



MEASUREMENT COMPUTATION

innovations from Hewlett-Packard

NEWS

MAY/JUNE 1975

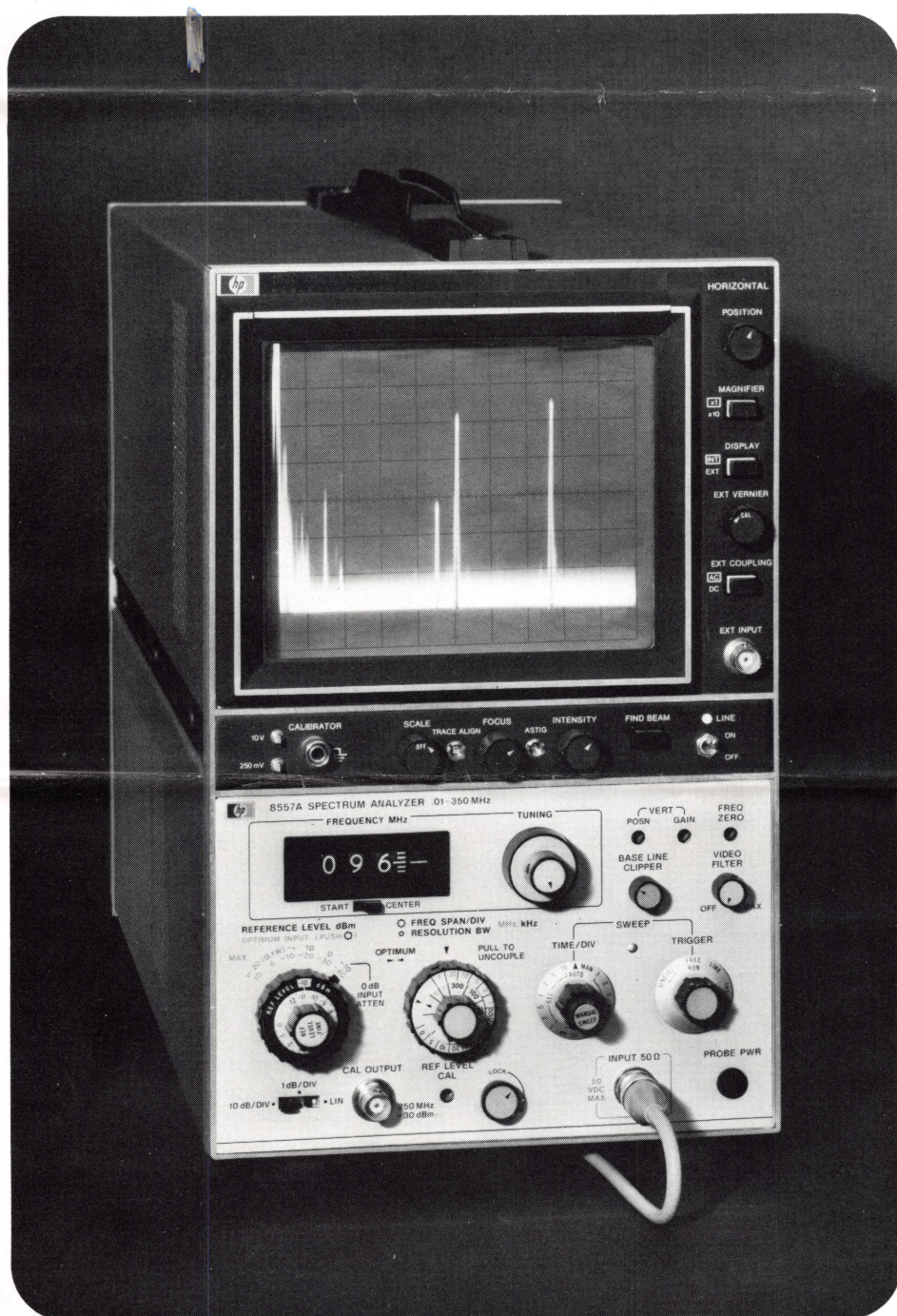
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10,000 component measurements per hour with LCR meter
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New VHF Spectrum Analyzer Offers Lab-Grade Performance at a Low Price

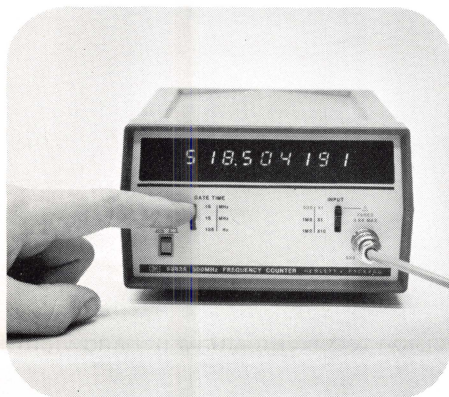
New 350 MHz Spectrum Analyzer plug-in is accurate, easy to use, and economical.

