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On-line curator: Glenn Robb
Advantages:

- Extreme operating dependability
- Brilliant, high resolution trace
- Automatic triggering system
- Sensitivity 1 mv per centimeter
- High gain, balanced input
- 21 calibrated sweeps; direct reading
- Wide pass band, dc to 300 KC
- Similar X and Y amplifiers
- Twist-off bezel; easy CRT change
- High stability, unique versatility
- Etched, unitized circuits

Use To Measure:

Provides new convenience in evaluating complex voltages. Particularly ideal for measuring mechanical quantities through a transducer such as complex voltages, stress, strain and vibration, pressure and displacement, acceleration, etc.

Most Dependable Oscilloscope Offered Commercially

Here at last is a new kind of oscilloscope—actually the first commercial instrument to combine three basic features you want most—broad usefulness, simple operation, and the degree of dependability you expect from time-tested HP instruments. HP 130A provides each of these advantages, and sets new standards for oscilloscope usefulness, simplicity and reliability.

Covering frequencies from dc to 300 KC, HP 130A is a versatile, all-purpose tool for laboratory, production line and industrial processing measurements. In addition to its versatility as an oscilloscope, HP 130A can be used as a millivoltmeter or voltmeter.

Simple operation is an outstanding characteristic of the new instrument. Controls are at a minimum, are color-coded to front panel markings and are arranged by function. 21 sweep times may be directly set on the panel control; no arithmetic or interpolation is required to determine sweep settings. Horizontal sweeps are calibrated from 1 μsec/cm to 5 sec/cm. Accuracy is within 5%, and sweeps are highly linear.
Automatic Triggering

Two novel circuit features contribute to the instrument's unique operating convenience. First, the oscilloscope accepts signals directly from conventional transducers without preamplification in the majority of cases. Findings are presented in a brilliant, high resolution trace visible under all lighting conditions. Second, the instruments contain a "universal" automatic triggering system. Under almost all circumstances, one single preset condition provides optimum triggering. The sweep may be operated free-running when it is desired to determine the base line. A high degree of stability and freedom from horizontal jitter is maintained under all sweep conditions.

Similar X, Y Amplifiers

Horizontal and vertical amplifiers are similar, and provide high sensitivity of 1 mv/cm or 10 mv full scale deflection. The amplifiers have wide pass bands from dc to 300 KC, and offer balanced input circuits on the five most sensitive ranges. (These circuits are particularly useful in industrial, medical and similar applications where it is more convenient to accept a low level balanced signal direct from a transducer.) The amplifiers also provide single ended input, and may be either ac or dc coupled.

Use as Voltmeter

Both amplifiers on the -hp- 130A are highly stable, requiring virtually no adjustment during operation. Their gain may be standardized by an internal 1,000 cycle 10 millivolt source. These features, together with the instrument's precision input attenuator, make possible use of the oscilloscope as a millivoltmeter or voltmeter accurate within 5%.

Quick CRP Interchange

-hp- 130A is arranged physically for maximum convenience in use. In addition to concentric, color-coded controls, a tilt bail is provided to raise the instrument to a suitable viewing angle. The CRT bezel removes instantly with 1.5' twist, providing rapid means of changing filters and replacing cathode ray tube if different phosphors are required. Bezel locks to provide firm mount for standard oscilloscope camera equipment. An alignment lever provides quick and direct orientation of the CRT trace with the graticule.

Etched Circuitry

Electrically and electronically, the design of Model 130A is highly conservative. Components are operated well below ratings. Etched circuitry is used extensively to stabilize capacities and increase operating dependability and accessibility. The entire instrument is broken down into several sub-assemblies, each functionally integral and readily reachable for servicing.

Specifications

Sweep

Range: 1 μsec/cm to 15 sec/cm.
Calibrated: 21 calibrated sweeps in 1-2-5-10 sequence, 1 μsec/cm to 5 sec/cm. Accuracy within 5%.
Vernier: Permits continuous adjustment of sweep time.
Triggering: Internally, line voltage, or externally with 2 v or more.
Trigger Point: Any positive or negative level on the positive or negative slope of the signal triggering the sweep. +30 to -30 volt range for external trigger.
Preset Triggering: Switch position on sweep mode control automatically selects optimum setting for stable triggering.

Input Amplifiers

Vertical and horizontal amplifiers have same characteristics.
Sensitivity Range: 1 mv/cm to 50 v/cm.
Input Attenuator: 14 calibrated ranges, in a 1-2-5-10 sequence, 1 mv/cm to 20 v/cm. Vernier permits continuous adjustment between ranges.
Pass Band: dc to 300 KC, independent of attenuator setting.
Coupling: ac or dc.
Balanced Input: On 1, 2, 5, 10 and 20 mv/cm ranges. Input impedance 2 megohms shunted with 50 ppf.
Single Ended Input: On all ranges. Input impedance 1 megohm shunted with 50 ppf.
Undistorted Deflection: Three screen diameters.
Amplitude Calibrator: Fixed amplitude, accuracy within 5%. Approximately 1 KC square wave.

General

Illuminated Graticule: Edge lighted graticule with controlled illumination, 10 cm x 10 cm, marked in centimeter squares with 2 mm subdivisions on major horizontal and vertical axes.
CRT Bezel: CRT bezel readily removed by a 15° twist, providing rapid means of changing filters and replacing cathode ray tube if different phosphors are required. Bezel locks to provide firm mount for standard oscilloscope camera equipment.
CRT Plates: Direct connection to deflecting plates via terminals on rear.
Intensity Modulation: Terminals on rear; 20 v positive signal blanks CRT at normal intensity.
Cathode Ray Tube: 5AQ5 mono-accelerator flat face type with 3000 volt accelerating potential. Available with P1, P7, or P11 screen.
Size: Width—9½"; Height—15¾"; Depth—20".
Weight: 39 lbs net.
Power Supply: 115/230 volts ±10%, 50/400 cycles, approximately 175 watts.
Filter: Color of filter compatible with screen phosphor.

Data subject to change without notice.
Advantages:

- Maximum usefulness, reliability
- Brilliant, full screen high resolution trace
- No halo or bloom effect
- Leading edge of signal always visible
- 24 direct reading calibrated sweeps
- Automatic sweep triggering
- 0.25 μsec distortionless delay line
- Plug-in vertical pre-amplifiers, single or dual trace
- New pen-sized low capacity probe
- Sweep magnification of 5, 10, 50 and 100 x
- Single shot sweep with lock-out
- Twist-off bezel; CRT access door
- Etched circuits, unitized construction
- Color-coded, concentric controls, simplified and functionally grouped

Uses:

- General purpose laboratory instrument for fast circuit work in pulse applications such as radar, TV, nucleonics and guidance systems.
- Presents the ultimate in waveform observation and complex voltage measurement.

Setting New Standards of Oscilloscope Dependability!

**Maximum** usefulness, convenience, and utmost electrical and mechanical dependability—these were the objectives in designing the new **hp-150A Oscilloscope**. The result is a high frequency instrument which answers more laboratory and production problems more conveniently than previous equipment, and is the industry’s most outstanding oscilloscope value.

