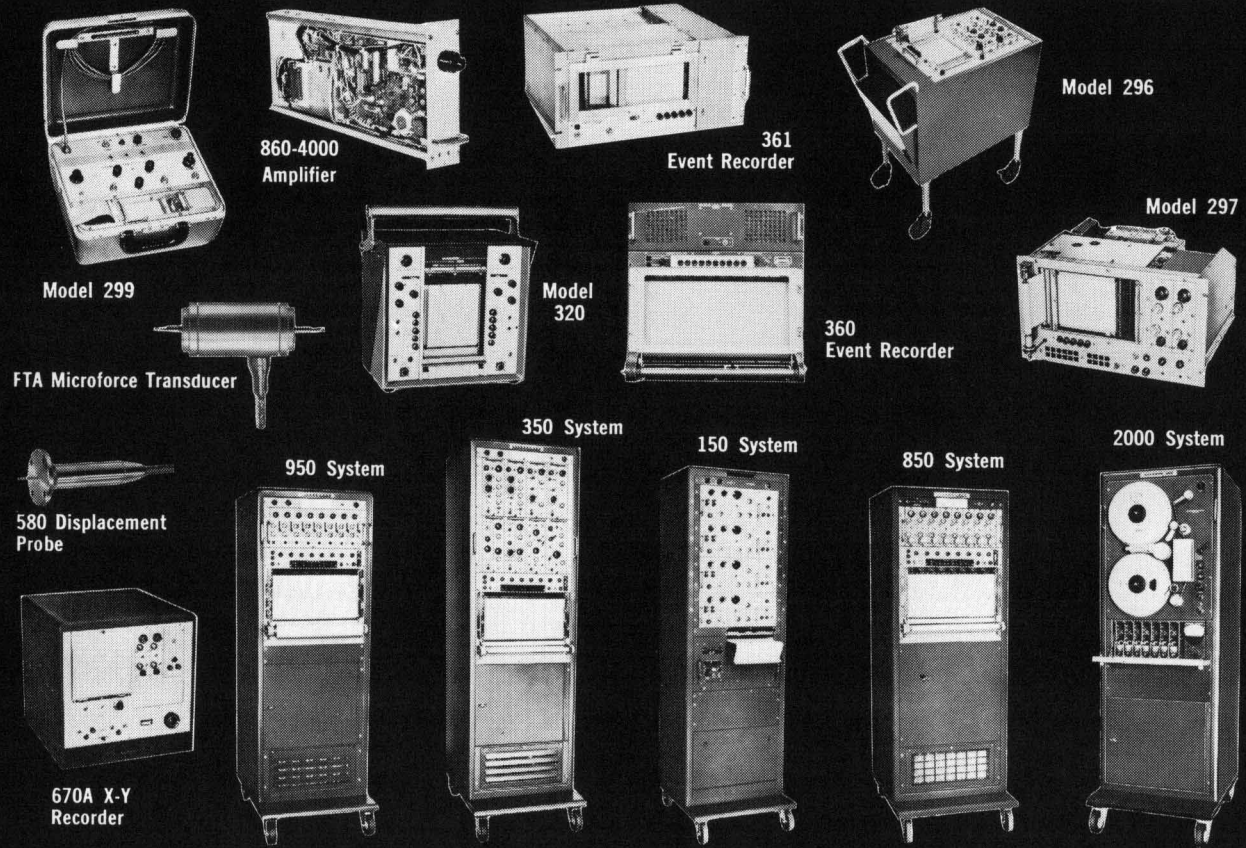
*Price for cabinet model, rack mount \$5 more. **Price for cabinet model, rack mount \$15 less. ***Power handling capacity of all 764, 774 series couplers 50 watts cw 10 kw peak. †Approximately, depends on options, modulations. #Requires external step-down transformer for 230-volt operation. ■ Not available in Europe.

NEW INSTRUMENTS

SANBORN INSTRUMENTATION FOR DATA

Sanborn Company's Industrial Division now offers a complete range of oscillographic recording and related instrumentation — including transducers; data amplifiers; portable to multi-channel direct writers; dc to 5 kc optical systems; magnetic data, event and high speed optical x-y recorders; 4- to 8-channel, 17" screen scopes, chart viewer, transducer amplifier-indicators and other related instrumentation.

These instruments and systems operate from 115 volt, 60 cps power lines; 115/230 volt, 50 cps versions are available at a slight additional charge.