In the past, engineers usually time-shared one expensive spectrum analyzer, even though most of their measurements did not require high resolution. Now comes an analyzer priced for every bench, so the expensive analyzer can be reserved for more demanding measurements.

The new HP 8557A Spectrum Analyzer, a plug-in for HP 180-series scopes, features performance and accuracy that qualify it for lab use. Yet its ease of operation and economy make it attractive for such cost sensitive applications as production test, service, maintenance, and education. With 10 kHz to 350 MHz range, it's well suited for CATV, telecommunications, mobile radio, broadcast systems, navigational aids and telemetry measurements.

(continued on third page)

Direct counting up to 520 MHz with NEW low cost counter



Simple, virtually error-free operation complements the 5383A's high accuracy.

Low cost counters generally use prescalers (input frequency dividers) to get up to 500 MHz. Unfortunately, prescalers impose a resolution or speed penalty—usually a decrease of 4 to 10 times. Now, however, by borrowing unique circuitry from our sophisticated higher priced counters, we're able to offer the HP 5383A, a new, laboratory quality, low cost model using the speedy, accurate, direct counting technique. This technique gives 1 Hz resolution up to 520 MHz using a 1 second gate time.

You're likely to find the 5383A close to ideal for production line testing, communication, navigation and telemetry equipment servicing and R&D since it offers a host of useful features such as:

- 10 Hz to 520 MHz, direct counting
- Nine digit readout
- Accuracy of ± 1 count \pm time-base error
- Time base aging rate < 0.3 ppm/month
- Optional TCXO time base for high accuracy calibration needs
- 1 megohm, or fuse protected 50Ω input
- 25 mv to 50 mv sensitivity
- Gate times of 0.1, 1.0, 10 seconds
- Rugged aluminum case.

Start on your way to speedier, more certain frequency measurements by looking into the 5383A today. For all its features and quality the price is surprisingly low. 5383A, \$795, optional TCXO time base, add \$100.

For a data sheet, check J on the HP Reply Card.

New 4-Channel Recorder with Interchangeable Plug-ins offers greater versatility

Now you can record one to four input signals against time with the new HP 7404A oscillograph recorder. You can adapt this new recorder to your varied applications including the capability to amplify and measure dc signals with a broad range of sensitivities, or record transducer outputs with ac or dc excitation supplied.

With the choice of plug-ins, you can measure parameters such as voltage, pressure, flow, force, displacement and temperature with respect to time.

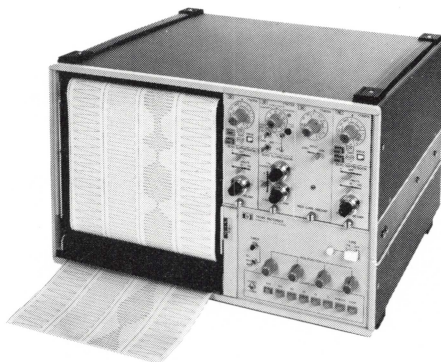
The 7404A is a four-channel recorder but will also record on two 80 mm-wide channels.

Clear traces that dry immediately upon contact with the paper are produced by the pressurized ink system of these units. The pens are designed to last the life of the instrument, and will not be damaged by any input signal frequency.

Twelve chart speeds are front-panel selectable as standard on the 7404A. Remote operation is also possible by contact closure or TTL.

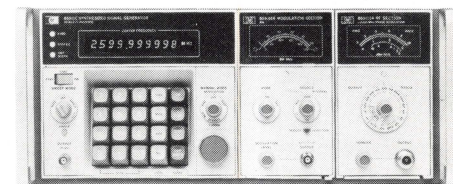
The 7404A mainframe (less plug-ins), \$4400.

To help you choose the recorder for your needs, find out more by checking L on the HP Reply Card.



New 4-channel recorder with easy paper loading, rugged stainless steel pens, modular construction.

New 1-2600 MHz signal generator features phase modulation, is HP Interface Bus compatible



L-Band communications and telemetry applications now have a new precision signal source.

The new HP 8660C synthesized signal generator spans the range 1 MHz to 2600 MHz in steps as small as 2 Hz. Also being introduced are two new modulation plug-ins which offer HP's first calibrated phase modulation capability.

This added frequency range and phase modulation capability provides precision signals needed to test satellite and space telemetry receivers or communications links. Or, it can serve as a local oscillator in certain frequency-agile transmission systems. The phase modulation also permits comprehensive analysis of phase-lock loop circuits.

The new plug-in modules include an RF Section (86603A) which generates output from 1 MHz to 2600 MHz at levels from +7 dBm to -136 dBm. Model 86634A is a phase modulation plug-in which provides calibrated, linear phase modulation at rates to 10 MHz. Another new modulation plug-in (86635A) provides phase modulation plus frequency modulation.

The 20-key mainframe keyboard provides digital entry of center frequencies, steps, or sweeps. The synthesizer's digital sweep mode is particularly useful in testing extremely stable or sharply tuned components, such as crystal filters.