For maximum usefulness, **hp-150A** is designed for operation with plug-in vertical amplifiers. Currently, these include **hp-151A**, a high gain unit with 5.0 mv/cm maximum sensitivity and frequency response from dc to 10 MC; and **hp-152A**, a dual amplifier permitting two phenomena to be presented on the CRT simultaneously. Either of **hp-152A**‘s dual amplifiers may be used separately. For dual trace presentation, an electronic switch applies amplifier outputs to alternate traces, or switches outputs at a 100 KC rate.

**0.25 Microsecond Delay Line**

The oscilloscope's vertical amplifier provides excellent transient response and less than 0.035 μsec rise time; the pass band is dc to 10 MC. A distortionless 0.25 μsec delay line permits viewing the leading edge of the signal triggering the sweep, and requires no adjustment. A single, direct reading front panel control selects any of 24 calibrated sweep times. No calculation or interpolation is required. Sweep times are accurate within 3% and cover the range 0.02 μsec/cm to 5 sec/cm. The sweep may be triggered by internal or external voltage, or may be free running. Triggering may be accomplished on positive or negative slopes and at positive or negative voltages of ±30 to −30 v.
**Sweep Magnification**

Model 150A’s horizontal amplifier provides sweep magnification of 5, 10, 50 and 100 times, and a multi-turn positioning control provides a fine degree of horizontal adjustment so that any 10 cm portion of the magnified scale may be examined. Indicating lamps show when the magnification circuit is in use, or when a combination of sweep time and magnification exceeds the fastest calibrated sweep time. The horizontal amplifier, which has a separate input, also includes a calibrated input attenuator, and has a maximum sensitivity of 200 mV/cm over a pass band dc to more than 500 KC.

Two special features of -hp- 150A add much to the instrument’s convenience and versatility. One is the automatic triggering circuit by which single preset adjustment establishes optimum triggering for almost all conditions and eliminates most adjustment during or even before measurement. The other feature is the single shot sweep circuit. After firing, this circuit remains locked out until reset. A light indicates when the circuit is armed.

**Etched Circuits**

Every possible step has been taken to insure the mechanical and electrical convenience and reliability of -hp- 150A Oscilloscope. Controls are simplified, direct reading, concentric, color-coded and arranged logically by function. Tubes and circuits are grouped on hinged panels that swing out for simplified testing. Wherever possible, circuits are etched and unitized; and may be isolated from the instrument by unplugging. Etched circuits are mounted on translucent plastic for “look-through” convenience. A 15° turn removes the bezel, facilitating filter and CRT interchange. A door on the cabinet top gives direct access to CRT terminals, and a lever inside permits the CRT trace to be aligned with the graticule. The instrument includes a large, high volume cooling fan with replaceable air filter. All components are of highest quality obtainable. Model 150A is housed in a lightweight, streamlined metal cabinet equipped with leather carrying straps and a tilt bail for convenient viewing.

**New Low Capacity Probe**

For use with Model 150A, -hp- has developed a new, precision test probe with miniature alligator jaws. The probe has a 10 μF capacitance, 10 megohm impedance and provides a 10:1 voltage division. Compensating capacity is adjustable by rotating one portion of the nylon barrel.

**Utilized Circuits**

Utilized construction is a new concept in oscilloscope design. Basic circuit elements are etched or assembled as separate units; circuits may be disconnected without soldering, merely by unplugging. Tubes are instantly accessible on swing-out panels.

**Specifications**

-**-hp- 150A**

**Sweep**

<table>
<thead>
<tr>
<th>Range</th>
<th>0.02 μsec/cm to 15 sec/cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrated</td>
<td>24 calibrated sweeps in 1, 2, 5 and 10 sequence.</td>
</tr>
<tr>
<td></td>
<td>0.1 μsec/cm to 5 sec/cm. Accuracy within 3%.</td>
</tr>
<tr>
<td>VERNIER</td>
<td>Permits continuous adjustment of sweep time.</td>
</tr>
<tr>
<td>TRIGGERING</td>
<td>Internally, line voltage; externally with 0.5 v or more.</td>
</tr>
</tbody>
</table>

Trigger Point: Any positive or negative level on positive or negative slope of signal triggering sweep. +30 v to −30 v range for external trigger.

**Horizontal Amplifier**

Sweep Magnification: Sweep may be expanded 5, 10, 50 or 100 times. Multiturn horizontal positioning control provides a fine degree of adjustment, permits viewing any 10 cm portion of expanded sweep.

Indicators: “Reman” lights glow when sweep magnifier is used, or when expanded sweep time exceeds fastest calibrated sweep time.

External Input: Pass band dc to over 500 KC. Sensitivity range 200 mV/cm to 25 v/cm. Five calibrated ranges plus vernier.

**Vertical Amplifier**

Main Vertical Amplifier: Pass band dc to more than 50 MC. Optimum transient response and rise time less than 0.035 μsec.

**Signal Delay**: 0.25 μsec delay permits viewing leading edge of signal triggering sweep.

Input: Through plug-in preamplifier.

**General**

Amplitude Calibrator: 18 Calibrating voltages in 2, 5, 10 sequence, 0.2 mV to 100 v peak-to-peak, are available at a binding post to provide maximum flexibility. Accuracy within 1%.

Approximately 1 KC square wave with rise and decay times less than 1 μsec.

Sawtooth Output: +20 to −20 v sawtooth waveform of sweep.

Gate Output: +20 v for duration of sweep.

Illuminated Graticule: Edge-lighted graticule with controlled illumination, marked in centimeter squares with 2 mm subdivisions on major horizontal and vertical axes.

CRT Bezel: CRT bezel readily removable by a 15° twist, providing rapid means of changing filters and replacing CRT if different phosphors are required. Bezel locks to provide firm mount for standard oscilloscope camera equipment.

**CDT Plates**: Direct connection to deflecting plates via terminal in access compartment.

Intensity Modulation: Terminals provided; 20 v positive signal blanks CRT at normal intensity.

Cathode Ray Tube: SAMP mono-accelerator flat face type with 5,000 v accelerating potential. Available with P1, P2, P7 or P11 screen.

Size: Width—13½"; Height—17½"; Depth—25".

Weight: Approximately 65 lbs. net.


Accessories Furnished: 2—AC-21A Probes. 1—Filter compatible with screen phosphor. 2—AC-76A BNC to binding post adaptors.

Price: $1,000.00 f.o.b. Palo Alto, California. (Normally supplied with P2 screen. For P1 screen, specify 150A-1; for P7 screen, specify 150A-7; for P11 screen, specify 150A-11.)

**-hp- 151A High-Gain Amplifier**

Sensitivity Range: 5 mV/cm to 50 v/cm.

Input Attenuator: 12 calibrated ranges, in 0.5, 1, 2, and 5 sec- sequence, from 5 mV/cm to 20 v/cm. Vernier permits continuous adjustment between ranges.

Input Impedance: 1 megohm shunted with 50 μF.

Pass Band: dc to 10 MC, 0.035 μsec rise time.

Coupling: ac or dc.

Dual Inputs: Two signal inputs with Type BNC. Selection of either input by panel switch.

Price: $100.00.

**-hp- 152A Dual Channel Amplifier**

Sensitivity Range: 0.05 v/cm to 50 v/cm.

Input Attenuator: 9 calibrated ranges, in 1, 2, 5 and 10 sequence, from 0.05 v/cm to 20 v/cm. Vernier permits continuous adjustment between ranges.

Input Impedance: 1 megohm shunted with 50 μF.