Instrument, System	Basic Features and Specifications	Price
Model 2007 7 track, 4 speed, 1/2" tape Model 2107 7 track, 7 speed, 1/2" tape Model 2114 14 track, 7 speed, 1" tape	MAGNETIC DATA RECORDING SYSTEMS Highly flexible, compact Sanborn solid state electronics with Ampex transports; meet IRIG standards; interchangeable FM and Direct Record/Reproduce circuits; Record/Reproduce amplifiers on same card; system accuracy 1%; non-linearity ±0.5% on dc, ±1% on ac; direct record bandwidth 50 kc, FM 5 kc (at 30 ips); std. 4 speeds are 3 3/4 to 30 ips, std. 7 speeds 15/16 to 60 ips; electronics for 7 channels only 7" high, entire system in 31" of panel space; portable cases also available; Direct Record/Reproduce inserts \$155 ea.; FM Record/Reproduce Insert \$180 ea.; Direct Equal. Plug-in \$30 ea.; FM Freq. Plug-in \$40 ea.; wide choice of optional speeds, accessories	(Basic Assemblies, less amplifiers and speed plug-ins) 2007, \$5960 2107, \$10,465 2114, \$12,505
Model 361, 30 channels Model 360, up to 120 channels	EVENT RECORDERS Sharp, clear traces of events as short as 1.3 msec. on dry, electrosensitive 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 std. speeds	361, \$2250 (with +6 to +40 v or -6 to -40 v writing control) 360, \$3900 (w/out writing control)
Model 860-4000 Model 860-4200 Model 860-4300	DATA AMPLIFIERS 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	4000, \$825 4200, \$600 4300, \$425
Model 670A	X-Y RECORDER Writing speeds of 2500 in/sec, frequency response to 130 cps within 3 db at 8" p-p deflections; Model 850-1300B DC Coupling Preamps supply input, included in basic system price; other 850 preamps and 670-800 Time Base Generator optional	\$2635
For linear displacement, velocity and acceleration; gas and fluid pressures; low forces.	TRANSDUCERS and RELATED INSTRUMENTS 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 H ₂ O, \$295; FTA Series Microforce for bi-directional forces ±1 to ±100 grams, \$175 to \$200; Models 311 and 312 Transducer Amplifier-Indicators for excitation and output display on meter, with strain gage bridges, LVDT's, etc. \$300 and \$425. Note: Many "specials" of different ratings quickly available, consult Transducer Division	(See Features at left)

SANBORN

HANDLING, RECORDING, READOUT

SANBORN

SINGLE-CHANNEL PORTABLE DIRECT WRITERS

Model	Features	Response (at 10 div p-p)	Sensitivity	Non- Linearity	Speeds	Price
299	Compact, portable, 7" x 10½" x 12" wide; marker stylus, 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 μv rms/div to 2 mv/div (8-pos.)	Max. 0.625%	5 mm/sec 50 mm/sec	\$750
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	0.5 mv rms/div to 500 mv/div (10-pos.)	Max. 0.625%	5 mm/sec 50 mm/sec	\$750

DUAL CHANNEL PORTABLES

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	dc to 125 cps within 3 db	0.1 v/mm without 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; 10½" x 19" panel, rack mounted	(Same as 296)	0.1 v/mm without 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	(Same as 296)	0.5 to 20 mv/mm and v/cm (12-pos.)	Max. 0.5%	(Same as 296)	\$1650 (cabinet) \$1800 (rack)
321	Similar to 320, except provides excitation for and records outputs of ac-excited transducers, etc.	(Same as 296)	10 μv rms/mm to 2 mv/mm (8-pos.)	Max. 0.5%	(Same as 296)	\$1495 (cabinet) \$1645 (rack)
322	Moderate gain, tube-transistor direct-coupled amplifiers; common mode rejection 50:1; has zero suppression	(Same as 296)	10 mv to 10 v/mm (10-pos.)	Max. 0.5%	(Same as 296)	\$1395 (cabinet) \$1545 (rack) (322A without Zero Sup., \$100 less than above)