With the HP-IB (Interface Bus), the generator may be connected as a programmed signal source for a variety of user-assembled mini systems for lab and production uses. (Option 005)

A typical complete system with 8660C mainframe, 2600-MHz frequency range, and phase modulation, is priced at \$19,600.

To receive more information, check Q on the HP Reply Card.

New Bench Supplies for MOS, CMOS and Linear IC Designs

Now there are two low-cost bench supplies designed specifically for industrial and educational labs working with MOS, CMOS and Linear integrated circuits. The HP 6237A delivers three outputs: 0 to 18V, up to 1A; and dual-tracking 0 to $\pm 20V$, 0 to 0.5A.

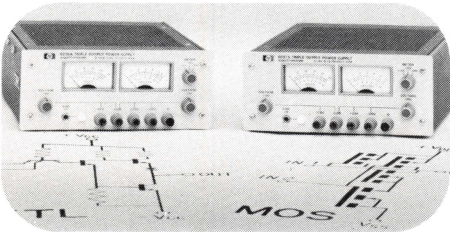
The Model 6237A, and the 6236A shown below, are compact, easy to use and incorporate the key performance and safety features needed in the lab environment.

The complimentary Model 6236A has outputs: 0 to 6V, up to 2.5A; and 0 to $\pm 20V$, 0 to 0.5A, and is intended primarily for use with TTL/Linear IC designs.

Each supply can be powered from a nominal 100V, 120V, 220V, or 240V, 47-63 Hz ac input. Both the single and dual-tracking outputs are protected from overloads by fixed current limiting circuits.

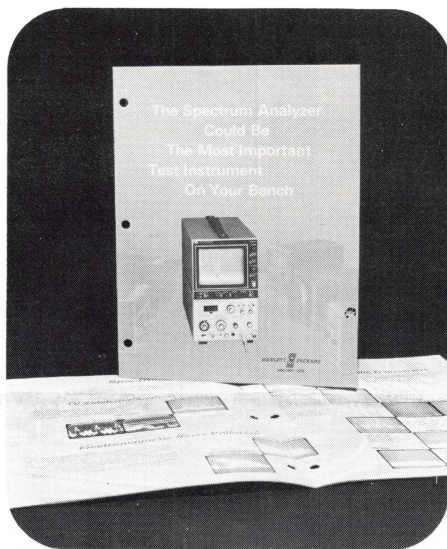
Models 6236A and 6237A are priced at \$325.00.

For more information, check K on the HP Reply Card.



What every industrial and educational lab needs: convenient, low-cost dc power for TTL, MOS, CMOS and Linear IC test and development.

Why you should consider spectrum analysis



Our new spectrum analysis brochure shows the spectrum analyzer's versatility in making RF signal measurements such as field strength, power, noise, frequency, distortion and modulation. The brochure demonstrates these measurements as they may apply to your work: in powerful techniques for component evaluation, equipment testing and system performance verification.

In addition, the brochure is a guide to help you select the right analyzer for your application by defining critical spectrum analyzer specifications such as resolution bandwidth and amplitude measurement range.

For your copy of the brochure, check U on the HP Reply Card.

New automatic receiver system for versatile communication uses

The HP ARS-400 is a fully automatic precision receiver for signal detection and analysis in the 100 kHz to 18 GHz frequency range. It has many useful applications including satellite system monitoring, spectrum management, site surveillance, electronic intelligence, and EMI testing.

The system consists of reliable, field-proven commercial equipment under program control. The high-speed precision receiver features IF bandwidth from 10 Hz to 3 MHz, multiple detectors for AM, FM and SSB detection.

Specially designed calls have been included to allow the receiver to tune and measure at very fast rates.

Application programs can be created by the user and stored on the disc unit for future use. Output data is written on the IBM-compatible, 9-track magnetic tape for later analysis on the ARS-400 or larger computer systems.

Critical signal parameters such as power, or modulation levels, signal bandwidth, carrier-to-noise ratio, etc. can be provided on-line.

The ARS-400 is capable of gathering significant amounts of usage information over several communications channels. This data can be analyzed on-line or stored on magnetic tape.

The ARS-400 is a totally integrated system, providing a fully characterized precision receiver, data processing capability, interactive graphics, and mass storage devices.

Prices for the ARS-400 system begin at \$152,500.

For details, circle P on the HP Reply Card.

New VHF Spectrum Analyzer

(continued from page one)

Signal amplitudes from +20 dBm to -117 dBm may be measured and viewed over sweep widths ranging from 350 MHz down to 50 kHz. Eight resolution bandwidths from 1 kHz to 3 MHz permit a wide variety of measurements, such as viewing modulation or analyzing pulsed RF spectra.

Impressive, also, is the 8557A's ease of operation. Most measurements are a simple three step process:

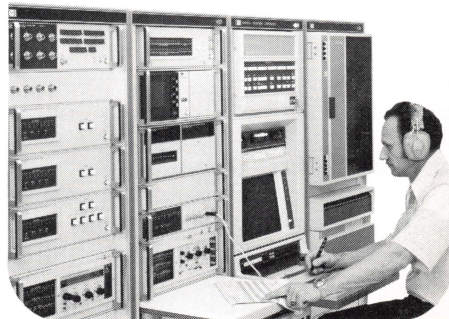
1) Tune the inverted marker to the signal to be measured and read its frequency on the digital readout.