Pass Band: dc to 10 MC, 0.035 μsec rise time.

Coupling: ac or dc.

Electronic Switching: By alternate sweeps or chopped at approximately 100 KC.

Vertical Positioning: Individually adjustable.

Polarity of Presentation: Input signal as applied or inverted.

Input Connectors: Type BNC both channels.

Price: $200.00.

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

Price: $115.00 to $1,000.00.
New! High Quality, Low Price

Offering utmost convenience and simplified operation along with high stability, wide frequency range, low distortion and built-in precision, compact and easily portable in new rugged lightweight cabinet. The latest -hp- development in RC oscillator circuits combined with a mechanical layout designed for durability and accessibility. Reliability assured by -hp- practice of incorporating highest quality components available and rated to provide a large safety factor.

These fundamental features of all -hp- oscillators are also incorporated in these three new oscillators.

-**hp- 200J**, 6 cps to 6 KC, replaces -hp- 2001 and is designed for interpolation and similar work where frequencies must be known with extreme accuracy. Features are: new 160 mw balanced output, waveform purity and frequency unaffected by load, less than 0.5% distortion, and very high stability.

-**hp- 201C**, 20 cps to 20 KC, replaces -hp- 201B and offers a superior attenuator with new compact styling at a lower price. Meets requirements for speed, accuracy, ease of operation, waveform purity for high fidelity audio system or component testing, frequency comparison, and transmission line measurements. Delivers at least 3 watts to a 600 ohm load resistor.

-**hp- 202C**, 1 cps to 100 KC, replaces -hp- 202B and covers a wider and more convenient frequency spectrum. Waveform purity and frequency are virtually unaffected by load resistance. Excellent for subsonic, sonic, and supersonic applications in industrial production, field, or laboratory. Also features new 160 mw balanced output, high stability, low distortion, and a short recovery time when switching ranges.

### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Calibration Accuracy</th>
<th>Output to 600 Ohms</th>
<th>Recommended Load</th>
<th>Maximum Distortion</th>
<th>Max. Hum. &amp; Noise</th>
<th>Input Power</th>
<th>Weight—Lbs. Net</th>
<th>Size (Inches) W x H x D</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>200A</td>
<td>20 cps to 6000 Kc (4 bands)</td>
<td>±2%</td>
<td>1 watt (25 v)</td>
<td>600 ohms</td>
<td>0.1%</td>
<td>0.0%</td>
<td>65 watts</td>
<td>15</td>
<td>7/8 x 11 1/2 x 14 1/4</td>
<td>$120.00</td>
</tr>
<tr>
<td>200B</td>
<td>5 cps to 100 Kc (5 bands)</td>
<td>±2%</td>
<td>50 mw 10 volts</td>
<td>600 ohms</td>
<td>0.5%</td>
<td>0.1%</td>
<td>110 watts</td>
<td>23</td>
<td>7/8 x 11 1/2 x 14 1/4</td>
<td>$150.00</td>
</tr>
<tr>
<td>200C</td>
<td>20 cps to 100 Kc (6 bands)</td>
<td>±1%</td>
<td>50 mw 10 volts</td>
<td>600 ohms</td>
<td>0.5%</td>
<td>0.1%</td>
<td>110 watts</td>
<td>23</td>
<td>7/8 x 11 1/2 x 14 1/4</td>
<td>$175.00</td>
</tr>
<tr>
<td>200D</td>
<td>250 cps to 1000 Kc (12 bands)</td>
<td>±1%</td>
<td>10 mw 10 volts</td>
<td>600 ohms</td>
<td>0.5%</td>
<td>0.0%</td>
<td>110 watts</td>
<td>27</td>
<td>18 1/4 x 9 x 11 1/4</td>
<td>$350.00</td>
</tr>
<tr>
<td>201A</td>
<td>20 cps to 20 Kc (3 bands)</td>
<td>±1%</td>
<td>3 watts (42.5 v)</td>
<td>600 ohms</td>
<td>0.5%</td>
<td>0.5%</td>
<td>75 watts</td>
<td>16</td>
<td>7/8 x 11 1/2 x 14 1/4</td>
<td>$225.00</td>
</tr>
<tr>
<td>201B</td>
<td>200 cps to 20 Kc (6 bands)</td>
<td>±2%</td>
<td>300 mw 10 volts</td>
<td>600 ohms</td>
<td>0.5%</td>
<td>0.1%</td>
<td>110 watts</td>
<td>27</td>
<td>7/8 x 11 1/2 x 14 1/4</td>
<td>$300.00</td>
</tr>
</tbody>
</table>

*Internal impedance is 600 ohms. Frequency and distortion unaffected by load resistance. Balanced output with amplitude control at 1000. Use line matching transformer for other control settings. **Internal impedance approximately 600 ohms with output attenuator at 10 db or more. Approximately 75 ohms below 1000 cps with attenuator at zero. ***Internal, non-operating controls permit precise calibration of each band. 10.5% 0 to 10 Kc at 1 watt output. 1.0% over full range at 3 watts output. ±0.5% 1000 Kc to 10 Kc. 0 to 10 cps. 2.5% at 2 cps. 3.0% at 1 cps. [Measured with respect to full rated output. Frequency response is flat ± 0.1 db over instrument range. Reference level at 1 Kc except -hp- 202 at 5 Kc. Maximum overall size and weights are given for cabinet models. 10" stack models are available. Power Source—115 or 220 volts ±10% at 50 to 60 cps."

Data subject to change without notice. Prices f.o.b. factory.
New! Extreme Accuracy of 1%;
Covers 10 cps to 4 MC

NEW -hp- 400H has been adapted from the popular
-hp- 400D voltmeter to make available an instru-
ment combining general-purpose utility with ex-
treme measuring accuracy.

Model 400H has a 5″ indicating meter with mirror
scale and measures voltages from 0.1 mv to 300 volts. The
high input resistance of 10 megohms effectively minimizes
loading to circuits under test. A stabilized amplifer-recti-
ifier with feedback loop provides exceptional long term
stability; even line voltage changes of ±10% cause negli-
gible variations. Readings are direct in volts or db. Opera-
tion is extremely simple with overvoltage protection up to
600 volts on any range. The instrument is of highest qual-
ity construction throughout, and is available either in the
lightweight, rugged -hp- portable cabinet or for rack
mounting.

Specifications

Voltage Range: 0.1 mv to 300 volts. 12 ranges, selected with
front panel switch. Full scale readings of:
0.010 0.030 1.0 30
0.003 0.100 3.0 100
0.010
0.300 10.0 300 volts

Frequency Range: 10 cps to 4 MC
Accuracy: With nominal line voltages from 103 to 127 volts,
overall accuracy is:
within ±1% of full scale, 50 cps to 500 KC;
within ±2%, 20 cps to 1 MC;
within ±5%, 10 cps to 4 MC.

Long Term Stability: Reduction in Gm of amplifer tubes to 75%
of nominal value results in less than 0.3% error from 20 cps
to 1 MC.

Calibration: Reads rms value of sine wave. Voltage indication
proportional to average value of applied wave. Linear voltage
scales, 0 to 5 and 0 to 1.0; db scale, -12 db to +2 db, based
on 0 dbm = 1 MW in 600 ohms, 12 ranges in 10 db steps.

Input Impedance: 10 megohms shunted by 15 μF, 1 to 300 v;
25 μF, 0.001 to 0.3 v.