MULTI-CHANNEL OSCILLOGRAPHS

Model	Features	Response (at 10 div p-p)	Sensitivity	Non- Linearity	Speeds	Price
150 Series	Choice of 11 tube-type plug-in preamps; packaging in portable cases, vertical mobile console or 4" high pulpit cabinet; horiz. chart plane; also with dual-channel dc amplifiers for telemetering, computer output	dc to 100 cps within 3 db	10 μv/div to 0.1 v/div, depending on preamp	Max. 1%	Nine: 0.25 to 100 mm/sec	See summary chart
350 Series	Flush-front or horiz. chart plane recorder; eleven 10½" high plug-in preamps useful alone to drive meter, scope, etc.; system also avail. without preamps, but basic input controls, for telemetering, computer output, other 5-volt full-scale applications	dc to 150 cps within 3 db	0.1 v/div, w/out preamps, 2 μv/div to 5 v/div, depending on preamp	Max. 0.5%	Nine: 0.25 to 100 mm/sec (9 more optional, mm/min) pushbutton-selected	See summary chart
650 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 6 or 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 system with galvan., \$4200; 8-channel, ampl \$2200 to \$3900
850 Series	Identical recorder to 350 Series, but lower cost, miniaturized plug-in preamps (8 in 7" x 19" panel space); (850 preamps also used in 297 System, 670A X-Y Recorder and with 950 Amplifier in 12 to 16 channel 950)	dc to 150 cps within 3 db	10 μv/div to 5 mv/div, depending on preamp	Max. 0.5%	Same as 350 Series	See summary chart
950 Series	Economical system with "all-alike" channels in any of five different 6 or 8 channel amplifier modules: 850 plug-in preamps may also be used with 950 module, for 8 channels alike, 8 more all different, up to a max. of 16 channels	dc to 150 cps within 3 db	10 μv/div to 5 v/div, depending on 950 amplifier module used	Max. 0.5%	Same as 350 Series	See summary chart

DIRECT WRITING, HEATED STYLUS SYSTEMS — AVAILABLE TYPES, PRICES

	150 SERIES				350 SERIES				850 SERIES				950 SERIES			
	4 channel		6 channel		4 channel		6 channel		4 channel		6 channel		4 channel		6 channel	
Basic Assemblies (without preamps) (Add Basic Assembly price to Preamp prices for total system cost)																
	\$3250		\$4870 2 cabinets		\$3835		\$5215		\$3200		\$4625		\$3000		Not available	
	\$5780		\$4705 single cabinet		\$6270		\$5300		\$5300		\$3300		\$3300		Price on request	
	Not available		Not available		Not available		Price on request		Price on request		Price on request		Price on request		Price on request	
Preamplifiers (add Series No. prefix)																
1000 DC	\$385°		\$425°		\$265°		\$425°		\$250°		\$365		\$2100°		\$1700	
1100 Carrier	\$360		\$360		\$445		\$445		\$320		\$320		\$1800		\$2200	
1200 Phase-Sensitive Demodulation	\$220°		\$220°		\$250°		\$250°		\$225°		\$225°		\$3000		\$3500	
1300 DC Coupling	\$305		\$305		\$475		\$475		Not available		Not available		\$3000		\$3600	
1400 Logarithmic	\$435°		\$435°		\$525°		\$525°		\$435		\$435		\$3000		\$3500	
1500 Low Level	\$470°		\$470°		\$550°		\$550°		\$375°		\$375°					
1800 Stabilized DC	\$495		\$495		\$850		\$850		Not available		Not available					
2300 AC Wattmeter	\$440		\$440		\$600		\$600		Not available		Not available					
2500 RMS Volt/Ammeter	\$360		\$360		\$525		\$525		\$400		\$400					
2600 Frequency Deviation	\$415°		\$415°		\$415		\$415		\$425		\$425					
2800 Frequency Meter																

(Note: System price is basic assembly price, plus price of preamps selected)

°With Zero Suppression

Data subject to change without notice.

Prices f.o.b. factory

NEW INSTRUMENTS

MOSELEY AUTOGRAF® X-Y,

F. L. Moseley Co. offers a complete line of x-y and strip-chart recorders, program controllers, servo voltmeters, analog converters, key-boards and accessories. A complete catalog of instruments is available by contacting your local representative or F. L. Moseley Co., 409 N. Fair Oaks Ave., Pasadena, Calif.

The Moseley line of Autograf X-Y Recorders includes various 8½" x 11" and 11" x 17" models, a 10" x 10" recorder with automatic roll chart advance, and another which provides recordings 30" x 30".

Model 135, 136 Series Recorders are today's most compact 8½" x 11" x-y recorders. One instrument may be used on a bench, rack mounted or carried anywhere. They are offered in single-pen or two-pen models. These x-y recorders feature vac-

uum paper hold-down. (Model 135C has new mechanical paper hold-down.)

The Autograf 2D Series are 11" x 17" recorders offered in a variety of cabinet and bench models. The 6S is a rack mount 10" x 10" recorder, while the Model 7 is the 30" x 30" instrument.

The Moseley Strip-Chart recorders, include the solid state 680 Series, each recorder a bench or rack mount model in one instrument.

One feature common to most Moseley recorders is incorporation of a highly stable zener controlled reference supply.

