VOL. 22 NO.

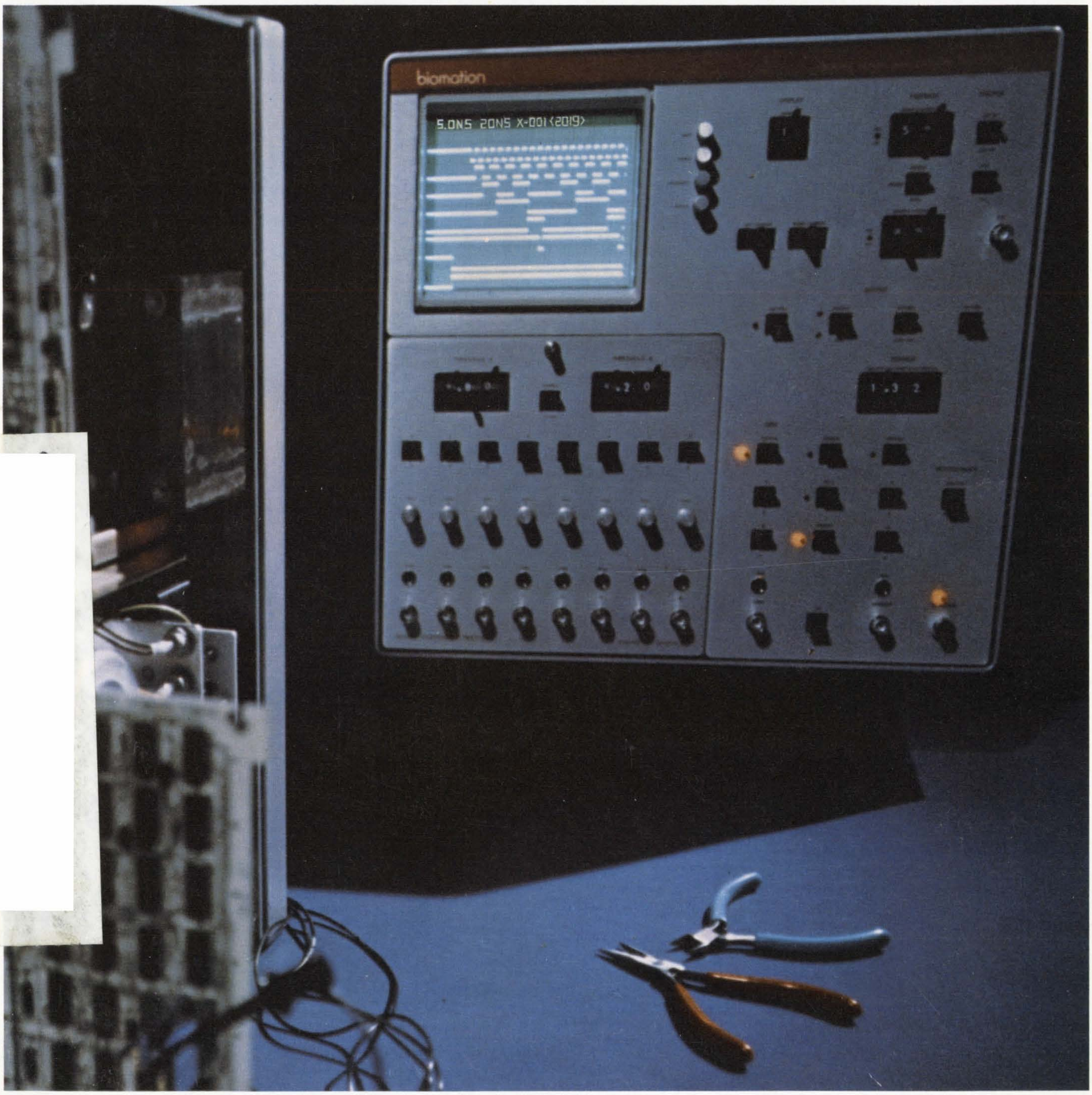
Electronic Design

5

FOR ENGINEERS AND ENGINEERING MANAGERS

MARCH 1, 1974

Check fast logic, bit by bit, or up to 2048 bits at a time, in each of eight pulse trains. Set thresholds you want, then record data at rates to 200 MHz and view at your leisure. Locate two cursors to isolate the pulses you want to study and display timing down to 5 ns. You can even catch 1-ns spikes. See page 69.



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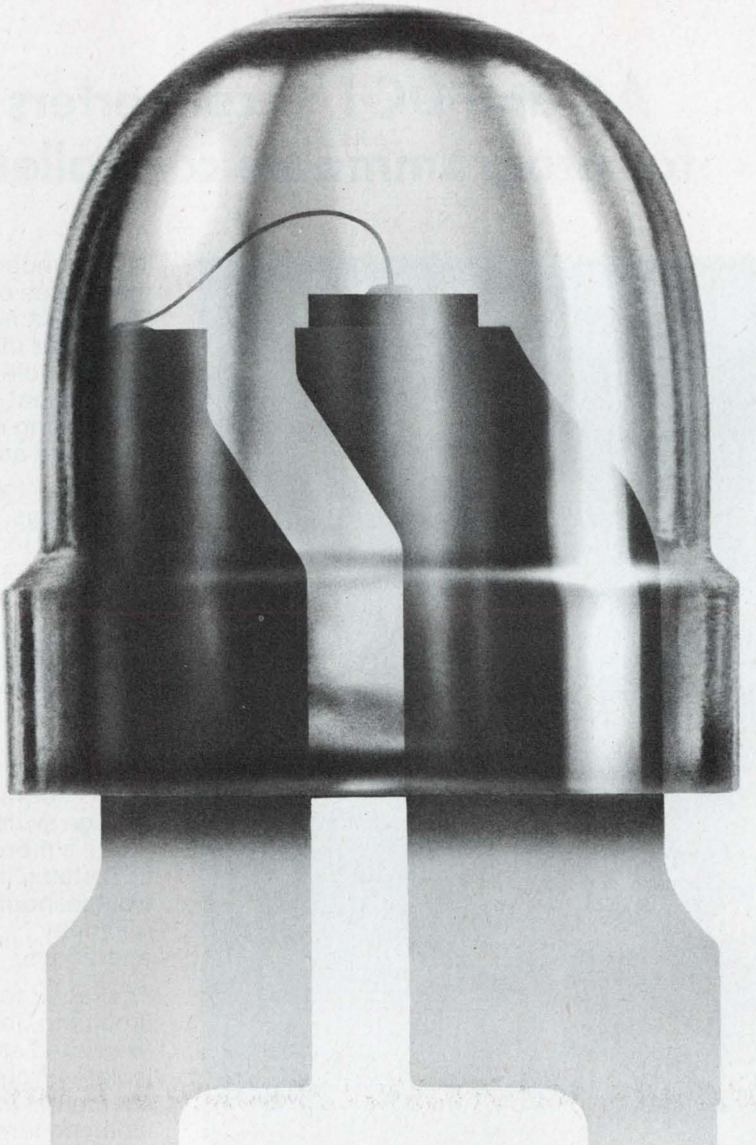