Amplifer: Output approx. 0.15 v max. Internal impedance 50
ohms. Max. gain approx. 150 on 0.001 v range.

Power: 115/230 volts ±10%, 50/6000 cps, approx. 100 watts.

Dimensions: 11½″ high, 7½″ wide, 11¼″ deep. 19″ rack mount
available.


Price: $325.00.

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

-hp- 492A

Frequency Range: 4 KMC to 8 KMC.
Gain: 30 db minimum.
Output Power: 10 milliwatts.
Noise Figure: Less than 25 db above theoretical.
Pulse Rise, Decay: 0.015 microseconds.
Mod. Pulse Delay: 0.020 microseconds.
Mod. Voltage Amplitude: 50 v positive pulse gives 40 db rf power change, sensitivity approx. 1 db/v.
Helix Mod. Voltage: Approx. 30 v peak-peak.
Hum, Spurious Mod.: 30 db below output signal.
Adjustments: Grid bias, helix voltage.
Meter Monitors: Cathode, Anode, Helix or Collector Current.
Input Impedance: 50 ohms. SWR less than 2.
Output Impedance: 50 ohms. SWR less than 3.
Connectors: Type N input and output, BNC modulation.
Power: 115 v ±10%, 50/60 cps, 110 watts.
Dimensions: Cabinet Mount: 7½" wide, 11½" high, 19½" deep.
Weight: Net 54 lbs. Shipping 93 lbs. (cabinet mount).
Price: $1,500.00, including tube.
Replacement Tube: $750.00 less $125.00 credit for returned tube and capsule.

-hp- 494A

Same as above except:
Frequency Range: 7 KMC to 12.4 KMC.
Gain: 25 db minimum.
Output Power: 5 milliwatts.
Mod. Pulse Delay: Approx. 0.015 microseconds.

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

Broad Band Amplification, Versatile Modulation, 2 to 12.4 KMC

Now -hp- offers Traveling-Wave Tube Amplifiers for all frequencies between 2 and 12.4 KMC.

-hp- 490B covers 2 to 4 KMC. This instrument supersedes -hp- 490A and has identical characteristics except for 30 db gain and provision for helix modulation. -hp- 491A covers the same range but with a higher output of 1 watt.

Details on both instruments are found in -hp- Catalog 22-A, pages 42, 43.

New -hp- 492A and 494A are low level, high gain instruments with 30 and 25 db gain respectively. They offer the unique versatility of amplitude, pulse, phase or FM modulation, and are ideal for use as broad band amplifiers or isolating buffer stages.

All models use the exclusive -hp- coupling system with two separate helices for full energy transfer over a broad frequency range. All have front panel controls and metering for performance checks or continuous monitoring. All modulation connectors are brought out to the front panel.

Replacement traveling-wave tubes are available from the factory, encapsulated and ready for use.
-hp- 485D Barretter Mounts

These instruments are accurate, square-law detectors for signal detection in reflectometer systems. -hp- mounts of this series are available for S, G, and J band waveguide systems. Mounts are supplied with factory installed barretters tested for SWR, frequency response, and square-law characteristics. Barretters employed are Sperry 821 or equivalent. (For other -hp- 485 series Detector Mounts, see -hp- Catalog 22-A, page 94.)

-hp- 421A Crystal Detector

At higher waveguide frequencies, crystals are provided as detector elements. -hp- X and P band detectors employ 1N26 silicon diodes. Supplied installed in a precision-made mount, the crystals have accurate square-law characteristics over a 40 db range when operated into a selected value video load resistor which is internal and factory installed.

- hp- AC-60K Matching Transformer

This instrument consists of two step-up transformers and appropriate bias circuitry for impedance matching between -hp- 485 series Barretter Mounts and the new -hp- 416A Ratio Meter. Designed specifically for this reflectometer system application, -hp- AC-60K operates with 200 ohm barretters such as Sperry 821 or Narda N821B as detector elements. An 8.75 ma bias current is supplied from the Model 416A Ratio Meter. The Transformer measures 4⅛" x 4" and is 3⅛" high. Weight is 2 lbs. Price, including three cable assemblies, $45.00.

**Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Maximum SWR</th>
<th>Typical Sensitivity</th>
<th>Frequency Response</th>
<th>Deviation from Square-Law</th>
<th>Waveguide Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5485D</td>
<td>2.60 - 5.95 KMC</td>
<td>1.35</td>
<td>0.5 volt/milliwatt</td>
<td>±1 db</td>
<td>±0.5 db</td>
<td>3&quot; x 1½&quot;</td>
<td>$145.00</td>
</tr>
<tr>
<td>G-485D</td>
<td>3.95 - 6.85 KMC</td>
<td>1.5</td>
<td>0.5 volt/milliwatt</td>
<td>±1 db</td>
<td>±0.5 db</td>
<td>2&quot; x 1&quot;</td>
<td>$140.00</td>
</tr>
<tr>
<td>J-485D</td>
<td>5.20 - 8.20 KMC</td>
<td>1.8</td>
<td>0.5 volt/milliwatt</td>
<td>±1 db</td>
<td>±0.5 db</td>
<td>1½&quot; x 3½&quot;</td>
<td>$135.00</td>
</tr>
<tr>
<td>X421A†</td>
<td>6.20 - 12.4 KMC</td>
<td>1.6</td>
<td>0.1</td>
<td>±2 db</td>
<td>±1 db</td>
<td>1&quot; x ½&quot;</td>
<td>$75.00</td>
</tr>
<tr>
<td>P421A†</td>
<td>12.4 - 18.0 KMC</td>
<td>1.5</td>
<td>0.1</td>
<td>±2 db</td>
<td>±1 db</td>
<td>7/8&quot; x 3/4&quot;</td>
<td>$85.00</td>
</tr>
</tbody>
</table>

*5.20 to 7.60 KMC, increase to approx. 2.0 at 8.20 KMC.
†Detector Mounts are available as "matched pairs" with similar frequency response and square-law characteristics. In this case frequency response tolerance and square-law characteristic combined (excluding basic crystal sensitivity) is held to within ± 2 db for the matched pair.
All have BNC connector for detector output.

*Data subject to change without notice. Prices f.o.b. factory.*
Advantages:
- Direct frequency, period or time interval readings
- Highest quality, broad applicability, yet moderate cost
- Basic accuracy ± 1 count; stability 2 ppm per week
- Color-coded panel simplifies use by non-technical personnel
- Pulse output for Z-axis oscilloscope modulation

Use To Measure:
- Frequency:
  - Production quantities
  - Nuclear radiation
  - Power line frequencies
  - Rps and rpm
  - Very low frequencies
  - Oscillator stability
  - Repetition rates
- Time between impulses
- Pulse length, shutter speeds
- Projectile velocity
- Relay operating times
- Precise event timing
- Interval stability
- Frequency ratios, phase delay

Time Interval, Period:
- Time between impulses
- Pulse length, shutter speeds
- Projectile velocity
- Relay operating times
- Precise event timing
- Interval stability
- Frequency ratios, phase delay

**New! Measures Period, Time or Frequency 10 cps to 1.1 MC!**

VERSATILE -hp- 523B is a completely new electronic counter designed to cover the widest possible range of measurement at no sacrifice of speed or convenience, and at lowest possible cost.