- 2) Zoom-in on the signal by decreasing the frequency span (bandwidth, sweep time, and video filtering are set automatically).
- 3) Raise the signal to the top of the CRT and read its amplitude (in dBm) from the reference level control.

Versions of the 8557A for measurements in 75 ohm systems are also available.

The 8557A costs \$3,450; add \$100 for 75 ohm (dBm or dBmV) options.

For more information, check O on the HP Reply Card.



New fully automatic precision receiver for spectrum management, electromagnetic interference, site surveillance, or system monitoring.

New RTE-III Operating System manages up to 512K bytes of memory, up to 64 partitions

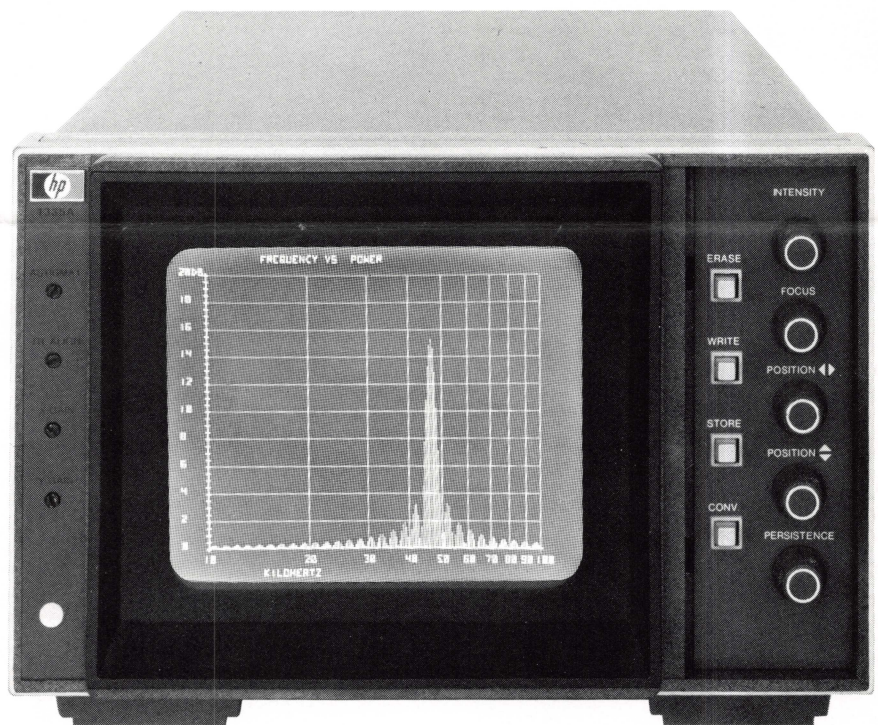
Hewlett-Packard's new RTE-III is a disc-based real-time operating system that manages up to 512K bytes of memory, organized in partitions, using the Dynamic Mapping System in 21MX M20 or M30 Computers. Up to 64 multi-user partitions can be defined for simultaneous use such as executing and developing programs, and managing data in a variety of high-level languages that can include FORTRAN IV, Multi-User Real-Time BASIC, and ALGOL. RTE-III supervises execution of many different user's programs in a multi-programming mode; programs may be scheduled by time, events, other programs, or operator command. Software includes a file manager for easy access to random or sequential files. Disc storage can start at 5M bytes, and can be expanded to 118M bytes.

With RTE-III, users at multiple terminals may be developing interactive programs while other user's terminals are engaged in data management. Multi-stream batch processing can be used to provide job control over program development and other background operations. Optional distributed multi-processing software provides for real-time program scheduling and file management functions from remote satellite computers. RTE-III can support a variety of peripherals, including mag tapes, line printers, card readers, plotters, and analog and digital I/O interfaces. System integrity is safeguarded; system software provides for power-fail restart with intact programs and data; a watchdog timer calls the user when I/O devices fail to respond. There are now two levels of memory protection, one by hardware fences and the other by the Dynamic Mapping System.

Price for the 92060A RTE-III is \$6,000.

For full details about this new operating system, check R on the HP Reply Card.

Two new OEM CRT displays feature high resolution with numerous options



Fine image detail and a well-focused spot at all intensity levels make the 1335A ideal for use in analytical and automatic test system applications.

Two new HP CRT displays offer exceptional picture quality and resolution, uniform focus with wide changes of intensity, and X-Y amplifiers with 70 ns rise times. These displays are ideal for use in systems for Spectrum, Fourier, Network and Chemical analysis, as well as in automatic test systems.

Model 1335A, shown above, is a variable persistence, storage, and non-storage CRT display with excellent performance. Persistence is continuously variable from about 0.2 seconds to full storage. The totally new CRT design offers a high resolution image with excellent contrast and uniformity for many applications.