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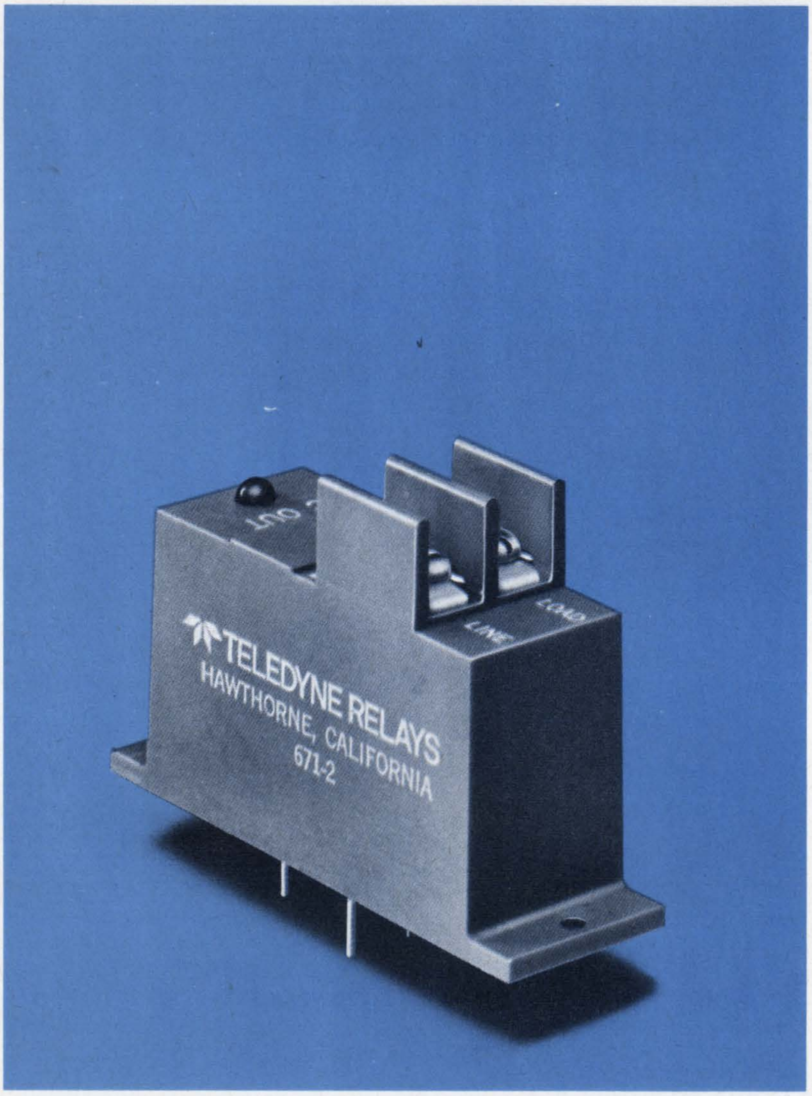

The boundary of the minicomputer mainframe or CPU world — of sensitive IC logic families — and the process control or machine tool world of motors, solenoids, lamps, and electro-mechanical switches is a tough place, demanding devices for fast quiet switching and load sensing — reliably.

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INFORMATION RETRIEVAL NUMBER 3

Electronic Design

VOL. 22 NO. 5

FOR ENGINEERS AND ENGINEERING MANAGERS

MARCH 1, 1974

NEWS

TECHNOLOGY

PRODUCTS

Departments

Cover: Photo by George Young, courtesy of Biomation.

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across the desk

Product safety seen giving way to profits

I'm writing in response to Stanley Runyon's editorial "Let's Not Become Another Auto Industry" in the Oct. 25, 1973 issue. In this editorial, Mr. Runyon stated that workers in the TV industry (engineers included) are to blame for safety hazards in TV sets. They should design, build, inspect and test these hazards out of existence.

Being somewhat familiar with the electronics industry, I can tell you that TV engineers do not control product safety any more than auto engineers do. A TV engineer can gripe about unsafe designs, but that will not have one iota of impact on the safety of TV sets as long as the marketing VP decides to sell a 16-inch, instant-on color TV for $249.95 and still make a reasonable profit. The TV engineer can design cool-running circuits with adequate safety margins, thermal and overload protection. His reward for these noble efforts will be (if he's lucky) a reprimand not to waste the company's money designing noncompetitive products. If he's unlucky, the reward will be severance pay. And the same strictures apply to wiremen, assemblers and testers. The workers are powerless to alter the safety of the product, because they're professionally powerless. Ralph Nader pointed that out years ago.

Mr. Runyon's lofty sentiments about the designer's conscience and responsibility are so much eyewash, because someone else is calling the shots, and his name is inscribed in gilt letters on the door of the corporate president's office. Until such time as safety hazards are legislated out of existence, or some engineering genius develops safer circuits at negligible additional cost—or the public gets educated and demands better—unsafe TV sets are here to stay. Just try buying a TV set with a three-wire plug and line cord.

These comments do not apply to my employer.

Robert Bruce, MSEE
15 Johnstone Rd.
Great Neck, N.Y. 11021

An old circuit is born again

In reference to "Line-Voltage Control Technique Improves Resolution, Lowers Parts Cost" (ED No. 23, Nov. 8, 1973, p. 138), the voltage-control circuit described is an old one, well-known to transformer people. I was first introduced to this technique over 10 years ago, and there was nothing new about it even then. The arrangement is known as a "buck/boost" circuit, and transformer manufacturers have for many years been making transformers specifically intended for use in such circuits.