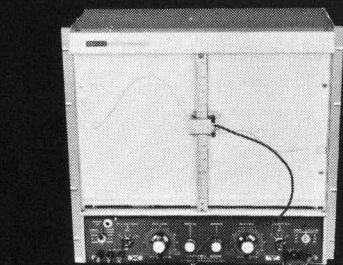
Model 2D-5 Transport Delay Simulator consists of a Model 2D X-Y Recorder (with roll chart) and a Type F-3 Line Follower. The 2D-5 records,

then reads out by positioning the arm of a potentiometer. The y-signal is obtained by connecting an external supply to the potentiometer. Delay between record and read is adjustable.

Model 22 DC Voltmeter is a high accuracy, servo-operated indicating device featuring a 14-inch mirror-backed scale. 11 ranges, 3 mv to 300 v full scale. Accuracy ±0.2% of full scale.

Accessory instrumentation in the Moseley line includes the Type A-1 Dual Channel AC/DC Converter, Type Q roll chart accessories, Model 60D Logarithmic Converter, Type F-3 Optical Line Follower, Type 101 Waveform Translator and a variety of character printers and keyboards for increasing the flexibility of recorder applications.

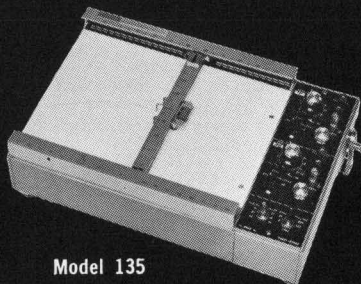
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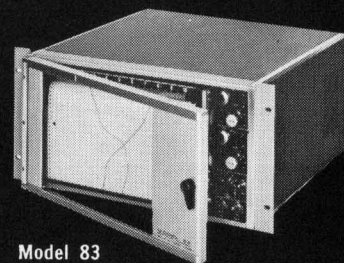
Model 2DR



