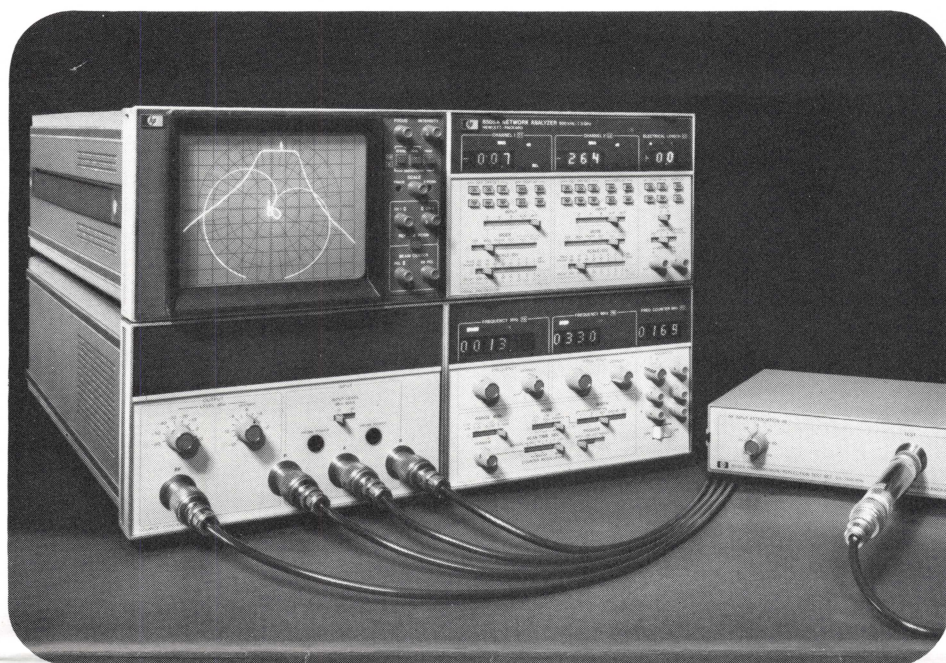




MEASUREMENT COMPUTATION

innovations from Hewlett-Packard

NEWS



Advances in network measurements: new 1.3 GHz Network Analyzer measures all major parameters—including delay—over wide ranges with high resolution

The state-of-the-art for RF network measurements has moved significantly ahead with the introduction of the HP 8505A Network Analyzer. Over its extremely wide frequency range, 500 kHz to 1.3 GHz, this new analyzer measures the magnitude and phase of a

network's transmission and reflection characteristics. Important in communications-related applications, the instrument also measures group delay and deviation from linear phase.

But the real story about the new analyzer is *how well* it makes these measurements! Major performance features include:

- Three independent input channels, each with 100 dB displayed dynamic range.
- Dual-channel CRT display of swept-frequency response in rectilinear and polar form.
- High-resolution digital readout of measured parameters at any frequency within sweep range (frequency is counted directly).

MAY/JUNE 1976

B

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Broad line of instruments for the OEM
(page 4 and 5)

New HP-27 Scientific/Financial Calculator
(page 6)

Synthesized outputs from 2 to 18 GHz
(page 5)

- Direct measurement of group delay in both broadband and narrowband networks, (no charts or calculations needed).
- Direct measurement of deviation from linear phase using integral electronic line stretcher (with almost 5 wavelengths compensation range).
- Integral high-performance sweep oscillator with seven independent sweep modes and exceptional spectral characteristics.
- Simple yet complete programmability via the HP Interface Bus (HP-IB). Unique "Learn Mode" permits storage of manually-set control positions for later recall.

A wide selection of precision test sets are offered for use with the 8505A Network Analyzer. These include

(continued on third page)

IC Tester brings new economy, versatility and simplicity to testing

Five-function autoranging makes the HP 3476 the right decision

Set up this digital IC tester quickly with magnetic program cards. HP's low cost magnetic program cards are the key to lower cost testing—of primary importance with today's proliferation of IC types.



Insert an inexpensive magnetic programming card, and in five seconds this new multi-family Model 5045A digital IC tester is ready for dc parametric and functional testing of digital ICs. It's that simple—absolutely no other set-up or programming is needed. And it'll do some of your RAM and ROM testing too. Programming is so versatile that it can set-up a unique voltage and current level on each pin of the device under test within the limits of ± 200 mA and 0 to 15V or ± 7.5 V range.

Flip a switch and the quiet built-in thermal printer prints out failure type, failed pins and the voltage and current on each failed pin. Use this data for diagnostic purposes, to detect failure trends, or to send back with the failed parts so the supplier can understand the reason for your rejecting his product.