William A. Robinson
Design Engineer
Oak Industries
Selectronics Div.
200 S. Main St.
Crystal Lake, Ill. 60014

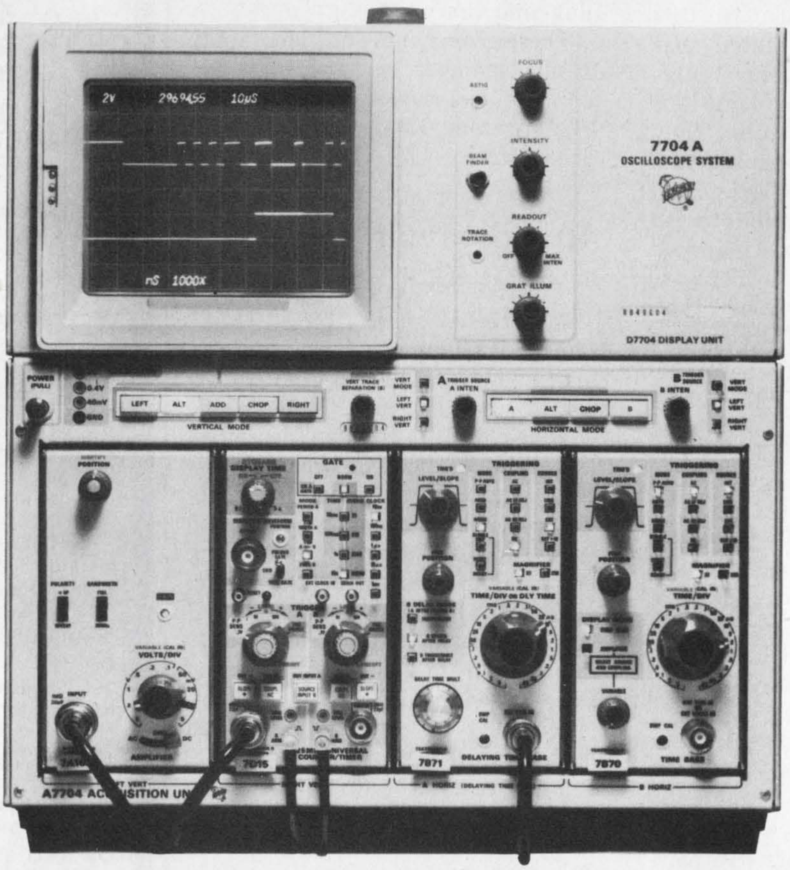
The author replies

Mr. Robinson is quite right that the "buck/boost" transformer idea has been around for a long time. However, I have never seen this technique used in conjunction with an autotransformer as a continu-

(continued on page 10)

Electronic Design welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to Managing Editor, Electronic Design, 50 Essex St. Rochelle Park, N.J. 07662. Try to keep letters under 200 words. Letters must be signed. Names will be withheld on request.

Oscilloscope plus Digital Plug-ins



Unique Solutions to Difficult Problems

Using the 7D15 Universal Counter/Timer

Problem:
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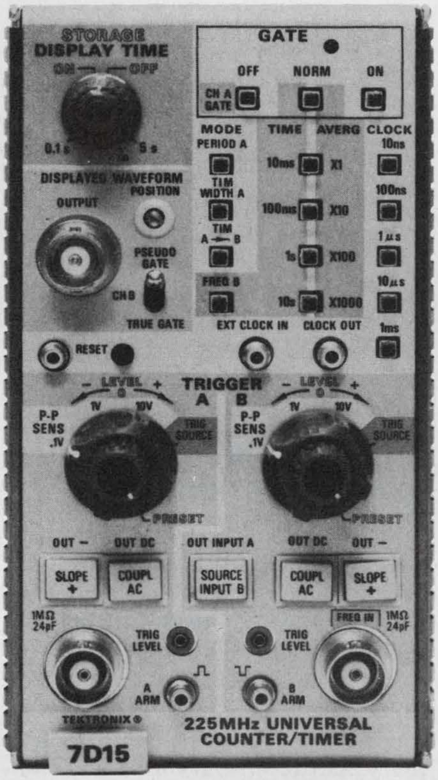
A Time Interval Counter, a Frequency Counter, a DMM, and a Delay Unit make up the 7000-Series Digital Family. These plug-ins bring the accuracy and convenience of digital technology to waveform measurements. Both analog and digital information can be displayed simultaneously.

Applications unique with the new 7D15 Universal Counter/Timer include measuring: time intervals

7000 Series Digital Family



of selected portions of complex waveforms (such as telemetry and computers); time between nonadjacent pulses; time between desired events (such as radar)—while ignoring effects of noise; frequency of burst—the arming feature permits measurement inside a burst so that burst turn on can't introduce possible error; and frequency of events —while ignoring signal ringing.

Teaming the 7D15 with a scope gives you more solving power for today's complex measurements. This unique combination allows you to: (1) *Display* on the CRT the measured signal together with the measurement interval, or the counter Schmitt trigger signal; (2) *Precondition* the signal via the scope's vertical amplifier to provide input possibilities such as, 10 μV sensitivity, Differential input, and Current probe input; and (3) *Accurately Control* the start and stop points of measurement by selective arming.

The new 7D11 Digital Delay Unit with its 100 ns-to-1 s delay range in Time-Delay mode and its 10,000,000 count range in the Events-Delay mode, fulfills many measurement requirements for accurate delays.

Applications in the Time-Delay mode include measuring: accurate low jitter sweep delays; propagation delays of delay lines or delay devices; delay path equalization in networks, logic systems, cable systems, or distribution amplifiers: oscillator stability; pulse width jitter, pulse-to-pulse jitter; and more.

Applications in the Events-Delay mode include: disc memory skewing adjustments; computer main storage or local storage timing adjustments; lost bit identification and location on disc memory or magnetic tapes; modulation analysis on time division multiplexing (TDM) or pulse modulation (PWM) in communication and data systems; and more.

The 7D13 Digital Multimeter with its unique temperature probe and 7D14 525-MHz Digital Frequency Counter are two more problem solvers in TEK's digital family.

TEK's concept of integrating these digital measurement capabilities with the scope brings you many advantages over separate test units:

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- fewer dollars invested
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INFORMATION RETRIEVAL NUMBER 7

ACROSS THE DESK

(continued from page 7)

ously variable buck/boost device.

I designed this device for an application that I could not fill with commercially available devices. The only cheap variable-voltage devices I found in the catalogs (Staco, Ohmite, etc.) were standard full-range autotransformers.

Although this simple idea may be "well-known to transformer people," this knowledge is apparently neither reflected in their products nor disseminated among "nontransformer" engineers and production people.

M. J. Salvati
Sony Corp. of America
47-47 Van Dam St.
Long Island City, N.Y. 11101

Don't overlook CAD to ease workload

The recent article by A. H. Hilbers and M. H. Burden titled "Calculate Large-Signal Behavior" (ED No. 23, Nov. 8, 1973, pp. 90-94) was well done. Unfortunately the basic premise—that S parameters cannot be used under large-signal conditions—is faulty (see Leighton, Chaffin, and Webb: "RF Amplifier Design with Large Signal S-Parameters," Sandia Laboratories, Albuquerque, N.M. 87115).