Model 1332A has a standard CRT with a spot of 0.305 mm (0.012 in.) diameter at high intensity levels which remains extremely well-focused over a wide range of intensity levels. The high resolution makes the display ideal for applications requiring sharp focusing

on multiple gray shades or varying writing speeds with frequent video drive level changes.

Numerous options are available to tailor the displays to fit a specific application. These factory-installed options include:

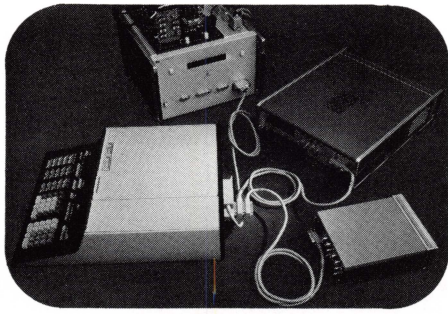
- (1) For the X-Y amplifiers: deflection factor, polarity, input impedance, and rise time;
- (2) Z-axis amplifier: blanking range, polarity input impedance, gain, and digital input;
- (3) for the CRT: graticule, phosphor (on the 1332A), and contrast filter; and
- (4) for the mechanical frame: covers, controls, line voltage, and tolerance, and special ac cords.

Prices: Model 1332A: \$1200.

Model 1335A: \$1900.

For more information on these two new displays, check B on the HP Reply Card.

For improved lab productivity, HP Calculator family now interfaces with many instruments



Instrumentation control from a desk-top programmable calculator.

Now, assembling a custom calculator-controlled instrumentation system is fast and easy because of interfacing cables that allow you to connect multiple instruments.

Digital voltmeters, electronic counters, waveform analyzers and synthesizers, scintillation counters, clocks, capacitance meters and other instruments can be interfaced directly to a 9800 series calculator which can then operate as both a controller or a data logger.

HP interface cards accommodate instruments using 8-4-2-1 BCD output, 8-bit parallel codes in any input and output formats, and bit-serial data.

The new Hewlett-Packard Interface Bus (HP-IB) provides a byte serial interface system that offers plug-to-plug compatibility between common instruments.

For more information on how to interface an HP 9800 series programmable calculator to your instrumentation, check S on the HP Reply Card.

The HP-46 offers a built-in LED display and printer for only \$675

Since its introduction nearly two years ago, thousands of scientists, engineers, and educators have purchased the HP-46. Applications range from the various engineering disciplines through biology and chemistry, to math, stat, medical research, navigation, even surveying.

The desk-top HP-46 has 48 preprogrammed scientific functions and operations. If you choose, it also prints a functional notation for each operation so you know what was done and when it was done. Thus, you can achieve the most effective use of the nine storage registers, three angular modes, and metric conversions.

The HP-46 reduces intricate and extensive calculations to a series of quick key strokes. And, you can combine arithmetic operations. Serial calculations, chain calculations, and mixed chain calculations are uncomplicated without the need of reference tables.

Put the HP-46 on your desk simplifying calculations, eliminating tedious recalculations, and saving your valuable time. In today's inflationary economy, the HP-46 is a great buy at \$675.



Select either scientific or fixed point display to match your calculations with up to 10-digit accuracy.

For details, check A on the HP Reply Card.

Retrofit kits boost accuracy, stability and reproducibility of Cesium Beam frequency standards

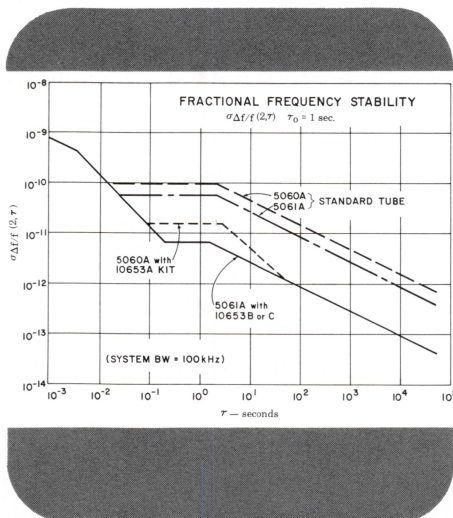
Newly available retrofit kits give present owners of HP's 5060A and 5061A Cesium Beam Frequency Standards an order of magnitude improvement in short term stability. This improvement was formerly only available in newly-ordered 5061As as Option 004. The state-of-the-art performance improvements were attained through major design changes in the cesium beam tube: increased length of the microwave cavity results in higher accuracy, which was achieved without increasing tube size; increased cesium beam flux and a unique HP design of multiple beams results in better short-term stability and greater immunity to shock and vibration; more effective

magnetic shielding reduces effects of external magnetic fields and improves settability.