We've also made your software problems as simple and inexpensive as we could. When you order a program type, we supply, for a very nominal cost, four cards: a pass/fail test card, diagnostic test card, and a duplicate of each for safekeeping. Our unique program coupon book makes purchasing programs simpler, faster and more economical. Buy a book of ten coupons and just mail

us one whenever you want a program. There are 1000 devices in our standard program catalog right now and we're adding more all the time.

We've also simplified interfacing to a variety of automatic IC handlers. Order one of our standard options and the 5045A comes ready to plug into the handler—mechanical and electrical interfacing have been pre-arranged. All fast rise-time circuits are in a removable test head so they can be placed within inches of the IC tested.

Consider the large and ever growing number of IC types and you can quickly calculate how the low cost of the 5045A's program cards alone saves some users more than the cost of the tester itself...to say nothing of the money saved every day by the 5045A's simple, rapid, error-free operation and ability to handle a multitude of testing assignments. These HP cards are $\frac{1}{4}$ to $\frac{1}{2}$ the cost of other available programs.

Prices 5045A, \$9,000 (for 16 pin ICs); \$11,000 (24 pins). Test programs: 1 to 9, \$30 each; 10 or more, \$25 each; 10-program coupon book, \$250.

For additional information, check J on the HP Reply Card.

When you need to make measurements of current, voltage, or resistance, the HP 3476A/B will make your job faster and easier through complete autoranging on every function.

All readings are made directly in volts, kilohms, or amps—on an LED display. A rangehold button speeds and simplifies repetitive measurements.

There's no need to worry about polarity or zero...they're both automatic also.

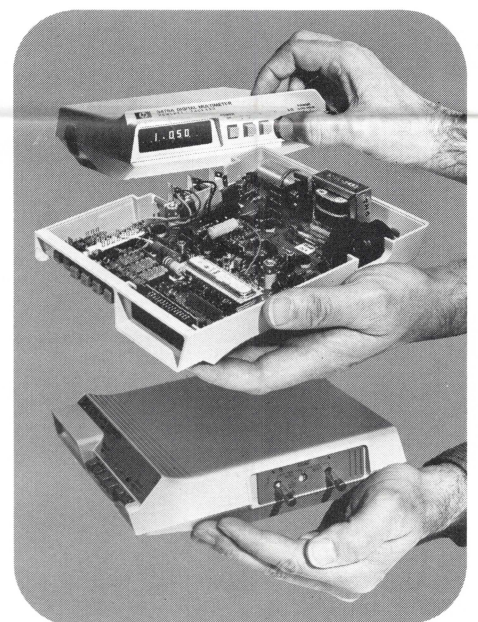
It is *lightweight*: 0.77 kg (1 lb. 11 oz.), *compact*: 5.8 cm (2.3 in.) high, 16.8 cm (6.6 in.) wide and 20.6 cm (8.1 in.) deep.

You have a choice of AC power operation with the 3476A or, in the 3476B, AC power and rechargeable nickel-cadmium battery operation.

The 3476A/B was made possible through the perfection of a new micro-circuit process—tantalum nitride on sapphire. All of the precision resistors required for the input attenuator are placed on a single chip. That means greater reliability and better temperature stability.

The 3476A is priced at \$225, the 3476B at \$275.

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



Compact new DMM with advanced circuitry and packaging resulting in high reliability. One circuit board contains all the electronics.

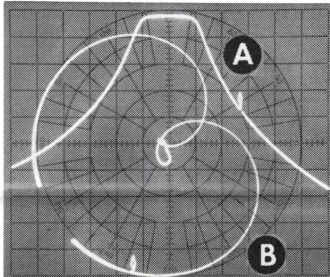
New network analyzer

(continued from first page)

HP 8502 high-directivity Transmission/Reflection Test Sets and HP 8503A S-Parameter Test Set (has HP-IB option) plus HP 11850 precision 3-way Power Splitters and several types of transistor test fixtures.

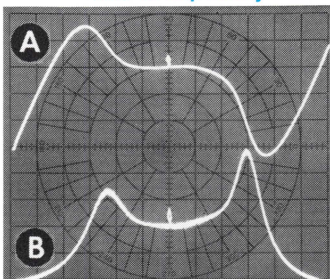
Examples of the measurement power of our new 1.3 GHz network analyzer:

Transmission and Reflection Coefficients



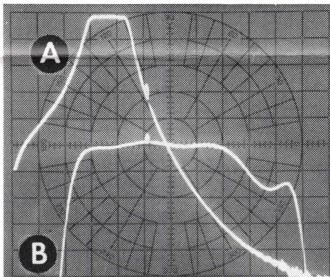
A. Transmission, 10 dB/div.
B. Reflection, (polar) full radius = 1

Deviation From Linear Phase and Group Delay



A. Deviation, 10°/div.
B. Delay, 5 ns/div.

Automatic Alternate Sweeps to show filter transmission



A. Total response, 10 to 500 MHz, 10 dB/div.
B. Passband response, 145 to 210 MHz, 0.1 dB/div.

Prices: 8505A Network Analyzer, \$22,500 (Option 001: HP-IB, +\$2,950); 8502 Transmission/Reflection Test Set, \$1,850; 8503A S-Parameter Test Set, \$3,700 (Option 001: HP-IB, +\$400); 11850 Power Splitter, \$450.