One of the biggest drawbacks to industry acceptance of CAD programs as a design tool has been the inconvenience in construction of valid device models and the near impossibility of relating model parameters directly to simple experimental measurements. This started because the old ECAP program forced the user to work with artificial models in the frequency domain; it took almost 10 years for frequency-domain CAD to recover.

In 1971 our program, MAGIC, marketed by University Computing Co., pioneered the complete avoidance of the "device-model" concept by working directly with measured data. Virtually all modern frequency-domain programs now use device parameters.

(continued on page 16)

If you need a 3-Station Digital Logic Test System, we can save you

$92,000

Compare the Hughes 1024's price and performance with the General Radio 1792, Teradyne 115, and other higher-priced systems. Three Teradyne 115s, for example, can easily set you back $210,000. Get the new Hughes 1024 system with three independent work stations instead, and you invest only $118,000.

We can charge less because we've built in more flexibility and economy. The 1024's disk-based system uses a common mini-computer and disk mass storage to drive up to three work stations. You can start with the basic control unit and one work station (256 two-way lines) for as little as $68,000, and readily add two more stations for $25,000 each.

The stations can be remotely located. They operate simultaneously, with each one performing a programming task or testing different card types. Not only that. Each station can handle up to 1024 two-way lines, with special interface configurations to test ECL and other logic families.

You get high speed, automatic dynamic-response testing (100 nsec) vs. the static testing most competitors offer. And a software-controlled probe quickly isolates manufacturing failures.

Now, all this might not mean much if the Hughes 1024 didn't have a superior test language and supporting software to cut test-program generation down to size. But it does. Plus a comprehensive file management, interactive CRT edit, and a real-time, disk-based operating system.

We'll supply test programs for your 1024, or other test systems. We'll also convert existing test programs to the 1024 language.

Hughes has pioneered in developing automatic test equipment for many projects. And now Hughes offers a complete logic-testing capability from hardware through test-generation service.

Mail the coupon today. How could you find a better way to save $92,000?

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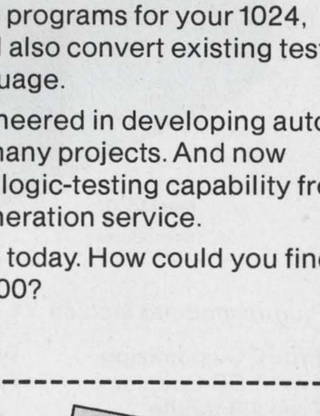

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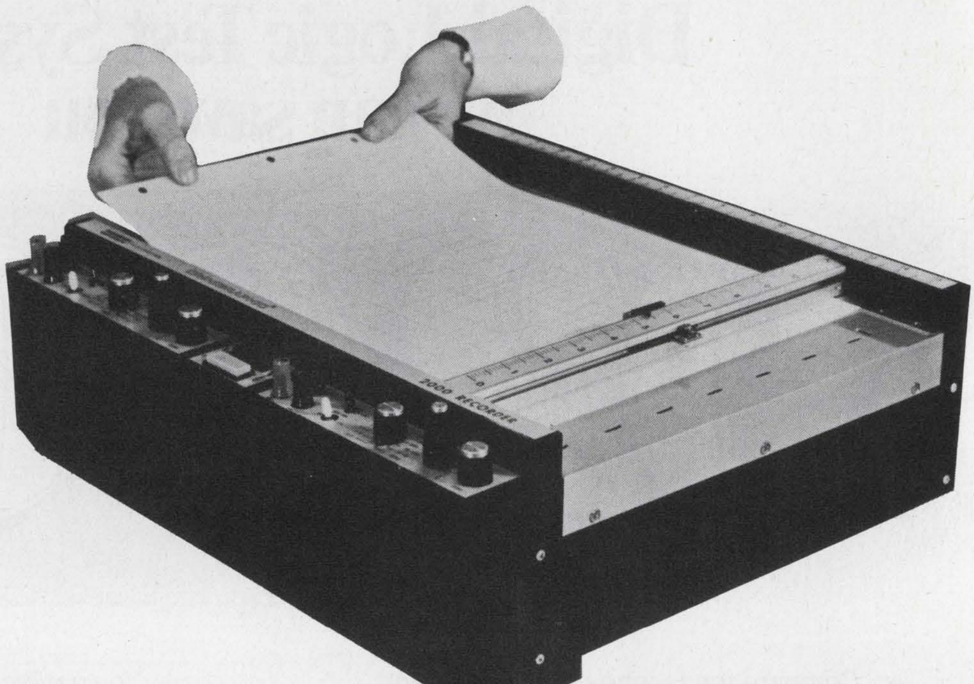
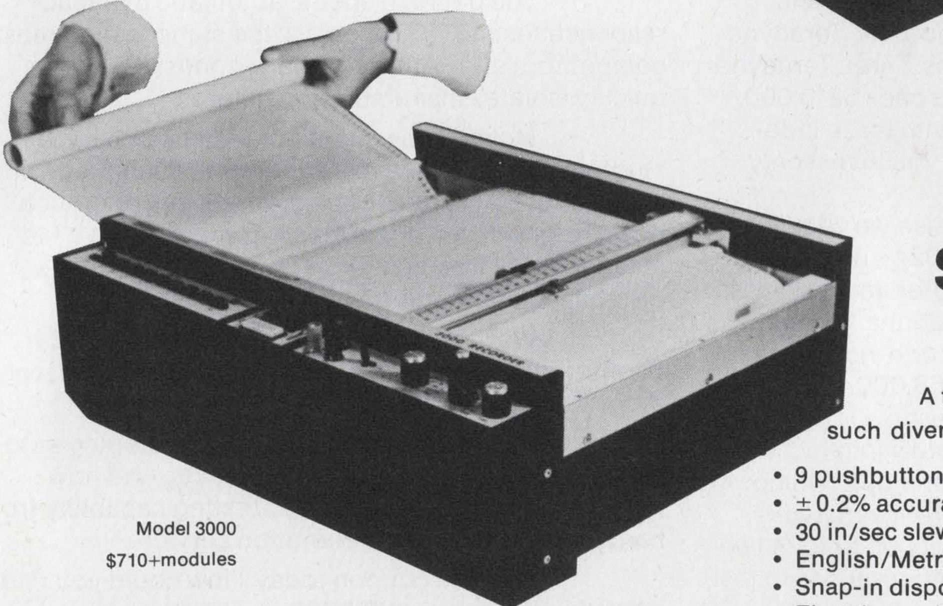


Model 2000
$770 + modules



Model 3000
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Type 8 Pre-Amp Attenuator /Time Base
Type 9 Precision Ranging
Type 10 High Sensitivity AC Converter
Type 11 1 mv Full Scale
Type 12 Precision Attenuator/Offset
Type 13 Integrator
Type 14 Log Converter
Type 15 Two Channel
Type 16/17 Point Plotter
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Type 51 Chart Drive
Type 52 Chart Drive
Type 53 Chart Drive
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INFORMATION RETRIEVAL NUMBER 10

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For example, we put both 14- and 16-pin sockets on the same board. We build in a unique "wire wrappable" section for discrete components. Also a "universal" section to take unusual components. And power decoupling. And "wire wrappable" test points. And so on, and so on.