Basically similar to the well-known -hp- 522B, new 523B offers a greatly broadened frequency range of 10 cps to 1.1 MC. Time interval coverage is also broadened—3 μsec to 100,000 seconds or 27.8 hours. Period measurement is available from 0.00001 cps to 10 KC.

Model 523B is conveniently contained in a small bench cabinet, and no extra-cost modification is needed to perform all functions. Results are displayed instantly and automatically in direct-reading form on six panels numbered 0 to 9.

Number illumination is bright for easy readability in any light; results are displayed in seconds, milliseconds, microseconds or kilocycles with automatic illuminated decimal point. Display time is variable from 0.1 second to 5 seconds or indefinitely.

Unskilled Personnel Can Operate

The new Counter is particularly designed for easy use by non-technical personnel. In addition to the direct reading and automatic decimal features, panel controls are color-coded for simple operation.
For frequency counting, -hp- 523B covers the range 10 cps to 1.1 MC. Measurements are accurate within ± 1 count plus crystal stability; stability is controlled to 2 ppm per week. Time base generator crystals are subjected to prolonged aging before installation in the Counter; and further to insure accuracy, a front panel connector permits application of a 100 KC primary standard; five gate times are available: 0.001, 0.01, 0.1, 1 and 10 seconds; the gate may also be operated manually.

For period measurement, the unknown controls the opening and closing of the gates, while the instrument's high dependability -hp- AC-4A Decade Counters record the number of cycles of an internal standard frequency. This internal decade divider circuitry provides a 10-period averaging measurement which reduces ten-fold the time effect of any triggering uncertainty. Period may be measured from 0.00001 cps to 10 KC in seconds, milliseconds or microseconds.

**Time Interval Measurements**

In time interval measurements -hp- 523B measures time from 3 microseconds to 100,000 seconds (27.8 hours), presenting results directly in seconds, milliseconds and microseconds. A special threshold feature permits measurements to be started and stopped only by signals of predetermined amplitude, polarity and slope. Separate start and stop channels are provided and each channel is separately adjustable for maximum flexibility. Two dual concentric panel controls permit time interval measurements to be started or stopped at any voltage level from -300 to +300 volts, on either positive or negative slopes. Terminals at the rear of -hp- 523B provide start and stop pulse voltages adjusted by these two controls. Model 523B employs etched circuits and high quality components throughout for maximum operating accuracy and dependability. Function lights are also provided to insure that circuits are operating properly.

Figure 1. The exclusive start and stop output of -hp- 523B permits presentation on an oscilloscope of the portion of a waveform being measured by the Counter. Visual presentation can be particularly helpful when complicated waveforms are involved. Bright spots on the oscilloscope (provided from the scope's Z-axis modulation input) indicate the interval being measured.

Many phenomena common to industrial research and manufacturing can be measured quickly and conveniently with -hp- 523B and a simple transducer converting mechanical phenomena into electrical impulses. Such transducers include: -hp- 506 Optical Tachometer Pickup for measuring rpm without mechanical contact to 300,000 rpm; and -hp- 508A/B Tachometer Generators for direct reading shaft speed measurements 15 to 40,000 rpm. Other transducers enable -hp- 523B to measure flow, pressure, projectile speed, etc.

**Specifications**

**Frequency Measurement:**
- Range: 10 cps to 1.1 MC.
- Accuracy: ±1 count ± stability (see General).
- Input Requirements: 0.2 volt rms minimum.
- Input Impedance: Approx. 1 megohm, 30 µuf shunt.
- Gate Time: 0.001, 0.01, 0.1, 1, 10 seconds.
- Reads In: KC; decimal point automatically positioned.

**Period Measurement:**
- Range: 0.00001 cps to 10 KC.
- Accuracy: ±0.03% (for measurements of one period), ±0.05% (10 period average) at 1 volt rms. Improved by greater input voltage.
- Input Requirements: 1 volt rms minimum. Direct coupled.
- Input Impedance: Approx. 1 megohm, 40 µuf shunt.
- Gate Time: 1 or 10 cycles of unknown.
- Standard Frequency Counted: 10 cps, 1 KC, 100 KC, 1 MC, or external applied frequency.
- Reads In: Seconds, milliseconds, microseconds; decimal point automatically positioned.

**Time Interval Measurements**
- Range: 3 µsec to 100,000 sec. (27.8 hours).
- Accuracy: ±1/100 std. freq. counted ± stability (see General).
- Input Requirements: 1 v peak minimum. Dc coupled.
- Input Impedance: Approx. 1 megohm, 25 µuf shunt.
- Start and Stop: Independent or common channels.
- Trigger Slope: Positive or negative on start and/or stop channels.
- Trigger Amplitude: Continuously adjustable on both channels from -300 to +300 volts.
- Std. Freq. Counted: 10 cps, 1 KC, 100 KC, 1 MC; External.
- Reads In: Seconds, milliseconds, microseconds; decimal point automatically positioned.

**General:**
- Registration: Six places on neon lamp decade units.
- Stability: 2/1,000,000 per week. May be standardized against WWV.
- Display Time: Variable approx. 0.1 to 5 seconds; display held indefinitely if desired.
- Output Frequencies: Secondary standard frequencies available at front panel: 10 cps, 1 KC rectangular, 100 KC and 1 MC sine-wave (stability as above).
- Trigger Output: Start and Stop pulse output (width approx. 0.1 µsec). Available for:
  1. Voltage level selection of input signal for frequency measurements.
  2. Z-axis modulation of oscilloscope for time interval measurements.
- Self Check: Panel control provides automatic count of internal 100 KC and 1 MC frequencies to assure accuracy of gate and proper operation of counters.
- External Standard: 100 KC from external primary standard can be applied to unit for highest accuracy.
- Power: 115/230 volts ±10%, 50/60 cps, approx. 285 watts.
- Dimensions: Cabinet Mount: 13¾” wide x 16½” high x 20” deep. Rack Mount: 19” wide x 14” high x 21” deep.
- Accessories Furnished: 2 AC-16D Cable Assemblies.
- Price: $1175.00.

*Data subject to change without notice. Prices f.o.b. factory.*
Advantages:
- Extends frequency counter accuracy to microwave region
- Permits measurement of pulsed, FM, CW, AM or noisy signals
- Provides multiple check for positive accuracy
- Measures FM deviation
- Includes self-contained oscilloscope detector
- Circuit elements usable separately
- Simple to use, compact, eliminates complex setups

Use It For:
- Fast, accurate determination of CW and AM signal frequencies
- Measuring center frequency or deviation range of FM signals
- Measuring frequency in presence of high noise levels
- High accuracy measurements of pulsed signals

Now! Measure Frequency to 12 KMC With Electronic Counter Accuracy

The development of the new -hp- 540A Transfer Oscillator has made possible, for the first time, convenient frequency measurements far into the microwave region. These measurements can be made with accuracy heretofore available only at much lower frequencies.

Model 540A contains a highly stable, 100 to 220 MC oscillator generating harmonics to 12 KMC for comparison with the unknown. The comparison device is a diode mixer, amplifier, and built-in oscilloscope (See Figure 1). Combined with -hp- 524B Electronic Counter, -hp- 525B Frequency Converter (524B's appropriate plug-in unit) and oscillosynchroscope or detectors as required, the 540A extends the 524B's range to 12 KMC with new convenience and accuracy.