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

New Interface for Real-Time HP-IB Minicomputer simplifies do-it-yourself assembly of automatic test and measurement systems



Now, system designers can connect HP-IB instruments, like the DVM, scanner, numeric display, thermal printer, timing generator, counter, and digital-analog converter shown above, to the powerful control, data processing, and storage capabilities of Hewlett-Packard Real-Time Minicomputers.

Automatic test and measurement systems using bus-connected instruments can now utilize the full power and flexibility of Hewlett-Packard's Real-Time Minicomputers with the addition of the new HP 59310B Hewlett-Packard Interface Bus (HP-IB) I/O Kit and real-time software Option 422.

The HP 59310B interface can serve up to 14 HP-IB instruments connected via standard bus cables. The Real-Time Minicomputer supports several HP 59310B interfaces at the same time for control of multiple instrument clusters for performing different functions or for optimizing throughput.

Over 35 different HP instruments currently mate with this IEEE Standard 488-1975 Digital Interface for programmable instrumentation. As a corporation, Hewlett-Packard is committed to steady growth in HP-IB capabilities.

With the Real-Time Minicomputer, initial setup requires only connection of instruments to the bus, setting of instrument talk/listen addresses, system generation, and programming. Programs in FORTRAN, HP Real-Time BASIC, or HP Assembly language can be developed on the Real-Time HP-IB Minicomputer at the same time it is controlling HP-IB instrument clusters.

Price for a 9640A Real-Time Minicomputer with HP 59310B HP-IB interface, RTE-II or RTE-III, and system console: \$34,950 to \$44,350, depending on choice of operating system and disc.

Price for HP 59310B HP-IB I/O Kit with real-time Option 422: \$1000.

A brochure describing the Real-Time HP-IB Minicomputer will be sent to you if you check G on the HP Reply Card.

With Hewlett-Packard, your OEM dollar buys more than just hardware

When you purchase OEM equipment from Hewlett-Packard, you are assured of product performance, service and applications assistance from a company that recognizes your reputation and success depend partly on the support you receive from your OEM supplier.

Confidence can be yours when you have HP instruments as part of your

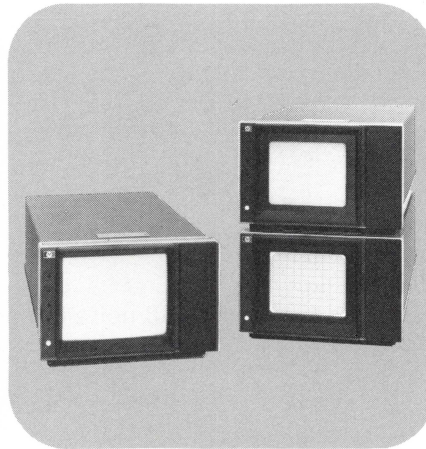
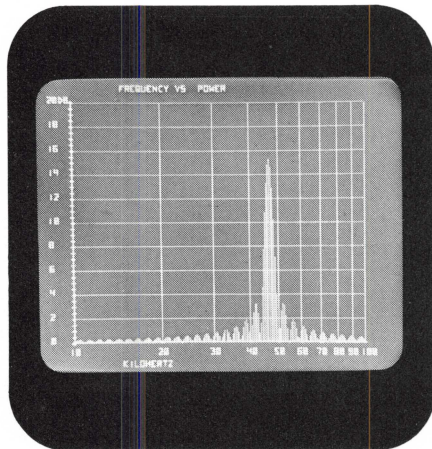
system. Complementing HP's reputation for leadership in new product development utilizing high technology is the knowledge that HP is ready to respond to your needs with over 3,000 sales, service and technical personnel located in 172 offices in 65 countries.

HP offers a highly competitive OEM discount structure across a wide selec-

tion of instruments. Through our purchase agreements, we can coordinate our equipment deliveries with your forecasted customer needs.

In addition, a wide selection of instruments can be custom tailored to meet your specific needs.

Choose an HP Display when your system needs a bright, sharp image



These HP high resolution CRT displays offer OEM users ease in integrating the modules into their packaging. Considerable effort has been taken in developing the structural, thermal and RFI characteristics.

End users of your OEM systems will judge capability by the information they are able to display. HP's 1332A, 1333A, and 1335A CRT displays make excellent choices for all types of systems—from spectrum, network, and chemical analyzers, to automatic test systems.