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INFORMATION RETRIEVAL NUMBER 13

(continued from page 10)

Frequency-domain, large-signal CAD is still state of the art, and it is conceivable that we may be forced back to device models. I sincerely hope not.

John D. Trudel
President
Scientific System Technology, Inc.
603 Business Parkway
Richardson, Tex. 75080

Women in ads leave future engineer cold

I have done a research project on "Treatment of Women in Technical Advertising," which focuses on material from ELECTRONIC DESIGN, *Electronics*, and *Electronic Products*, and I want to comment on your editorial "Women" (ED No. 17, Aug. 16, 1973, p. 41). Among the ads of prime interest in my study was the series on "Guardian Angel," which included the center-page foldout. My audience was both amazed and disgusted at the means to which the advertisers had gone to attract attention.

Let me pose a few questions to both the advertisers and editors of ED:

Why don't advertisers appeal to engineers in a professional way instead of screaming at them for attention?

Why are women pictured only as models and secretaries in the ads? This only serves to label women in servile roles, to which I object.

Why does a magazine editor think he can divorce the content of the magazine from the ads? I believe the ads reflect on the quality and appearance of the total magazine.

As a future woman engineer, I suggest that both the advertisers and the editors consider carefully what they choose to represent them.

Joyce Wetenkamp
803 Harding
Urbana, Ill. 61801

relays renewed

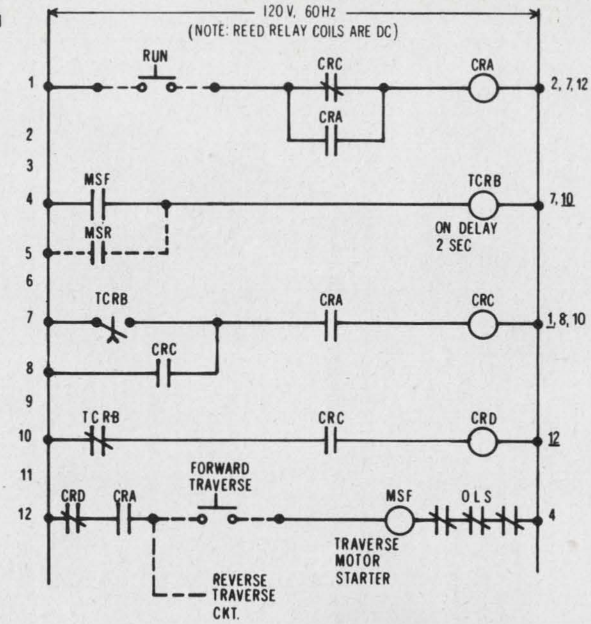
2 HANDED DEADMAN'S THROTTLE

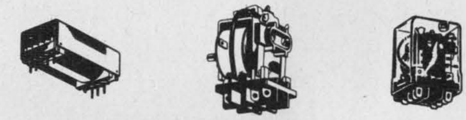
OSHA should be happy with this foolproof interlocked switching circuit that occupies both hands of a machine operator. The Run switch of Fig. 1 can't be simply taped closed, it must be cycled after each "Stop" of the "Forward-Stop-Reverse" Traverse switch.

Almost any combination of electromechanical or reed relays can be used since most contacts switch other control relays. However, with reed relay coils rated at 48 VDC maximum, the motor starter usually would require a separate power supply. Depending upon the size of motor starter MSF, control relays CRA and CRD could be S-D Frames 283, MRRN, or 314. For TCRB a modification of our Frame 236 would make an excellent choice.

Thanks to B.C.M., Nazareth, Pa. for this idea which he suggests for overhead cranes to insure that the operator keeps both hands inside the cab and on the controls.

FIG. 1





Here are just two of more than 800 relay applications submitted during Struther's-Dunn's 50th Anniversary Relay Contest last year. These thought starters are a small sample of the endless possibilities for relay-operated systems.

RELAY GUARDS SPRING-OPERATED MECHANISM

Here's a device that actually operates a conventional relay both electrically and mechanically. Its use of spring-stored energy may have other applications where a mechanical operation is needed without power or with only a local standby power source. Now used on stored energy operators of oil circuit breakers, this suggestion comes from F.L. of Foxboro, Ma.

The gear reduction motor of Fig. 2 charges a spring in one revolution of its output shaft. With the spring fully charged, a cam mechanically actuates the control relay into the energized position. As Fig. 3 shows, CR1 then stops the motor while CR2 readies a solenoid circuit that can delatch the spring whenever required. When the spring discharges, the cam "unlatches" the relay and the motor starts recharging the spring. A failure elsewhere in the mechanism operates a contact that electrically energizes the control relay and stops the motor to prevent damage from repetitive spring discharges.

Relays such as S-D Frames 314, B1, 425, 219, are only a few of many types suited for such an arrangement. The choice depends largely on mounting requirements and number of poles required.