In operation, with approximate signal frequency known, the -hp- 540A is tuned until one of its harmonics zero beats with the unknown. The multiplying factor is noted. The transfer oscillator frequency is then measured directly on the 524B counter. The 524B frequency reading, times the multiplying factor, gives the frequency of the unknown
signal. When the signal frequency is totally unknown, a convenient calculation employing two or more harmonics is used to determine the multiplying factor.

In measuring carrier frequency of pulsed signals, an external oscillosynchroscope is used to display the detected pulse. Zero beat appears as horizontal lines across the pulses when the oscillator is tuned to an exact sub-multiple. Video amplifier frequency response controls can be used to simplify this procedure.*

In working with noisy or AM signals, the -hp- 540A response can be narrowed to obtain a more accurate indication of zero beat.*

In signals with appreciable FM, the 540A's oscilloscope presents a characteristic pattern pin-pointing upper and lower frequency deviation limits. If FM deviation is present, center frequency may also be determined.*

**Accuracy**

The system's accuracy is approximately 1 part per 1,000,000 or better on clean CW signals. On pulsed signals, accuracy is governed by carrier frequency and pulse length. On noisy or intense AM signals, the transfer oscillator system with -hp- 540A often provides the only means of accurate measurement. Overall system accuracy is better than 10 times that of the best microwave wavemeters.

**Quality Features**

Each of the circuit elements of -hp- 540A (Figure 1) may be used separately by shifting front panel patch cords. Controls are provided for coarse and fine mechanical tuning. There is also an electrical vernier with range approximately ±125 ppm. The video amplifier has both gain and bandwidth controls. Horizontal input to the internal oscilloscope is power line frequency with phase control. Input attenuation is variable from approximately 20 to 80 db to adjust signal for optimum mixing level.

*For complete discussion of microwave measuring with transfer oscillator and electronic counter, write -hp- for Hewlett-Packard Journal, Vol. 6, No. 12.

**Specifications**

### General

**Frequency Range:** 10 MC to 5,000 MC. (10 MC to 12,000 MC or higher with external detector such as -hp- 440A.)

**Input Signal:** CW, FM, AM or pulse.

**Input Signal Level:** Varies with frequency and individual crystals. Minimum input signal approx. 0 dbm to attenuator.

**Accuracy:** CW: Approx. 1/1,000,000 or better.

### Oscillator

**Fundamental Frequency Range:** 100 MC to 220 MC.

**Harmonic Frequency Range:** Above 12,000 MC.

**Stability:** Less than 0.002% change per minute after 30-minute warmup.

**Dial:** Six inch dia., calibrated in 1 MC increments. Accuracy: ±1/2%.

**Output:** Approx. 2 v into 50 ohms.

### Attenuator

**Range:** Approximately 20 db to 80 db.

**Input Impedance:** 50 ohms, SWR: 1.5 max. at 1 KMC; 3 max. at 5 KMC.

### Amplifier

**Gain:** Variable. Maximum 40 db or more.

**Bandwidth:** Variable. High Frequency: 3 db point adjustable approx. 1 KC to 2 MC. Low Frequency: 3 db point switched from 100 cycles to below 10 KC. Adjustable to above 400 KC.

**Output:** 1 volt rms maximum into 1,000 ohms.

### Oscilloscope (Self-Contained)

**Frequency Range:** 100 cps to 200 KC.

**Vertical Deflection Sensitivity:** 5 mv rms per inch at mixer output.

**Horizontal Sweep:** Internal, power supply frequency with phase control, or external (connection at rear) with 1 v per inch. Sensitivity, 20 cps to 5 KC.

### Miscellaneous

**Connectors:** Attenuator input, type N; all others type BNC.

**Size:** Cabinet Mount: 20½” wide, 12¾” high, 15¾” deep.

**Power Supply:** 115/230 v ±10%, 50/1,000 cps, approximately 110 watts.

**Auxiliary Equipment:**

- -hp- 524B Electronic Counter, $2150.00.
- -hp- 525B Frequency Converter, $250.00.
- -hp- 440A Detector Mount, $85.00.
- -hp- 150A High Frequency Oscilloscope, (see pages 4, 5).

**Price:** -hp- 540A Transfer Oscillator, $615.00

Data subject to change without notice. Prices f.o.b. factory.
Advantages:
Direct reading frequency control
Direct reading output control
10 mw output over full range
CW, FM or pulsed output
Internal square wave modulation
Broad pulsing capabilities
Low internal SWR
High stability, high accuracy
Sturdy, compact, precision-built

Use To Measure:
Receiver sensitivity
Selectivity or rejection
Signal-to-noise ratio
Conversion gain, SWR
Antenna gain
Transmission line characteristics

Direct Reading, High Power—10 to 21 KMC!

Here are two new -hp- signal generators which extend the measuring versatility, convenience and accuracy of -hp- vhf signal generators to 21 KMC. The new -hp- 626A covers frequencies 10,000 to 15,500 MC, and the -hp- 628A covers frequencies 15,000 to 21,000 MC.

In design and operation, the new instruments are similar to -hp- generators for lower frequency ranges. Operation is very simple. Carrier frequency in MC is set and read directly on the large tuning dial. No voltage adjustment is necessary during tuning because the unique -hp- coupling device causes oscillator repeller voltage to track frequency changes automatically. Oscillator output is also set and read directly, and no frequency correction is necessary throughout operating range.

Versatile Modulation
Both -hp- 626A and 628A offer internal and external pulse modulation as well as internal square wave modulation and FM. Pulse repetition rate is continuously variable.
from 40 to 4,000 pps, and pulse width is variable from 0.5 to 10 μsec. Sync out signals are simultaneous with the rf pulse, or in advance of the rf pulse by any time span from 3 to 300 μsec. The generators may be synchronized with an external sine wave and also with positive or negative pulse signals.

For internal FM, both instruments feature a sine wave sweep at power line frequency. Frequency deviation is variable up to ±5 MC. For external FM, the generators have capacitive coupling to the klystron oscillator repeller.

**Figure 1. Basic circuit, -hp- 626A/628A.**

Figure 1 shows the basic circuits of the new -hp- signal generators. The reflex klystron oscillator is tuned by a plunger driven by the direct-reading frequency dial and control. Repeller voltage is automatically tracked so that correct operating potentials are maintained over the entire frequency range. Klystron output is introduced into a power monitoring directional coupler through a rotary vane power set attenuator. The attenuator is adjusted to provide a fixed reading on the power monitoring meter.

The directional coupler provides very uniform coupling over the entire frequency range. The rotary attenuator which follows the coupler assures high accuracy and stability because the attenuation is governed by a precise mathematical law related to the angular rotation of the attenuator. The conductivity of the attenuating film does not affect the attenuation; thus the output of the generator is independent of humidity, temperature or the effects of long term aging. The attenuator also provides low SWR over the complete frequency range. On both -hp- 626A and 628A, the output connector is waveguide. Adapters furnished permit the instruments to be connected to WR-42, WR-62, or WR-90 waveguide. Thus the generators can be employed with all RETMA guides suitable for the 10 to 21 KMC range.