Each display has a very small spot size that focuses uniformly over the complete viewing area, regardless of writing speeds or intensity level. Fine image detail with excellent contrast and uniformity make them particularly well suited for applications involving complex graphics, especially those with alphanumeric data.

If you need a large viewing area and a brighter image at fast scan rates, consider the 1332A. The 9.6×11.9 cm viewing area offers superior performance.

For photographic recording of displayed data, the 1333A offers an extremely small spot size (.20 mm) for

accurate photo evaluation.

The 1335A, a variable-persistence, storage, and non-storage display introduces a totally new CRT design. Erase, store, write, conventional or variable persistence can be selected with manual front-panel controls, remote program inputs, or a combination of both.

For convenience, all frequently used controls have been placed on the front panel for maximum accessibility.

Five large screen graphic displays are also available for OEM computer graphic and instrumentation applications. These models offer a linear writing speed of $25.5 \text{ cm}/\mu\text{s}$ for visible writing.

Check C on the HP Reply Card for information on the HP 1310, 1311, 1317, 1321 large screen displays. For the smaller displays, 1332, 1333 and 1335, check D on the HP Reply Card.

A fine-line of recorders

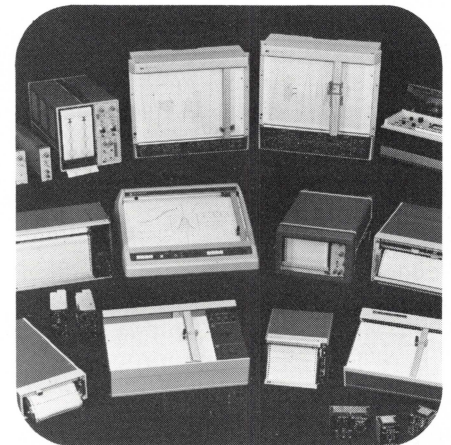
Hewlett-Packard offers a wide selection of analog recorders and graphic plotters designed to fulfill the needs for recording and displaying data in conjunction with your equipment.

X-Y recorders are available in two basic chart sizes built around a one-piece die-cast aluminum mainframe—a rugged platform for the modular features you select. These recorders are engineered for long, reliable service, even in harsh environments.

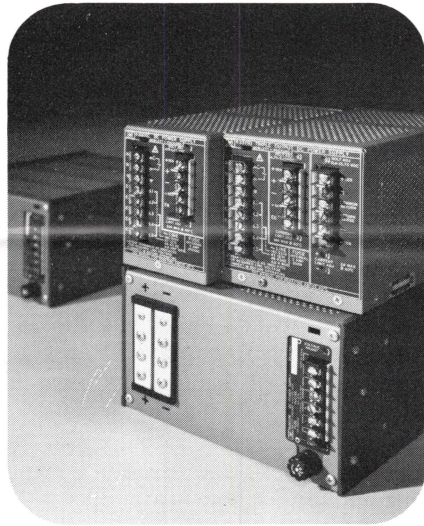
Three levels of performance parameters are available depending upon measurement needs. Certain models have high sensitivity and high common mode rejection. Metric and English scales are optional. Two-pen models are also available.

An OEM catalog describing other recorders and printers is available. Models include X-Y, strip chart, oscillographic, and instrumentation tape recorders, plus graphic plotters for computer, timeshare, and calculator use.

For your copy, check O on the HP Reply Card.



Choose from 89 Models of OEM Modular Power Supplies



Switching and linear regulated OEM modular power supplies are available with rack mounting and power system accessories. HP OEM power supplies are UL recognized components.

You can select from five families of switching supplies that give top performance and reliability demanded by today's OEM. Ratings cover the range from 110 to 600 watts, with individual voltages from 4 to 48V in single output models. For smaller systems, there is a compact 110W triple output model with 5V, +12V to $\pm 15V$, and +12 to +15V outputs. All offer the benefits of technologically advanced 20 kHz switching regulation: high efficiency, small size, and low heat dissipation—factors that help cut your end-product size and cost.

Single and dual-output, linear regulated power supplies in the 6 to 200W range, with outputs from 3 to 48V are also available—in several different package designs.

A Special Design Group is ready to provide product modifications, assembled power systems, and applications assistance if the standard models do not meet your needs.

Prices start from \$315 for 110W switching supplies and \$67 for 6W linear supplies, in quantities of 25.

Complete specifications are contained in a new 20-page OEM brochure. Check P on the HP Reply Card.