FIG. 2

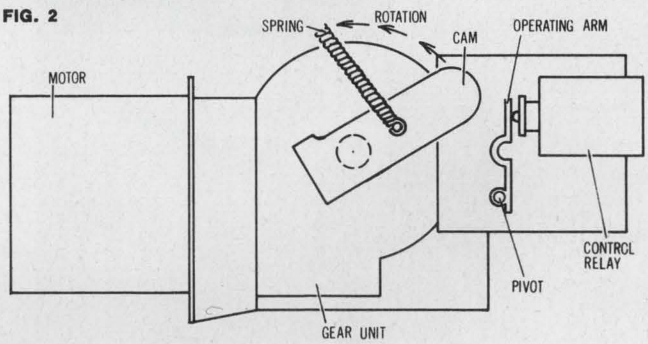
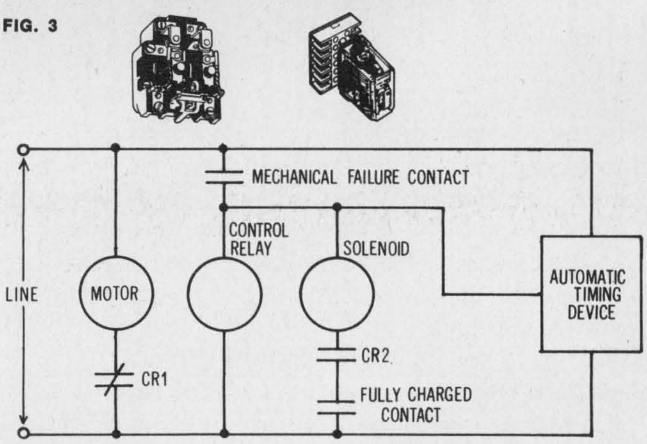
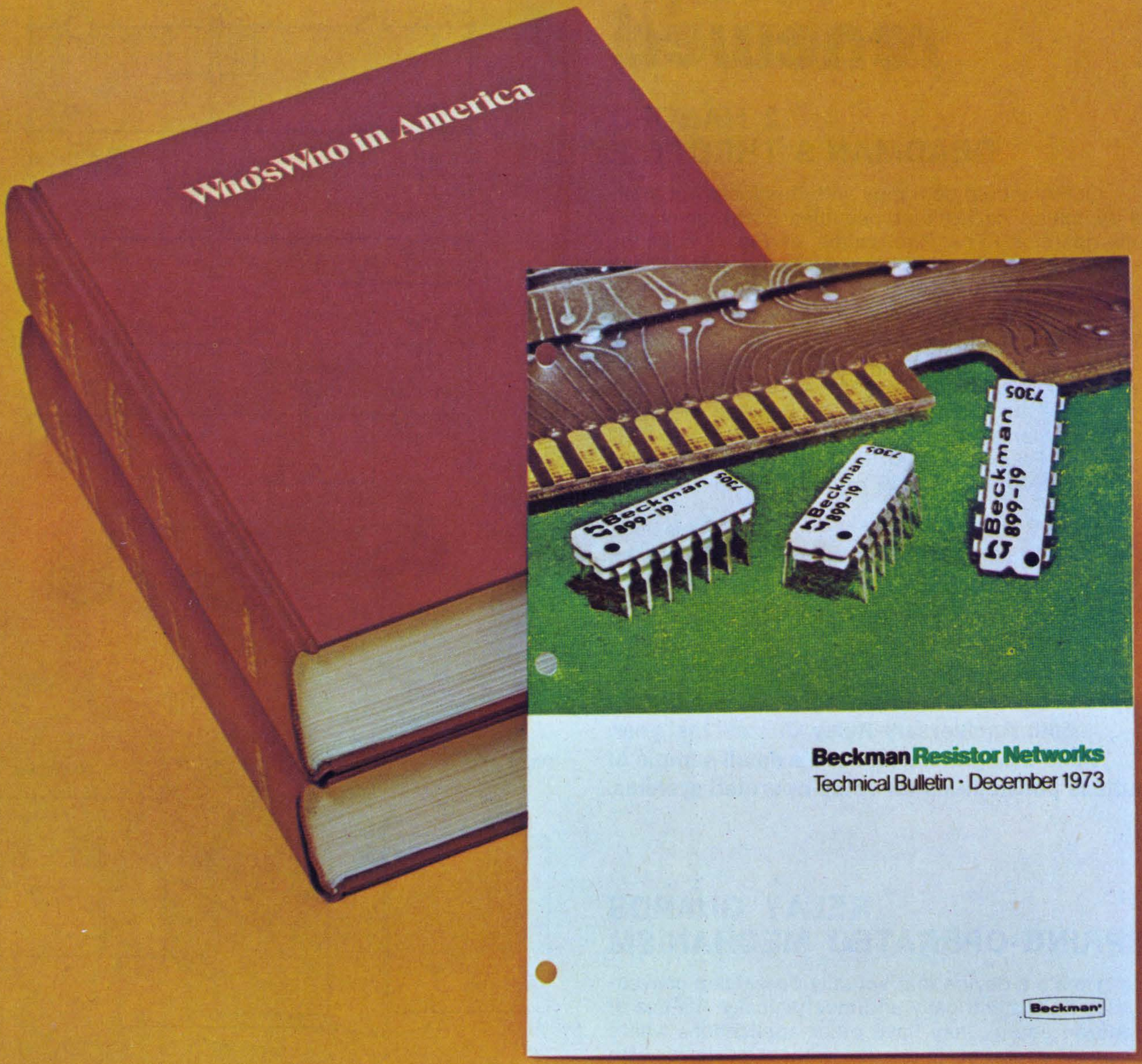


FIG. 3





The two-volume set is famous as a living, changing record of persons whose accomplishments are notable and important in American life. The catalog is growing famous, too. Because it details the Beckman RESNET™ DIP resistor network line—No. 1 in worldwide brand preference.

For good reasons, you should think of Beckman resistor networks, too, for any applications involving pull-up/pull-down, digital pulse squaring, line termination, current limiting, ECL terminators, and interface networks.

Why? Consider this. Production is totally automated. Laser tailoring is computer-controlled. Every part is 100% inspected, in process and during final assembly. Packages are dimensionally uniform, which means Beckman RESNET DIPs are ideal for automatic insertion techniques.

Then, we offer the broadest available line of standard resistor networks—both 14- and 16-pin versions. And these are kept in full stock by our distributors all around the country.

Another reason we're No. 1 in preference is our materials technology. We have 20 years in developing, improving and manufacturing our cermet materials. This shows up on your end as performance... accuracy... reliability.

Of course, if you need custom resistor networks, think of Beckman again. We offer them to suit virtually any market application. And custom applications assistance, as well. (If you need immediate literature, or the phone number of your local Beckman/Helipot representative, call toll-free 800-437-4677.)

Look into Beckman RESNET DIPs. Our achievement can help you with your achievement.

That could be money in your pocket. Allen-Bradley's exclusive hot molding process offers physical consistency that can reduce your installation costs. Bodies are a uniform size with clean squared ends, free from coatings which adversely affect automatic handling equipment. Lead lengths and diameters are precise. Resistors with uniform physical characteristics, accurately placed on tape reels, eliminate insertion machine jam-ups. And trouble free assembly means less production down-time; lower cost. That's A-B quality. Consistent shipment after shipment. If you think all resistors are the same, send for our free booklet, "7 ways to tell the difference in fixed resistors." Allen-Bradley Electronics Div., 1201 S. 2nd St., Milwaukee, WI 53204. Export: Bloomfield, NJ 07003. Canada: Allen-Bradley Canada Ltd., Cambridge, Ont. U. K.: Jarrow, Co. Durham NE32 3EN.