### Specifications

**Frequency Range:** 626A, 10,000 to 15,500 MC; 628A, 15,000 to 21,000 MC.

**Frequency Calibration:** Dial direct reading in megacycles. Accuracy better than ±1%.

**Output Range:** 10 mw to 1 μW. (+10 dbm to −90 dbm, 0 dbm = 1 mw.) Attenuator dial directly calibrated in output dbm. SWR less than 2.5 at +10 dbm; 1.2 at 0 dbm and lower.

**Output Monitor Accuracy:** Better than ±1 db.

**Output Attenuator Accuracy:** Better than ±2% of attenuation in db introduced by output attenuator.

**Output Connector:** 626A, 0.850" by 0.475" waveguide, WR-75, Flat Cover Flange. 628A, 0.590" by 0.335" waveguide, WR-51, Flat Cover Flange.

**Leakage:** Less than minimum calibrated signal generator output.

**Modulation:** Internal or external pulsed, FM, or square wave.

**Internal Pulse Modulation:** Repetition rate variable from 40 to 4,000 pps. Pulse width variable 0.5 to 10 μsec.

**Internal Square Wave Modulation:** Variable 40 to 4,000 cps controlled by "pulse rate" control.

**Internal Frequency Modulation:** Power line frequency, deviation up to ±5 MC.

**External Pulse Modulation:** Pulse Requirements: Amplitude 15 to 70 volts peak positive or negative; width 0.5 to 2,500 μsec.

**External Frequency Modulation:** Provided by capacitive coupling to repeller of klystron. Maximum deviation approximately ±5 MC.

**Sync Out Signals:** 20 to 50 volts peak into 1,000 ohm load. Better than 1 μsec rise time.

1. Simultaneous with rf pulse—positive.
2. In advance of rf pulse—positive, variable 3 to 300 μsec.

**External Synchronization:**

1. Sine wave, 40 to 4,000 cps, amplitude 5 to 50 volts rms.
2. Pulse signals 0 to 4,000 pps, 5 to 50 volts amplitude, positive or negative. Pulse width 0.5 to 5 μsec.
   Rise time 0.1 to 1 μsec.

**Power:** 115/230 volts ±10%, 50/60 cps, approx. 200 watts.

**Size:** Cabinet Mount: 17" wide, 13¾" high, 14¾" deep.

**Weight:** Net 65 lbs.; Shipping 100 lbs.

**Accessories Furnished:** -hp- 626A (a) M to X Band waveguide adapter, WR-75 to WR-90 guide. (b) M to P Band waveguide adapter, WR-75 to WR-62 guide.

-hp- 628A (a) N to P Band waveguide adapter, WR-51 to WR-62 guide. (b) N to K Band waveguide adapter, WR-51 to WR-42 guide.


**Price:** -hp- 626A, $3,250.00. -hp- 628A, $3,000.00.

*Data subject to change without notice. Prices f.o.b. factory.*
Advantages:
Coverage of all frequencies 2.6 to 10 KMC
10 mw output full range
Automatic adjustable motor-driven frequency sweep
Full modulation capabilities
Direct-reading frequency dial

Use Them For:
Reflectometer measurements
Waveguide test voltages
Slotted line measurements
Microwave system frequency response
Antenna checks

Four Automatic-Sweep Microwave Oscillators Cover 2.6 to 10 KMC

These unique new instruments are compact, efficient, versatile sources of test voltages for measurements in the S, G, J and H microwave bands. They provide at least 10 milliwatts of power throughout their ranges. Waveguide-beyond-cutoff attenuators provide a convenient method of varying the output level.

Automatic Frequency Sweep
Frequency control is operated by a directly calibrated dial. An unusual feature is the automatic, adjustable motor drive provided for this dial. Two adjustable stops determine upper and lower limits of the automatic sweep. The sweep may be set to cover a 10% to 20% segment, or any larger portion of the instrument's frequency range. The sweep system operates at a constant velocity selected to provide an easily seen trace on a medium-persistence cathode ray tube. A linear sweep voltage proportional to the sweep
is available for horizontal oscilloscope deflection. Use of this sweep voltage enables the dc oscilloscope to present a frequency panorama with horizontal sweep distance approximately proportional to frequency.

- hp- 670 oscillators are supplied with or without mechanical sweep. The automatic sweep feature is easily added later.

**Varied Modulation Capabilities**

- hp- 670 series oscillators include provision for grid and reflector modulation. In conjunction with -hp- 717A Klystron Power Supply (see page 82 of -hp- Catalog 22-A) the following modulations are available—Reflector Modulation: FM, 60 cycle sine wave; Square Wave, repetition frequency continuously variable 400 to 1,000 cps. Grid Modulation: Square Wave, repetition frequency continuously variable 400 to 1,000 cps. For greater versatility, external modulation voltages can also be applied.

During automatic sweeping, grid modulation only is used because reflector voltage must track frequency changes. In manual use, either grid or reflector modulation may be used. AM or FM reflector modulation is available provided reflector voltage is adjusted for optimum output at each operating frequency. (This adjustment is provided on -hp- 717A Klystron Power Supply.)

**Wide Applicability**

- hp- 670 oscillators are versatile sources of both fixed and swept frequencies for all types of microwave measurements where high level test signals are required. The instruments are particularly useful in slotted line measurements and checks of transmission system characteristics. They are also ideal sources of fixed or swept frequencies for reflection coefficient measurements. Motor-driven models are particularly useful with -hp- 416A Ratio Meter (see page 98, 99 of -hp- Catalog 22-A) in forming high speed, accurate systems for measurement of reflection coefficients. Suggested arrangement of equipment for such measurements is given on pages 96 and 99 -hp- Catalog 22-A, on Technical Data sheet for -hp- 416A Ratio Meter, and in Volume 6, No. 1-2 of the Hewlett-Packard Journal. (Any of above sent on request.)

**Operation**

The operating principle of the -hp- 670 series oscillators is illustrated in Figure 1. The sweep motor produces three simultaneous actions: (1) through a rack and pinion gear assembly, shorting plungers are moved in and out within the resonant cavity; (2) reflector voltage is tracked to insure accurate frequency control; (3) sweep voltage is generated as a horizontal oscilloscope input.

**Specifications**

**Frequency Range:** -hp- 670S—2.6 to 4.0 KMC; -hp- 670G—4.0 to 6.0 KMC; -hp- 670J—5.85 to 8.2 KMC; -hp- 670H—7.0 to 10.0 KMC.

**Output Power:** At least 10 mw full range.

**Attenuator Range:** 100 db (not calibrated).

**Modulation:** (a) Grid modulation for optimum swept-frequency performance. (b) Reflector modulation for optimum single-frequency performance. Modulating signals must be provided from external source (normally -hp- 717A Klystron Power Supply which may be externally modulated).

**Mechanical Sweep:** Adjustable to cover any 10% to 20% or larger segment of instrument’s frequency range. Sweep rate approx. 30 to 50 cycles per minute depending on swept frequency range.

**Sweep Voltage Provided:** Linear voltage proportional to mechanical sweep. (Approx. 100 v change equivalent to maximum swept frequency range.)

**Connectors:** Type N rf output, BNC sweep voltage. Special power cables mating with -hp- 717A provided.

**Power:** 115 v ±10%, 50/60 cps, 25 watts. Requires external power supply for Klystron. (-hp- 717A Power Supply recommended.) Requires: 1,000 v, 20 ma; 0–600 v, 5 ma; 6.3 v ac, 0.6 ma.