HP's new microwave synthesized signal generators provide precision signals 2-18 GHz

Two new fully programmable microwave synthesizers are now available from Hewlett-Packard. The 8672A Synthesized Signal Generator covers the full 2-18 GHz range in one solid-state package only 5¼" high. With AM/FM and calibrated output usually associated only with signal generators, 8672A also offers the resolution, spectral purity, stability and programmability of a high-quality synthesizer. The complementary Model 8671A, provides 2-6.2 GHz with FM capability only and minimum +9 dBm output.

The broad 2-18 GHz range of the 8672A makes it ideal for use in ECM and broadband component testing. Frequency resolution is 1 KHz in the 2-6.2 GHz range, 2 KHz from 6.2-12.4 GHz, and 3 KHz from 12.4-18 GHz. Frequency stability is 5×10^{-10} per day.

The 8672A's exceptional spectral purity will be important for other applications such as satellite receiver testing. Spurious signals are more than 70 dB below the carrier at 6 GHz, -60 dBc at 18 GHz. SSB noise is more than -78 dBc, 1 KHz away from a 6 GHz carrier, and 109 dBc at 100 KHz offset.

True signal generator performance is

achieved with calibrated output from +3 to -120 dBm. Ranges are displayed on a 2½ digit LED readout and internal leveling is flat to ± 1.25 dB.

Amplitude modulation signals are externally supplied but internally monitored with an AM bandwidth of 500 KHz at 6 GHz and 100 KHz at 18 GHz. Metered and calibrated ranges are 30% per volt and 100% per volt.

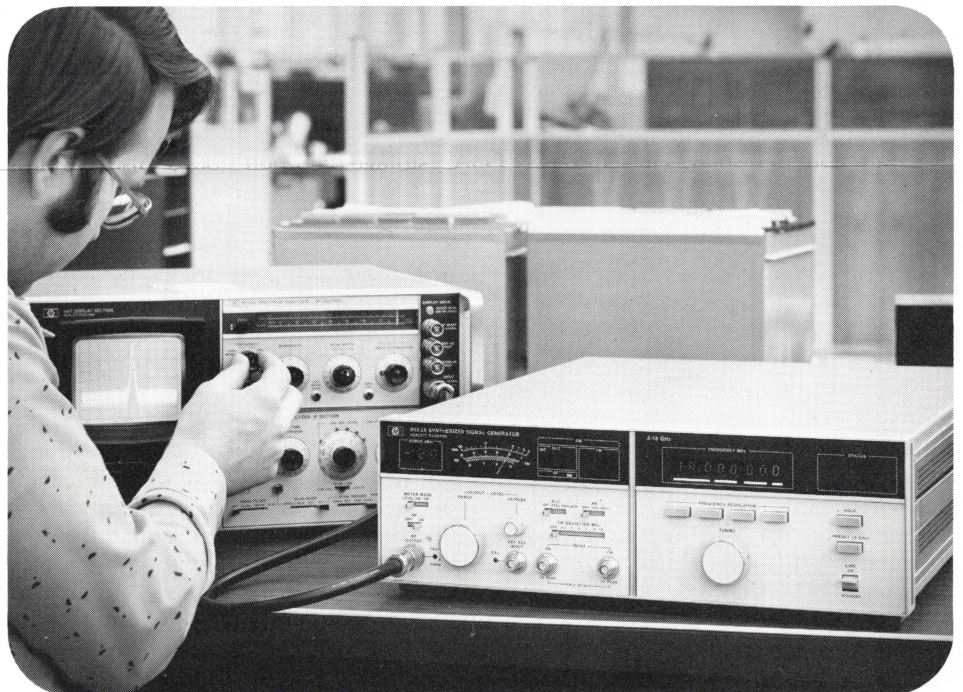
Broadband frequency modulation is possible to 10 MHz rates and 10 MHz peak deviation. Six calibrated ranges from 30 KHz per volt to 10 MHz per volt monitor the input signal. Simultaneous AM and FM may be applied.

All front panel functions can be remotely programmed, via the HP Interface Bus, as a standard feature. Frequency will typically switch within 15 ms.

The HP 8671A Microwave Synthesizer (2-6.2 GHz) is ideal for many S and C band local oscillator applications, and offers the same wideband FM features as the 8672A.

Price of the standard 8671A is \$16,500. Standard 8672A is \$26,000.

For additional technical data, check M on the HP Reply Card.