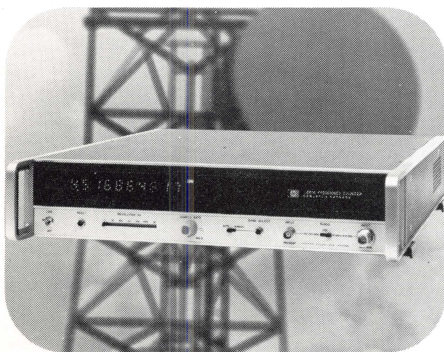
See the graph to the left for performance characteristics. Other principal specifications of instruments upgraded by the kits are:

Accuracy	$\pm 7 \times 10^{-12}$
Reproducibility	$\pm 3 \times 10^{-12}$
Settability	$\pm 1 \times 10^{-13}$
Long Term Stability	$\pm 3 \times 10^{-12}$

Prices for the Models 10653A/B/C kits (HP-installed), including credit for the old tube, are approximately \$8,000. To receive complete technical data, check T on the HP Reply Card.



New 4.5 GHz Counter offers highest performance in its frequency class.



The 5341A Counter offers "best case" performance gems like 30 MHz peak-to-peak FM tolerance, -20 dBm sensitivity, 100 μ sec acquisition time and $+30$ dBm damage level on its microwave range.

For cost-effective UHF and microwave equipment production testing, as well as lab troubleshooting from 10 Hz to 4.5 GHz, the new HP 5341A Automatic Frequency Counter is close to ideal.

Compare its range, sensitivity, FM tolerance, speed, accuracy, resolution, overload tolerance, systems compatibility and built-in diagnostics—the new 5341A is unexcelled in the "up to 4 GHz" class of automatic counters today. Its unique "switchable filter" heterodyne technique allows a much faster signal acquisition than other methods. The 5341A can acquire and begin measurement of any frequency to 4.5 GHz within 600 μ seconds (100 μ sec in MANUAL mode). Operator convenience is a key feature of the 5341A, with a choice of automatic or manual operation and a unique self-troubleshooting technique.

The ten-digit LED display provides 1 Hz resolution all the way to 4.5 GHz. The 5341A may be purchased with frequency range limited to 1.5 GHz at a reduced price. If desired, you can later upgrade it to 4.5 GHz.

We welcome your comparison of the price-to-performance ratio with other microwave counters. For \$3600, the HP 5341A is an outstanding Automatic Microwave Counter. The 1.5 GHz version is \$2600. For systems work, the versatile HP Interface Bus option adds \$390.

For more information, check I on the HP Reply Card.

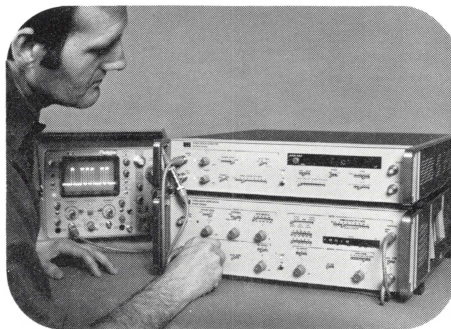
New capabilities added to bit-error-rate measurement system

Hewlett-Packard's 3760A Data Generator and 3761A Bit Error Rate (BER) Detector provides more flexibility and convenience for communication testing in such areas as fiber optics, digital radio, digital cable and millimeter wave transmission systems. The 3760A/3761A are also useful in applications such as digital multiplex and digital tape and disc recording.

HP's measurement system operates between 1 Kb/s and 150 Mb/s, providing a broader operating range than previously available. Both mean signal and dc triggering are available as a switch selectable option in the 3761A Error Detector. This allows the equipment to be used in either continuous or burst (e.g., time division multiple access transmission systems) signal modes. A second data output, delayed from the primary output by eight bits, is available on the 3760A Data Generator. This effectively provides two uncorrelated outputs for such test applications as four-phase, phase-shift-keyed transmission systems, and cross-talk interference tests. Fixed crystal clock speeds are available for the 3760A Data Generator. This provides the user added convenience where frequent testing at specific speeds is required.

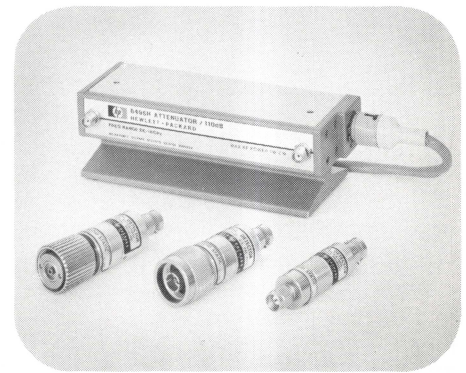
The 3760A Data Generator is also very useful as a stand-alone instrument. It provides flexible pattern (i.e., PRBS, 1010 sequence) and word generation signals with pulse generation quality.

For technical information on the 3760A, 3761A and the new options, check C on the HP Reply Card.



For design, development, commissioning and maintenance of pulse code modulation, PCM, systems, data generator and error detector provide a complete local or remote bit error rate measuring system.