EC80

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Soviet to exhibit for export at New York IEEE show

For years the Russians have been familiar attendants at the IEEE show in New York City's Coliseum. Treading softly in comfortable sandals, they are usually equipped with cameras and flash bulbs, tape recorders, ballpoint pens and notebooks, and they ask good questions. This year they're moving in, and in a big way—six booths, or 600 square feet, on the main floor—with products for export.

For newcomers—and the first exhibitors from the Communist bloc—six booths are not a bad start. The Japanese, who dropped permanent anchor some years ago at the IEEE show, will have exhibits by 13 companies using 28 booths, Britain will have eight companies in 15 booths, the West Germans, five companies in seven booths, and the French, two booths.

The Russians may even bring technical papers, "but we won't know this until they get here," says Ted Shields, assistant manager of the show, called Intercon, which will be held March 26-29.

The Soviet exhibit, organized by Amtorg Trading Co. of New York, will feature components, computers and microwave equipment, according to the entry forms, Shields reports. The products they said they would show are general-purpose analog and digital computers, computer peripherals, control equipment, data-acquisition and processing equipment, valves (tubes), semiconductor devices, integrated circuits. SHF instruments, gas discharge devices, camera and oscillographic tubes, electronic multipliers, photocells, ferrite elements, as well as a line of resistors and capacitors.

3-day work week spurs semiconductor output

How can a semiconductor manufacturer with a backlog of orders save energy, increase production without making new capital outlays and have happier employees who miss fewer work days?

Advanced Memory Systems in Sunnyvale, Calif., says it has achieved all by changing its production schedules and putting its employees on a three-day week.

Like many semiconductor makers, it formerly operated 24 hours a day, using three shifts, five days a week. This meant that the furnaces, which are never turned off in a semiconductor plant, burned two days, or 48 hours a week, without producing anything.

Now the plant runs round the clock, six days a week—which leaves the furnaces going unproductively for only 24 hours a week. On the new schedule, two crews work 12 hours a day for three days and then have four days off. Two more crews come in from their long weekend and work the remaining three days.

Production is up by 40 percent due to the extra work day and more employees. Though labor costs have increased—more employees have been hired and the pay is higher—there are savings in energy, and the company won't have to build a new plant—an alternative that had been considered.

"Before the change, we already had the highest density output per area of any semiconductor manufacturer, and now with the new schedule we've increased this by 20%," a company spokesman says.

"The employees like the new arrangement, because they have so much time off. They also make more money—overtime every day after the first eight hours."

Absenteeism has also dropped. "Maybe you think twice about staying home a day when that day means a third of your week's pay," the company spokesman notes.

DEC goes West to build LSI mini

In an effort to meet competition from West Coast LSI minicomputer manufacturers, Digital Equipment Corp., Maynard, Mass., has given Western Digital a \$6-million contract to develop an LSI version of its PDP-11/05 mini.

The LSI-11 processor that is being developed will consist of a two-chip set that uses fast n-channel MOS technology. It's reported that the new machine will be faster than the initial LSI mini offered by Computer Automation and will have wider memory access than the 8-bit SOS unit from General Automation.

The LSI-11 is expected to sell for about \$2000, which would be \$1000 less than present units are going for.

Although neither DEC nor Western Digital has made any official announcements of this project, the latest annual report from Western Digital shows a picture of the PDP-11/05 with two LSI chips next to it.

IMPATT power sources produce 10 mW at 150 G

By combining ion-implanted, double-drift IMPATT oscillators with careful packaging, scientists at Hughes Aircraft Co. Research Laboratories, in Malibu, Calif. have produced the first active solid-state power sources that operate above 100 GHz. The cw output power levels are in excess of 80 mW in the 135-to-140-GHz region, and over 10 mW at 150 GHz.

Dr. John Forster, associate director of the facility, says the major application of the sources will be to pump parametric amplifiers that operate in the 50-to-70 GHz range and to serve as local oscillators for mixers up to 150

GHz. Efficiency is about 2%, and MTBF is estimated at 10,000 hours.

"The crucial part of the program was the development of the semiconductor diode itself," Forster says. "Although circuit work is difficult because of the small dimensions, it is generally a scaled version of lower-frequency technology.

The diode technology combines ion implantation, carefully controlled thin-layer epitaxial growth, and ultra-shallow, low-temperature diffusion. Packaging of the diodes requires a combination of large-area bonding techniques, an integral heat sink and a quartz standoff with a tapered ribbon contact lead. The output is via rectangular waveguides.

Development of the sources is the result of a year-long research project that was supported by the Air Force Avionics Laboratory, Wright-Patterson AFB, Ohio.

Small crystal gauge overpowers noise

Quartz and sapphire crystal gauges are extremely handy for measuring very-high-pressure shock waves of short duration from impacts, explosions or pulses of radiation from solid-state materials. But the gauges also have a disadvantage. When they're small —for use on small devices—they put out a signal so weak that it's often drowned out by electrical noise.

A lithium-niobate crystal gauge has been developed that overcomes this problem: Even when small, the gauge produces a clear, strong electrical signal that can be easily distinguished through noise. According to its developers at Sandia Laboratories in Albuquerque, N.M., the new gauge comes through loud and clear under conditions that would render the quartz and sapphire gauges useless.

The only tradeoff—and this is important only in very special cases—is a loss in range in pressure. The lithium-niobate gauge can measure pressures up to 250,000 psi (about 17 kilobars) when created by shock waves that last only a few millionths of a second. The quartz gauge can measure pressures up to 600,000 psi and the synthetic sapphire gauge up to about a million psi.

Making accurate measurements of high-pressure, short-duration phenomena is of vital importance to laboratory engineers who are working with pulsed-laser effects in solids and pulsed lasers for diffusion, as well as for engineers working with solid-state materials.

The lithium-niobate gauge is relatively simple, says the principal investigator, Robert A. Graham of Sandia's Physics of Solids Research Dept. It consists basically of a disk of lithium niobate, a piezo-electric material—ranging from 0.5 to 2 inches (1.27 to 5.08 cm) in diameter and 0.1 to 0.5 inches (0.25 to 1.2 cm) thick—with electrodes on both faces. The front of the disk is placed flush against the back of the test object, and the electrodes are then connected to electronic circuitry.