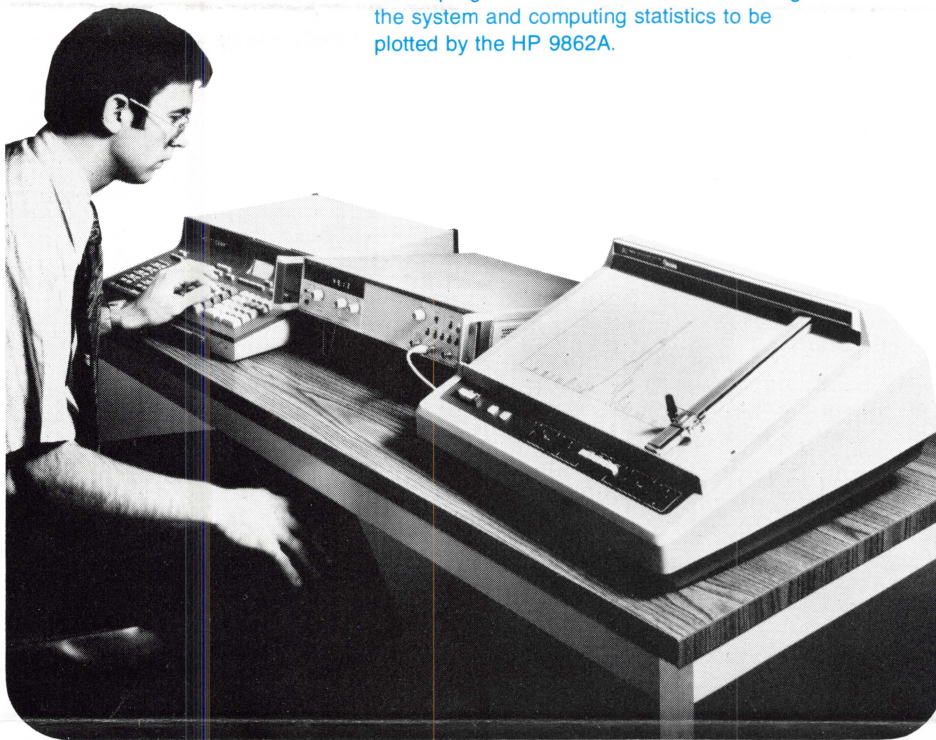


The new HP 8672A Synthesized Signal Generator with wide dynamic range and exceptional stability provides features important to both broadband testing or to highly stable receiver tests.

New option adds complete "hands-off" operation to universal counter

HP has integrated into the NEW HP-27 the most significant functions used by scientists and financiers

Fully programmable front panel of 5328A universal counter facilitates assembling versatile measurement/computation systems. System shown makes ordinary or statistical time interval and frequency measurements. An HP 9800 series programmable calculator is controlling the system and computing statistics to be plotted by the HP 9862A.



The HP-27 Scientific/Plus is the most powerful preprogrammed pocket calculator Hewlett-Packard has ever built.

Five new functions never before offered by HP include variance, correlation coefficient, normal distribution, net present value and internal rate of return.

You will be able to solve difficult scientific and statistical problems with the 28 math and trig functions, 15 statistical functions and 10 financial functions.

You can simplify complex calculations through the use of the 20 memories; store constants in 10 addressable registers; manipulate data in four operational stack memories.

Multiple clearing operations let you preserve data in some registers while preparing others for a new calculation.

For today's engineer solving complicated equations or preparing budgets, cost analyses or forecasts, the HP-27 is an outstanding price/performance tool to assist in technical and resource management decisions.

All this for only \$200.

Check A on the HP Reply Card.

Add Option 041 to the Model 5328A Universal Counter for completely automated operation under computer or calculator control *plus* higher performance time interval measurements.

This new option adds full remote programming of all input signal conditioning controls. Trigger slope, trigger level, attenuators, AC-DC coupling, and 50 Ω or 1M Ω input impedance can now be set remotely. This is in addition to all the other front panel controls which are remotely set by the Hewlett-Packard Interface Bus (HP-IB) Option 011, a requirement for this total capability.

Option 041 also significantly increases the resolution and versatility of the 5328A counter's time interval

measurements. Included among the many improvements are 10 ns single shot time interval resolution and the HP exclusive jittered clock that can give more accuracy and certainty to averaged time interval measurements.

Combine Option 011 and 041 with the 5328A and you will have a counter that will simplify your automation and measurement tasks.

Other 5328A options available include a 512 MHz channel, choice of two types of built-in DVMs and an ultra-stable time base oscillator.

Prices for the 5328A start at \$1300. Option 041 is \$950, Option 011, \$350. For more information, check K on the HP Reply Card.



The HP-27 offers all the scientific functions we've preprogrammed into earlier scientifics *plus* new stat and financial functions, new storage capacity, new clearing operations and engineering notation.

HEWLETT-PACKARD COMPONENT NEWS

Higher power for microwave impulse train generators



New coaxial step recovery diode modules are of rugged, reliable solid state hybrid integrated design.

Two new step recovery diode modules for comb generation are added to Hewlett-Packard's line. Model 33005C is a complete comb generator with dc return and 3mm connectors; Model 33005D is a cylindrical module with axial leads. Input frequency for both is 1000 ± 50 MHz. Guaranteed output power at 18 GHz is -15 dBm with 0.5 watt drive. Applications include measurement of spectral behavior of linear components such as filters and slow wave structures, frequency and amplitude calibration of receivers and antennas, and reference frequency generation for phase locked systems.