New detectors and step attenuators for microwave measurements



Detectors

Low barrier hot carrier diode technology (LBHCD) has permitted a new family of microwave detectors covering the 10 MHz to 18 GHz range; HP 8470B (APC-7 or Type N), 8472B (SMA) and 423B (Type N, 12.4 GHz). These detectors have much flatter frequency response than previous point-contact types: ± 0.2 dB over any octave to 8 GHz; ± 0.3 dB, 10 MHz to 12.4 GHz; ± 0.6 dB, 12.4 to 18 GHz.

Microwave detectors are general purpose components, widely used for CW or pulsed power detection, leveling of sweepers, and frequency response testing of other microwave components. Thus, improved flatness and SWR are highly desirable and directly yield more accurate measurements.

Programmable Attenuators

Models 8495 G/H and 8496 G/H programmable microwave attenuators offer 70 dB or 110 dB range in 10 dB steps from DC - 18 GHz. Models 8494G/H offer 11 dB range in 1 dB steps. Programmability makes the attenuators particularly well-suited for mini-system use under Interface Bus control, using the HP 59306A Relay Actuator.

The design uses an innovative self-latching magnet mechanism for each section. Switching time is less than 20 ms and momentary actuation current is approximately 100 mA for the 25V solenoids.

Detector prices: HP 8470B, \$230 or \$215, 423B, \$190, 8472B, \$215. Attenuator prices range from \$575 to \$900 depending on frequency range and attenuation range.

For detailed information on the detectors, check M; for the attenuators, check N on the HP Reply Card.

HEWLETT-PACKARD COMPONENT NEWS

High speed measurements of low-value components with digital meter

If you're testing diodes and capacitors or trimming IC capacitors and resistors, you need fast precise inductance, capacitance, resistance and loss measurements. Plug the HP 4271A Digital LCR meter into your system and you get 10,000 measurements or more per hour.

Using a four-pair measurement technique that reduces stray capacitance and residual inductance, this 1 MHz digital meter measures capacitance from 0.001 pF to 19.000 nF with an accuracy of 0.1%, and inductance from 0.1 nH to 1900.0 μ H. Capacitance loss components are measured as parallel conductance or as dissipation factor (as

low as 0.0001). Inductance loss components are measured as series resistance (10 Ω to 10 K Ω) or dissipation factor (as low as 0.0001). And you can vary dc bias from 0 V to 39.9 V in 0.1 V increments.

The LCR meter has a four-digit LED display with 90% overrange, and it interfaces easily with HP computers, calculators, and digital recorders.

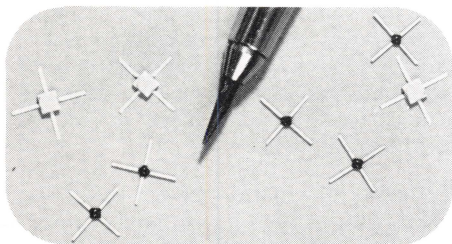
Price is \$4,760.

For information on improving component testing, check D on the HP Reply Card.



Typical uses for the 4271A LCR meter include: testing discrete components and varicap diodes, checking semiconductors, and L or C examinations of delay lines.

Stripline Schottky Diode Quads for Double Balanced Mixers



For the first time, Schottky diode quads designed for use in microwave integrated circuits, microstrip or stripline, from 1 to 8 GHz, are available in hermetically sealed packages.

The 2.54 mm (0.10 in) square package, 5082-2261/62/63, contains a monolithic array of Schottky diodes interconnected in ring configuration. Uniform electrical characteristics among the four diodes result in a tightly matched quad.

Broadband quads, 5082-2291/92/93/94, for applications to 18 GHz, are available in a sub-miniature 1.27 mm (0.05 in) square ceramic package whose leads are brazed to the substrate for maximum package ruggedness.

Prices range from \$24.50 to \$54.50 in quantities of 1-9.

For details, check F on the HP Reply Card.

Guaranteed ruggedness in new beam lead PIN diode

Each lead of these new beam lead PIN diodes will survive a two gram pull. This high lead strength is achieved by a new process enabling Hewlett-Packard to guarantee the ruggedness of this Model 5082-3900.

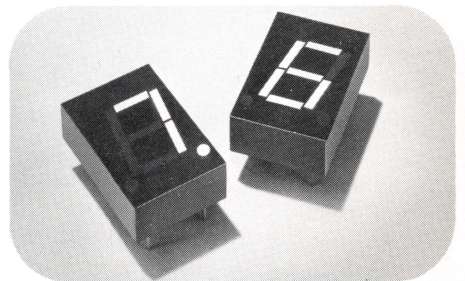
Breakdown voltage of the new diodes is a guaranteed minimum of 150 volts, and 200 volts is typical. Capacitance (C_0) is a low 0.02 picofarads, resulting in isolation equal to or better than other presently available PIN diodes.

These diodes are for use in strip-line or microstrip circuits using welding, thermocompression or ultrasonic bonding techniques. Applications include switching, attenuating, phase shifting, limiting and modulating at microwave frequencies.