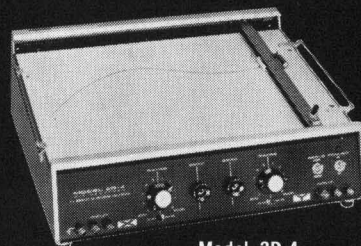
Type F3



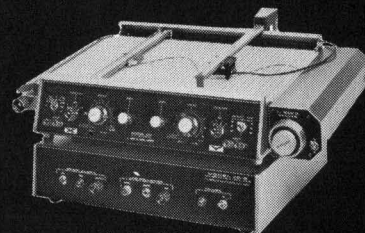
Model 135



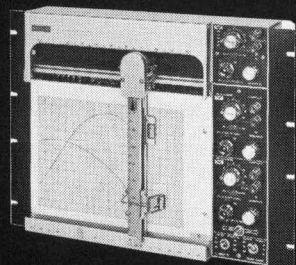
Model 83



Model 2D-4



Model 2D-5



Model 136



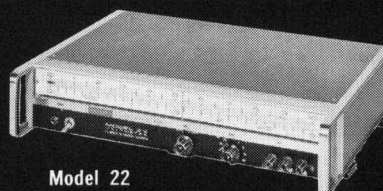
Model 2D-2



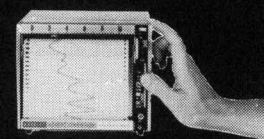
Model 60D



Type 101



Model 22



Model 680

F. L. MOSELEY CO.

STRIP-CHART RECORDERS

F. L. MOSELEY CO.

Model	Characteristics	Recording Size (in.)	Recording Pen Speed	Input Ranges	Accuracy	Price
1	X-Y recorder; full range zero set; isolated inputs each axis	8½ x 11	1 sec each axis for full scale pen travel	5, 10, 50, 100, 500 mv; 1, 5, 10, 50, 100 v each axis	Better than 0.2% of full scale	\$1190‡
2D (bench) 2DR (rack)	X-Y recorder; accepts ac or dc inputs on each axis; built-in time base x-axis	11 x 17	20 in/sec each axis	Each axis: dc, 16 ranges 0.5 to 50 mv/in and 0.1 to 50 v/in; ac, 8 ranges 0.1 to 20 v/in	dc, better than 0.2% of full scale; ac, from 0.5% to 10%, depending on frequency	\$2250
2D-2 (bench) 2DR-2 (rack)	Similar to 2D, except will accept only dc inputs on each axis			Metric scaling optional		\$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			Metric scaling optional		\$2050
2D-4	X-Y recorder, dc input, 10 ranges and variable range control on each axis; mechanical paper hold-down	11 x 17	15 in/sec on each axis	10 ranges on each axis, 0.5 mv/inch to 10 v/in; metric scaling optional		\$1490
2D-5	Transport delay simulator; combines a 2D Series Recorder with roll chart accessory and Type F-3 Line Follower on a second recorder arm; provides adjustable delay from 4 seconds to 7 minutes					\$5900‡
2FRA	Two-pen x-y, y, recorder, built-in time base on x-axis	11 x 17	1.5 sec or less each axis for full scale pen travel	10 ranges each axis, 0.5 mv to 50 v/division (inch)	Better than 0.2% of full scale	\$3575 Rack Mount
6S	Rack mount x-y recorder with automatic chart advance, up to 120 charts on single roll	10 x 10	1 sec each axis for full scale pen travel	16 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	30 x 30	20 in/sec max. pen speed each axis	13 ranges, 1 mv/in to 10 v/in	Better than 0.2% of full scale	\$6500
80A	General purpose lab strip-chart recorder; pushbutton selection of 6 different chart speeds; chart speed may be synced to external pulse	10" chart to 120' long	0.25 sec for full scale pen travel; 6 chart speeds, 2 to 60 in/min	10 ranges 5 mv to 100 v for full scale deflection	±0.2% of full scale	\$2495‡
83	Two-pen, six-speed strip-chart recorder; chart speed may be synced to external pulse	10" chart to 120' long	0.25 sec for full scale pen travel; 6 chart speeds, 2 to 60 in/min	15 ranges each axis, 5 mv to 200 v full scale	±0.2% of full scale	\$3450‡
135	Compact portable, desk or rack mount x-y recorder, occupies less than ½ cu ft, built-in time base	8½ x 11	0.5 sec each axis for full scale pen travel	16 ranges each axis, 0.5 mv/in to 50 v/in**	Better than 0.2% of full scale	\$1650
135C	X-Y recorder, dc input, 10 ranges and variable range control on each axis; mechanical paper hold-down	8½ x 11	15 in/sec on each axis	10 ranges on each axis, 0.5 mv/inch to 10 v/inch**		\$1190
136	Two-pen version of Model 135 X-Y Recorder; similar characteristics (x-y, y)					\$2650‡
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 680, except is thermocouple operated, built-in cold junction compensation			Metric scaling optional		\$675‡
683°	Similar to 680, except makes current measurement			Metric scaling optional		\$625‡
685	Includes standard 680 with optical line follower	5" active paper width	Provides delay time from 4 sec to 2.9 hrs			\$1780
*Built-in dc inverters available for operation from 12 v or 28 v dc; 1% frequency stability add \$225; 0.1% frequency stability add \$300 **Metric scaling optional						
22	DC Servo Voltmeter, 11 ranges, 3 mv to 300 v full scale, linear scale, zener reference					\$595‡
60D	Logarithmic Converter, converts dc or ac to dc proportional to the log of the positive peak amplitude of the input					\$575‡

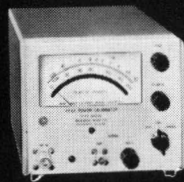
RECORDER ACCESSORIES

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-3	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, 80A or 680 Recorders	\$795‡ plus installation
Type 101	This waveform translator permits plotting of repetitive oscilloscope traces on x-y recorders	\$575‡

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

NEW INSTRUMENTS

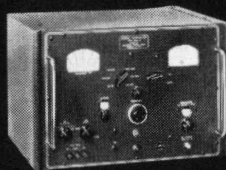
BRC IMPEDANCE MEASURING INSTRUMENTS, FM-AM



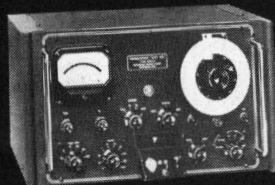
8900A



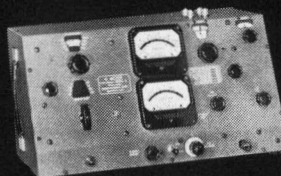
245C



225A



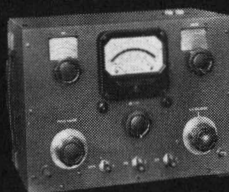
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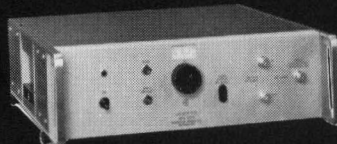
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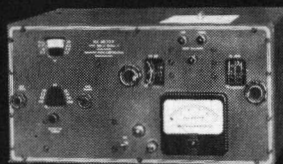
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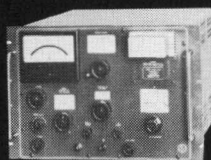
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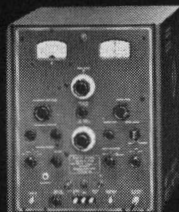
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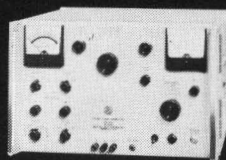
250A