When driven at the appropriate input frequency, the devices generate a train of narrow, high amplitude pulses at a repetition rate equal to the input frequency. The resulting comb spectrum consists of lines at all multiples of the input frequency up to and beyond 18 GHz.

Output pulses are typically 10 volts amplitude and 150 picoseconds wide with 0.5 watt drive at 1000 MHz. Input is matched to 50 ohms.

Model 33005C is \$265 for quantities of 1-9; Model 33005D is \$205 for quantities of 1-9.

For technical data, check E on the HP Reply Card.

Two new hermetic LED displays with on-board decoder/divider

Two new series of LED 4×7 dot matrix numeric/hexadecimal displays are hermetically sealed for high reliability. Both displays provide a 7.4 mm (0.29") character height.

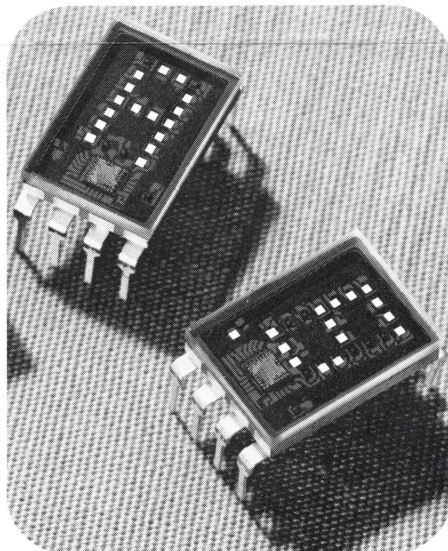
Models 5082-7356, -7357 and -7359 are intended for the industrial user who requires the degree of reliability offered by ceramic packages.

Models 5082-7391, -7392 and -7395 are intended for demanding requirements of military, satellite and spacecraft applications, and for industrial users demanding the ultimate in reliability.

These displays are categorized for luminous intensity assuring uniformity of light output from unit to unit within a single category.

In quantities of 100, prices for the 5082-7356/7/9 range from \$18.55 to \$19.30; Models 5082-7391/2/5 are priced from \$54.00 to \$59.00 in quantities from 1 to 99.

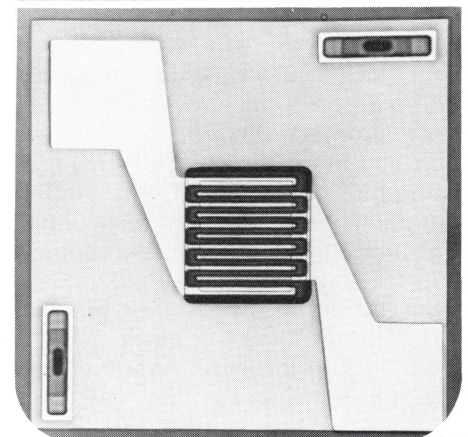
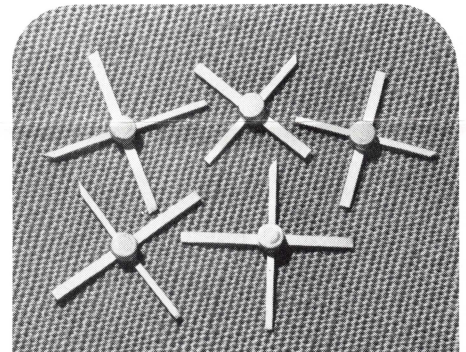
For more details on displays for high reliability applications, check H on the HP Reply Card. For less demanding applications, check I on the card.



New series solid state numeric and hexadecimal indicators with 5-bit memory designed for use in military and adverse industrial environments.

New ultra-low noise bipolar transistor with only 2.7 dB NF at 4 GHz

The chip is packaged in the HPAC-70GT, a rugged co-fired metal/ceramic hermetic package.



A new NPN bipolar transistor utilizing ion implantation techniques in its manufacture is provided with scratch protection over its active area.

Designers of ultra low-noise amplifiers will find this new microwave bipolar transistor ideal for use from 1 to 4 GHz in applications such as radar preamplifiers, ECM equipment, microwave links, broadband IF amplifiers and satellite systems.

The HXTR-6101 has a specified noise figure of 2.7 dB typical (3 dB max.) at 4 GHz and 1.5 dB typical at 1.5 GHz. Typical associated gain at NF conditions is 9.0 dB at 4 GHz and 15 dB at 1.5 GHz.

Price is \$150 each in quantities of 1-9.

For further details, check N on the HP Reply Card.