**Klystron:** Type 5721 supplied with instrument.

**Dimensions:** Cabinet mount: 7½" wide, 11½" high, 20" deep.

**Weight:** Net 18 lbs. Shipping 54 lbs.

**Accessories Furnished:** 1 Power Supply Special Mating Connector, 1 Power Cord.

**Accessories Available:** -hp- AC-16D Video Cable Assembly, $2.65; -hp- AC-16Q rf Cable Assembly, $12.00; -hp- 717A Klystron Power Supply, $375.00; -hp- AC-97A Sweep Motor Assembly, $75.00; -hp- AC-97B Sweep Motor Assembly (¼ Normal Speed), $100.00.


Data subject to change without notice. Prices f.o.b. factory.
Permit Reflectometer Measurements In Coaxial Systems

Reflectometer systems save much engineering time in the development and manufacture of broadband apparatus; now the new -hp- dual directional couplers make reflectometer measurements practical in VHF-UHF coaxial systems.

The new couplers have a very flat frequency response and high directivity so that reflectometer accuracy is adequate for system checks and alignment. Their high power handling capacity and low insertion loss means they may be installed permanently in coaxial lines for power monitoring. They are dual devices; hence a power meter or detector may be connected to either “incident” or “reflected” secondary terminals to simplify maximizing forward power. Collectively, the four couplers cover all frequencies from 216 to 4,000 MC.

The instruments are compact, with a sturdy aluminum frame for unique ruggedness. Highly stable heat resistant materials are used to insure long term operating accuracy.

Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Coupling (db)</th>
<th>Frequency Range (MC)</th>
<th>Primary SWR (max.)</th>
<th>Secondary SWR (max.)</th>
<th>Directivity (minimum)</th>
<th>Coupling Accuracy</th>
<th>Price</th>
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<td>20 db</td>
<td>216 - 450</td>
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<td>1.10</td>
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<td>$125.00</td>
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Power handling capacity, all couplers 50 watts CW, 10 kw peak. Type N connectors throughout. All couplers include -hp- 802A-76G Shorting Plug for reflectometer calibration.

Data subject to change without notice. Prices f.o.b. factory.
In electronic test instruments, Hewlett-Packard gives you complete coverage several different ways.

**In development** — *hp*-engineer teams are continually at work designing and producing accurate, helpful new instruments that meet and anticipate the demands of electronics.

**In instrumentation** — the *hp*-line is the world's largest and most complete. You choose from over 250 instruments the ones that provide exactly the measuring coverage you require.

**In frequency coverage** — *hp*- makes nearly every kind of useful electronic test instrument. And, for almost all useful frequencies, too. For example, *hp*-signal generators offer solid frequency coverage from 10 to 21,000 MC; *hp*-voltmeters from 2 to 700,000,000 cps, oscillators from .008 to 10,000,000 cps.

**In personal service** — *hp*-has selected the best independent organizations to give you personal help with measuring problems. Electronics specialists — men trained by Hewlett-Packard — save you time by helping select the exact *hp*-instrumentation you need — and following through to be sure the equipment is properly utilized to serve you best. These men are located in major business centers — as near as your telephone. Call them when you need personal help,— in your plant, today.

<table>
<thead>
<tr>
<th>Location</th>
<th>Contact Information</th>
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<tbody>
<tr>
<td>Albuquerque, New Mexico</td>
<td>Neely Enterprises 107 Washington St. S.E. Albuquerque 5-5546</td>
</tr>
<tr>
<td>Asbury Park, New Jersey</td>
<td>I. E. Robinson Company 702 Matison Avenue Dunirk 9-2464</td>
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<tr>
<td>Atlanta 5, Georgia</td>
<td>Bivins &amp; Caldwell 3133 Maple Drive, N. E. Cherokee 7522</td>
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<td>Bogota, New Jersey</td>
<td>R. M. C. Associates 114 East Main Street Diamond 2-5545</td>
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<td>Yewell Associates, Inc. 1101 East Main Street Forest 6-5456</td>
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<td>Alfred Crossley Associates, Inc. 4501 North Ravenswood Ave. UPTown 8-1141</td>
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<td>S. Sterling Company 4511 Mayfield Road EVergreen 2-4114</td>
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<td>Dallas 9, Texas</td>
<td>Earl Lipscomb Associates P. O. Box 7084 ELinburne 5345</td>
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<tr>
<td>Fort Myers, Florida</td>
<td>Arthur Lynch &amp; Associates P. O. Box 466 Edson 4-4451</td>
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<td>Earl Lipscomb Associates P. O. Box 6573 OKessinger 4-9303</td>
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<td>Harry-Hanson Company 2814 South Brentwood Boulevard Mission 7-4530</td>
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<tr>
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<td>J. D. Ryerson Associates, Inc. 412 East Genesee St. SYRacuse 76-8544</td>
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<td>Upper Darby, Pennsylvania</td>
<td>L. E. Robinson Company 7404 West Chester Pike SHERwood 8-1294</td>
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<td>Westham 54, Massachusetts</td>
<td>Yewell Associates, Inc. 751 Main Street TWInbrook 3-7420</td>
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<td>Washington 9, D. C.</td>
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New, low cost, versatile

INDUSTRIAL COUNTER

New -hp- 521A is designed to be the most useful, accurate low cost industrial counter ever offered. It measures frequency, speed, rpm, rps, and counts random events within a selected time interval. With transducers, it measures weight, pressure, temperature, acceleration and other phenomena which can be converted to frequency. It is direct reading in cps, rpm or rps, and can be used readily by non-technical personnel. Period of count is 0.1 or 1 second; display time can be varied.

The 50/60 cycle power circuit is used as the time base; or, for greater accuracy, a plug-in crystal controlled time base is available at extra cost. There are accessory power supplies of -150 v dc, +300 v dc and 6.3 v ac. Connections are also supplied for photocells and an external 60 cycle standard. Lightweight, compact, sturdy; particularly useful with -hp- Optical Tachometer Pickups and Tachometer Generators. -hp- 521A, $475.00 (with plug-in crystal time base, $575.00).

Other versatile -hp- Counters

- hp- 524B Electronic Counter with 525/526 series Plug-Ins. Revolutionary all-purpose, direct-reading counter. Buy basic counter, plug-ins giving measuring coverage you need now. Later add other inexpensive plug-ins to double, triple counter’s usefulness. Basic counter range: Frequency 10 cps to 10 MC, period 0 cps to 10 KC, stability 1/1,000,000. -hp- 524B, $2,150.00.

- hp- 525A/B Frequency Converters extend 524B’s range to 100 or 220 MC, increase video sensitivity. -hp- 525A/B, $250.00.

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- hp- 526B Time Interval Unit permits counter to measure interval 1 μsec to 100 days with accuracy of 0.1 μsec, ±0.001%. $175.00.

- hp- 528B Electronic Counter. Compact, moderate price; frequency, period or time measurements. 10 cps to 100 KC. Reads direct in cps, KC, seconds, milliseconds. Automatic count reset, repetitive action. Stability 51/1,000,000, display length variable. Easily used by non-technical personnel. $915.00.

- hp- 506A Optical Tachometer Pickup. For measuring rotation 300 to 500,000 rpm. Ideal for moving parts of small energy or where mechanical connection is impractical. $100.00.

Data subject to change without notice. Prices f.o.b. factory. *Rack mount slightly less. *With transducers.