Price is \$14.00 (1-9)
\$10.50 (10-99)
\$ 8.50 (in quantities of 100).

For detailed specifications, check G on the HP Reply Card.

New common cathode .43" display



.43" display offers a bright, continuously uniform seven segment display in a 0.3" dual-in-line configuration.

A new, common cathode 0.43-inch (11 mm) high LED display is low cost and easy to interface. The new direct-drive MOS clock circuits interface directly with this new HP 5082-7760 indicator. It is expected to be widely used in many consumer applications, including clock radios, business machines, TV channel indicators and low-cost electronic instruments.

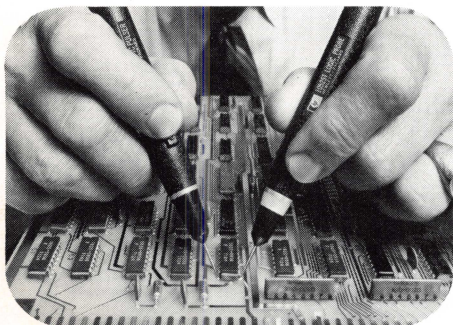
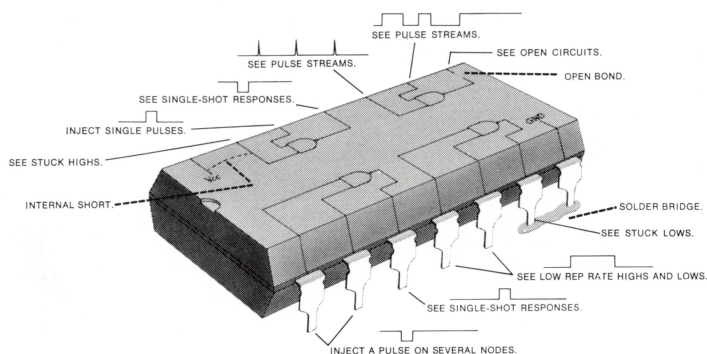
Designed for viewing distances of up to 20 feet, these single digit displays provide a high contrast ratio and a wide viewing angle. Prices are as follows:

1-99 \$4.50 each
100-999 \$3.50 each.

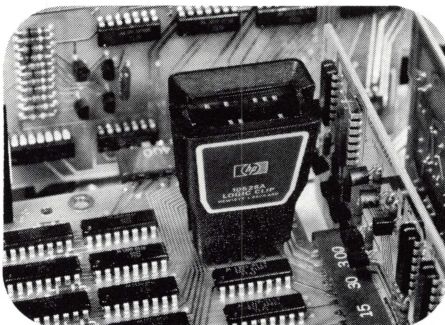
For more details, check H on the HP Reply Card.

The IC Troubleshooters show it like it is... at new reduced prices

Originated by HP, the Logic Probe, Logic Pulser, and Logic Clip have seen widespread use where digital circuits are designed, built or serviced. Their popularity stems from their rapid, simple, virtually error-free operation, coupled with ruggedness. Now, these new low prices will further enhance their popularity.



Using the 10526T Logic Pulser and 10525T Logic Probe you can inject pulses into TTL/DTL gates directly and see the results—without unsoldering or trace cutting. Simply press the Pulser's button to inject a pulse and the Probe quickly verifies gate operation—high, low or bad level. It'll read single pulses down to 10 ns and pulse trains up to 50 MHz. 10525T Probe, \$65; 10526T Pulser, \$75.



The 10528A is an easy-to-use tool for viewing all the pins of 14- or 16-pin IC's simultaneously. When used in conjunction with the 10526T Pulser, sequential logic circuits like shift registers come alive—each state change is immediately visible—and circuit analysis achieves new meaning. 10528A Clip, \$75.



The 5015T Mini-Kit puts it all together—for less. Order the Probe, Pulser, and Clip in this convenient kit with carrying case provided. Get all of the stimulus-response capability of our popular troubleshooters in this fully integrated kit for the lowest price we've ever offered... 5015T Mini-Kit, \$215.

For more information on the latest techniques in digital troubleshooting, check E on the HP Reply Card.

CHICAGO, IL (Skokie): 5500 Howard St., Ph. (312) 677-0400
 CLEVELAND, OH: 16500 Sprague Rd., Ph. (216) 243-7300
 COLUMBUS, OH: 1041 Kingsmill Parkway, Ph. (614) 436-1041
 DAYTON, OH: 330 Progress Rd., Ph. (513) 859-8202 DETROIT, MI (Farmington Hills): 23855 Research Dr., Ph. (313) 476-6400
 INDIANAPOLIS, IN: 7301 North Shadeland Ave., Ph. (317) 842-1000 IOWA CITY, IA: 1902 Broadway, Ph. (319) 338-9466
 KANSAS CITY, MO: 11131 Colorado Ave., Ph. (816) 763-8000
 MILWAUKEE, WI: 9431 W. Beloit Rd., Suite 117, Ph. (414) 541-0550 PITTSBURGH, PA: 111 Zeta Dr., Ph. (412) 782-0400
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