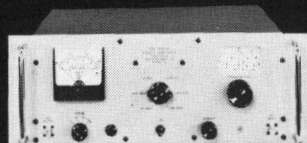
280A



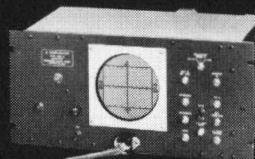
240A



202J



230A



265A



211A

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. In the *280A*, Q measurements are made by measuring the percentage bandwidth of the resonance curve and the direct reading dials mechanically compute the transfer function and read out directly in circuit Q. Q Meters are useful for measurement of coils, capacitors, resistors, and dielectric materials.

250A Rx Meter, is a self-contained extremely 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 semi-conductor 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.

SIGNAL GENERATORS, VOR/ILS/DME TEST EQUIPMENT

BOONTON RADIO

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.

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.

8900A 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; *Navigation Aids Test Set, Type 235A* provides complete facilities for DME and the ATC Beacon.

Q Meters (Type)	RF Range	Total Q Range	Res. C Range	L Range	Price
260A	50 kc to 50 mc	10 to 625	30 to 460 pf	0.09 μh to 130 mh	\$990
190A	20 mc to 260 mc	5 to 1200	7.5 to 100 pf	4 mμh to 8.5 μh	\$995
280A	210 mc to 610 mc	10 to 25,000	4 to 25 pf	2.5 to 146 mμh	\$2610

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

Univerter (Type)	RF Range	Accessory To	RF Output Range	Price
203B	100 kc to 25 mc	240A	1 μv to 2 v	\$445
207H	100 kc to 55 mc	202H,J	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 vpk.	>60 db below 100% output	>40 db below 100% output	\$975

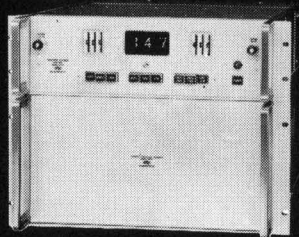
Signal Generator Calibrators (Type)	RF Range	RF Input Voltage Measurement Levels	RF Output Voltage	AM Range	Price
245C	500 kc to 1000 mc	0.025, 0.05, 0.1 v	5, 10, 20 μv	10 to 100%	\$460
245D	500 kc to 1000 mc	0.025, 0.05, 0.1 v	0.5, 1, 2 μv	10 to 100%	\$455

Peak Power Calibrator (Type)	RF Range	RF Power Range	RF Power Accuracy	RF Pulse Width	RF Repetition Rate	Price
8900A	150 mc to 1500 mc	200 mw peak f. s.	±1.5 db*	>0.25 μsec	1.5 mc max.	\$485

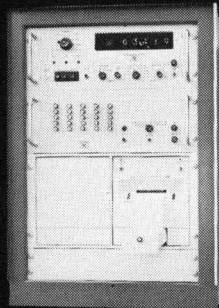
Aircraft Signal Generators (Type)	RF Range	RF Output Range	Calibrates	Price
211A	88 mc to 140 mc	0.1 μv to 0.2 v	VOR, ILS Localizer	\$1990
232A	329.3 mc to 335 mc	1 μv to 0.2 v	ILS Glide Slope	\$2175
235A	962 mc to 1213 mc	-10 to -100 dbm	DME & ATC Transponder	\$4900

*±0.6 db with custom calibration curve, add \$75.00.
Data subject to change without notice. Prices f.o.b. factory.

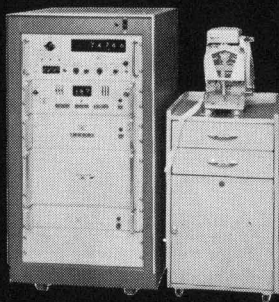
NEW INSTRUMENTS



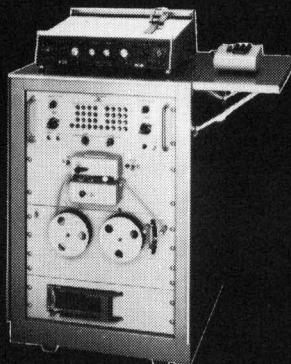
DY-2911A,B



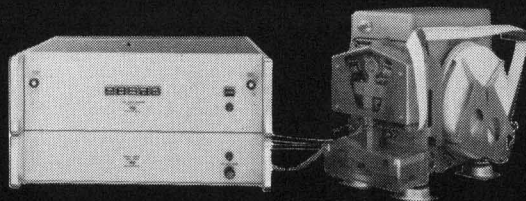
DY-2010A



DY-2010D



DY-2030



DY-2545



DY-2211B

Dymec Division of Hewlett-Packard offers instruments for digital data acquisition and rf measurement and control. Designing for compatibility with standard *hp* instruments, Dymec also offers inexpensive packaged systems, engineered and tested for maximum performance and reliability and available at low cost and with minimum delivery delay. Areas of measurement covered by Dymec instruments and systems include data acquisition, data processing, component testing and rf measurement and control.