We've revolutionized digital troubleshooting again— this time it's a current tracing probe

Put Hewlett-Packard's new Model 547A Current Tracer on or near a misbehaving logic circuit path and look for the light to illuminate at its tip. Now, you're on your way to solving some of digital logic troubleshooting's most difficult problems—you know just where logic current pulses from 1 mA to 1A are flowing...even in multilayer circuit boards...and for all logic families.

You'll be able to perform the following quickly and economically:

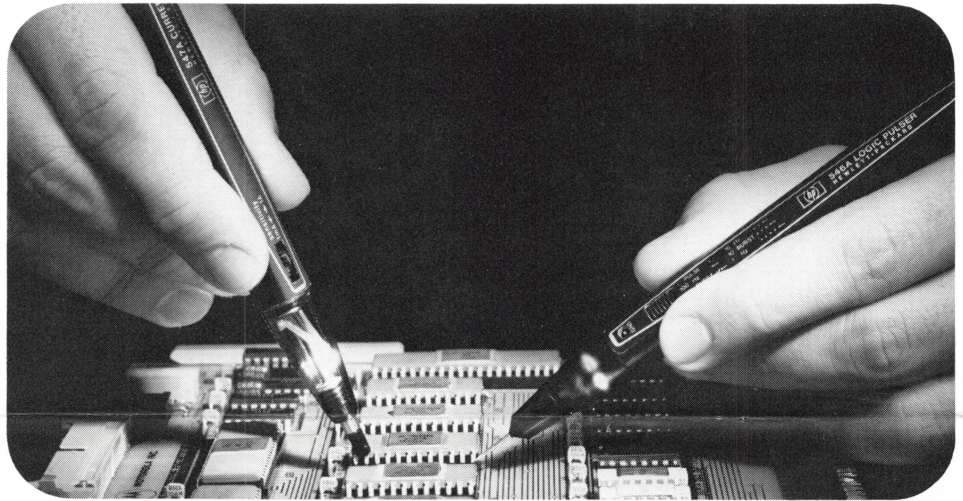
TROUBLESHOOT:

- Wired - AND/OR busses
- Three-state busses

PINPOINT:

- The one bad IC on a stuck node
- Hairline cracks/solder bridges
- Backplane/motherboard shorts

On a shorted node, all points are stuck in one state by the short. Many stuck node troubleshooting problems, particularly in wired-AND/OR configurations, result in wasted time and excessive costs since several ICs have to be removed before finding the bad one, and in the process, the circuit board may be damaged. Now, the 547A exactly pinpoints the one faulty point on a node. How do you determine that your circuit problem is a stuck node? With a voltage-sensitive logic probe like the new, all-family Model 545A announced in the March/April issue of Measurement/Computation News.



The Current Tracer's highly sensitive, shielded magnetic sensor precisely locates low impedance faults in digital circuits by "sniffing out" current sources or sinks in all logic families. If current pulses are needed, use the new programmable 546A Pulser to supply them.

The lamp in the 547A Tracer's tip indicates single-step current transitions; single pulses ≤ 50 ns wide; pulse trains to 10 MHz (typically 20 MHz for pulses ≤ 10 mA). Sensitivity is 1 mA for risetimes ≤ 200 ns and is adjustable up to 1A via a fingertip control. Power it from 4.5 to 18 Vdc, ≤ 75 mA.

If there's no current in the circuit or branch you're testing, you can supply it with our new Model 546A Logic Pulser. It's programmable to give one pulse per command, a 1, 10 or 100 Hz stream, or a burst of exactly 10 or 100 pulses. So now you can set your circuit

into its 852nd clock pulse state if you wish. It'll produce lots of short duration current to drive TTL or CMOS high nodes low or low nodes high—automatically and without harm to the circuit. Use it as pulse source for troubleshooting with logic probes, too. It's an amazingly capable pulse generator—especially for its small size.

Prices: 547A Current Tracer, \$350; 546A Pulser, \$150.

Circle B on the HP Reply card and we'll send data on all the above, and on our Logic Clip and Logic Comparator, too.

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 LOUISVILLE, KY: Suite 207, 3901 Atkinson Drive, Ph. (502) 456-1573 MILWAUKEE, WI (West Allis): 9004 W. Lincoln Ave., Ph. (414) 541-0550 PITTSBURGH, PA: 111 Zeta Dr., Ph. (412) 782-0400 ST. LOUIS, MO (Maryland Heights): 148 Weldon Parkway, Ph. (314) 567-1455 ST. PAUL, MO (Roseville): 2400 N. Prior Ave., Ph. (612) 636-0700.

HEWLETT  **PACKARD**

Sales and service from 172 offices in 65 countries.

 **MEASUREMENT
COMPUTATION** **NEWS**
innovations from Hewlett-Packard

MAY/JUNE 1976

New product information from
HEWLETT-PACKARD

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