Data Acquisition Systems from Dymec include a series of versatile standard packages engineered for a variety of input and output situations. The basic systems measure 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. In this series of *Dymec 2010 Systems*, the basic measuring element is the floated and guarded *DY-2401A Integrating Digital Voltmeter*, which permits accurate low-level measurements even in the presence of severe common mode and superimposed noise. Other Dymec systems are available to meet a variety of input and output requirements.

Data Processing Instrumentation includes two basic systems available from Dymec. These 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. Manual data entry also is possible. The *DY-2035A* operates from magnetic tape, with computer data recorded at normal writing speed, and includes all plotting commands for Dymec system operation. System also features automatic tape address search.

Dymec Input Scanners permit multiple signals to be measured with one measuring instrument or system. Operating modes include continuous-scan, single-scan and single-step, with manual or remote control capability. The *DY-2900A* 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 crossbar 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-2410A AC/ohms Converter*. Both instruments are fully programmable and compatible with the *DY-2401A 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-2401A 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.

RF Instrumentation from Dymec in the form of standard instrument packages is briefly described in other appropriate sections of this shortform catalog. Complete systems built around these instruments are available.

RF INSTRUMENTATION

DYMEC

Data Acquisition Systems	DY-2010A	DY-2010B	DY-2010E	DY-2010C	DY-2010D	DY-2010F
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; accuracy ± 1 digit \pm time base accuracy.					
Display	5 digits of data, range, function (polarity), channel number, all included in front-panel readout, logged on output recording device.					
Measurement Speed	5 channels/sec	10 channels/sec	1 channel/sec	5 channels/sec	10 channels/sec	1 channel/sec
Effective Common Mode Rejection	105 db	105 db	105 db	130 db	130 db	130 db
Output	Printed paper tape	Perforated tape	Punched card (IBM 526)	Printed paper tape	Perforated tape	Punched card (IBM 526)
Price	\$8675‡	\$10,800‡	\$9885	\$10,965‡	\$12,850‡	\$12,175
Options	Time of day information, ac voltage and resistance measurements, 10 mv full-scale sensitivity, cabinet.					

Data Processing 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-2035A	Operates from binary-coded decimal or binary magnetic tapes as specified; smooth, continuous curves are produced at 4 in./sec with accuracy of 0.2%; automatic plotting, automatic search; 15" x 10" standard plot, 30" x 30" optional.			\$29,975 ■

Input Scanners	Features	Price
DY-2900A	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 10-line contact closure output.	\$950
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.	\$4650

Signal Conditioners	Features	Price
DY-2411A	Expands DY-2401A capability down to ± 10 mv full scale, with 134 db common mode rejection; features 10,000 megohm input resistance, fast overload recovery and rapid rise-time design, full programmability.	\$1150
DY-2410A	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.	\$2250*‡

Integrating Digital Voltmeter	Features	Price
DY-2401A	Voltage ranges, frequency measuring ranges and display listed in "data acquisition systems" section above; accurate measurement of low-level signals in the presence of high common mode noise, accomplished by floated and guarded measuring circuitry and unique average-reading characteristic; effective common mode rejection 140 db at all noise frequencies, 160 db at dc; fully programmable.	\$3950

Voltage-to-Frequency Converters	DY-2210	DY-2211A	DY-2211B	DY-5207-1
Input Ranges	$\pm 1, 10, 100, 1000$ v dc	± 1 v dc optional attenuator	± 1 v dc optional attenuator	$\pm 0.1, 1, 10, 100, 1000$ v dc 1, 10, 100, 750 v dc
Output Frequency	0 to 10 kc	0 to 10 kc	0 to 100 kc	0 to 10 kc
Price	\$650 (rack)‡ \$660 (cabinet)‡	\$1250‡	\$1250‡	\$1850‡

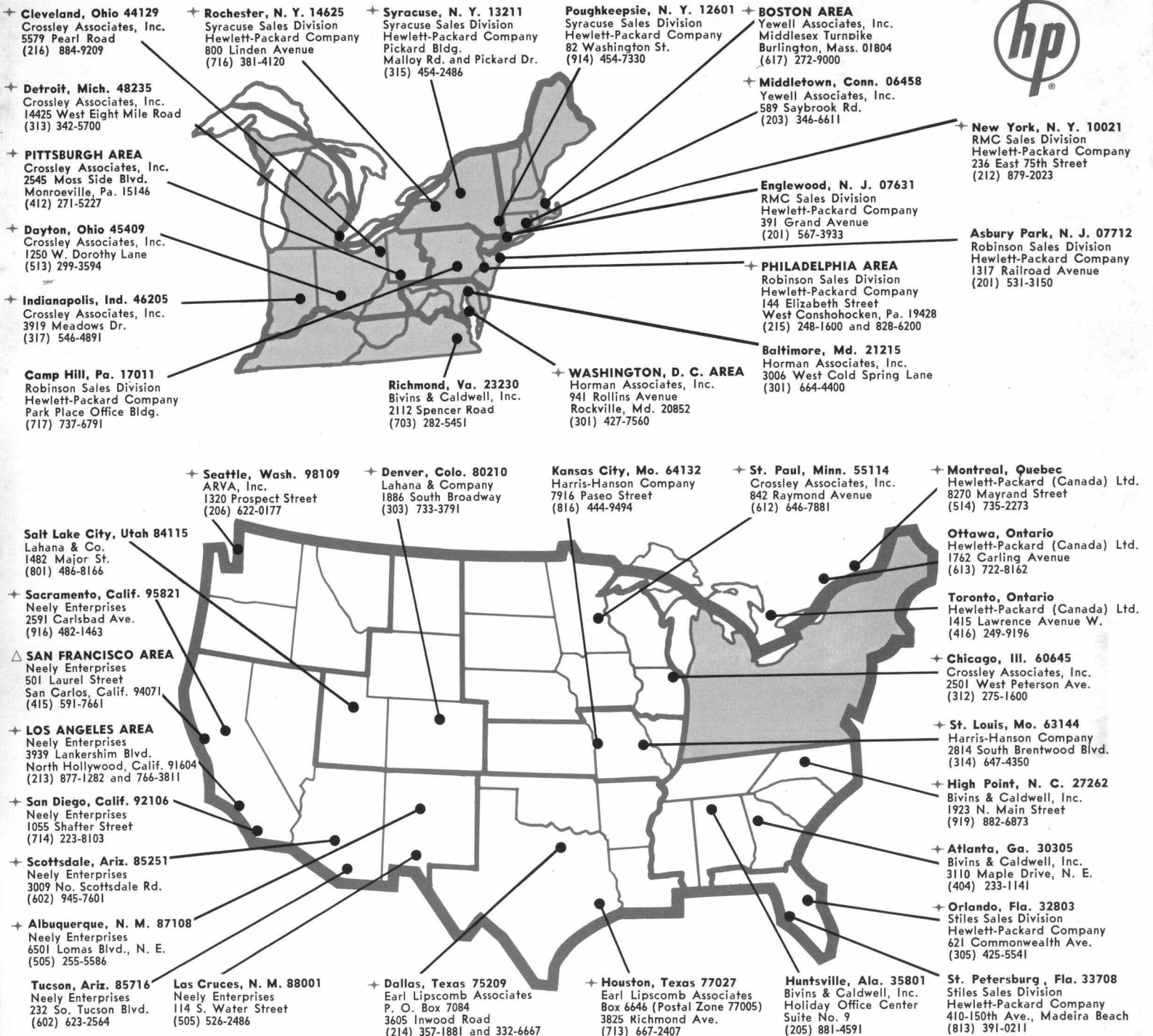
Output Couplers	Features	Price
DY-2526	Couples DY-2401A or electronic counter to IBM 526 Card Punch; standard model accepts 10 input digits in BCD form and features data storage for high-speed operation; all solid state.	\$3100 ■
DY-2545	Operates with Teletype BRPE 11 Tape Punch, records at 110 characters/sec; standard model accepts 10 input digits in BCD form, from DY-2401A 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-2530	Transfers data from electronic counters, digital voltmeters to parallel-entry card punches, digital comparators, displays.	\$770 to \$1510
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 ■

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

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

NEW INSTRUMENTATION

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△ For replacement parts and repair services in the San Francisco area, please contact Hewlett-Packard Company at: 395 Page Mill Road, Palo Alto, California 94306 (415) 326-3950.
 † Indicates Instrument Repair Stations

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