When a shock wave strikes the test object, the wave passes through it and into the gauge, compressing the lithium niobate and causing a charge to flow between the two electrodes. The charge varies directly with the amount of compression.

Night-vision modules yield alterable device

The days of one-of-a-kind, custom night-vision devices may be over. The Army has tested successfully a prototype comprised of building-block components that can be arranged and rearranged to fit the night-vision application that is needed.

Known as the Standard Far-Infrared Component program, it is intended to reduce design, procurement and maintenance costs. The work has been carried out at the Army's Night Vision Laboratory in Fort Belvoir, Va.

According to Richard Riordon, project engineer for the program, the new system design organizes thermal imaging night sights operating in the 8-to-14-μm band into seven standard modules. These can be used in a variety of night sights.

The building blocks are the detector; detector cooler; scanning system and infrared optics; video electronics, and a light-emitting diode array for image display. The Night Vision Laboratory's new modules are compatible with both low and medium-performance night-vision sights, because the detector is designed to accept different types of detector coolers. The detector-cooler combination is at present the most expensive part of a custom system.

The laboratory's component program is in the advanced development stage, Riordon reports. The standard modules are being incorporated into night sights for the Chaparral missile, the Tow missile system, the A-7 aircraft, the advanced remotely piloted vehicle, the airborne laser locator designator, and the Navy's Mark-68 gun director.

IEEE sees ample jobs for flexible engineers

"Career opportunities in electronics will continue to grow in most all areas of the industry." That's the conclusion of the first engineering and manpower report published by the Institute of Electrical and Electronics Engineers.

Titled "IEEE Manpower Report 1973," the 225-page compilation looks for significant growth in the power field—including utilities, machinery and switching- gear components. Employment in this area is expected to more than double by the 1980s.

The report is divided into four sections: industry, manpower, careers in engineering, and the engineering challenge. Engineers are advised to remain flexible, ready to transfer into another area as activity changes focus. Changes will be a fact of life, the report adds.

Dual radar distinguishes between 2 air targets

The Naval Research Laboratory in Washington, D.C., has developed a radar tracking system that can distinguish between two airborne targets that are very close to each other. It does this with two radars, one at millimeter wavelengths and the other at X band. The mm radar narrows the beamwidth that holds onto the targets, even when they move to within one or two beamwidths of the horizon.

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news

REPORT ON PORTABLE CIRCUIT TESTERS

For fast digital troubleshooting, low-cost detectors can't be beat

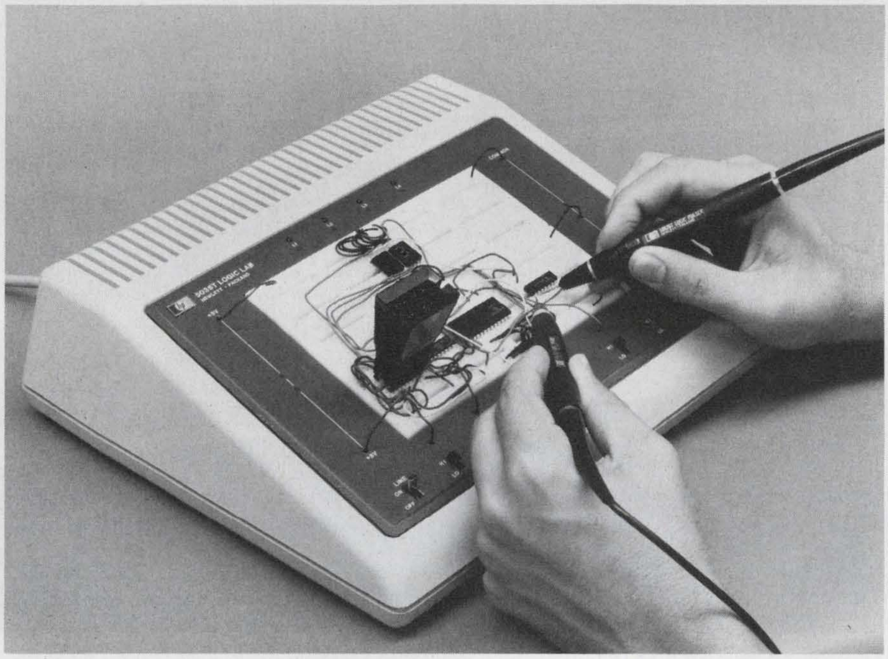
Logic probes, clips, comparators and pulsers are all part of a growing family of low-cost, portable digital circuit testers. They are saving time in the troubleshooting of digital equipment in the field and proving to be useful to the circuit designer in the laboratory as well.

A logic probe allows the user to view the static logic states of a circuit node, and, in more complex probes to see single-shot pulses and pulse trains as well. The logic clip is another digital-state indicator, allowing the logic state on each of the 14 or 16 pins of an IC to be observed simultaneously. A logic comparator clips on a suspect IC and compares the activity with a known good reference IC. Any difference in state is indicated on a LED array. The logic pulser injects a signal into a digital circuit, which permits the circuit to be exercised slowly enough to view changes of state and digital activity.

The units show only the digital activity in a circuit. They provide no information about pulse shapes, quantitative data on pulse timing relationships or other data that must be analyzed when digital circuits are designed. They cannot replace the oscilloscope for viewing the shape of pulses, but they can analyze most of the common circuit failures.

According to Jesse Pipkin, product manager-digital test for Hewlett-Packard, Santa Clara, Calif.: "Both field engineers and circuit designers find that 70 to 80% of all digital circuit failures are of the 'stuck node' variety. Usually one or more circuit nodes are not changing state, either due to a catastrophic IC failure or to a PC-board failure. The small logic testers are an ideal way to find such faults. They give just enough information and not too much for normal troubleshooting."

Northe K. Osbrink
Western Editor



Evaluation of a typical digital-circuit breadboard is expedited by the HP 10525-26T and 28A logic probe, pulser and clip.

The opinion is echoed by others in the field, including Allen Ross, president of Signal Laboratories, Orange, Calif. He says: "The logic probe and other small testers are potent tools. They enable the field serviceman to tackle a large piece of digital equipment with a minimum of test equipment. It represents a real improvement in technique over trying to do stimulus-response tests with scopes and signal generators."

The new logic testers that are emerging offer a choice of readouts, more sensitivity to logic levels and provision for more data. The next step is the "universal" logic probe, which will work with any logic family.

Probes: Simple and versatile

The simplest logic tester is the probe. It is touched to a circuit node and can indicate the logic state and show if it is static or pulsing. Manufacturers have shown great ingenuity in providing probes that give good dependable data, although the amount of data varies with the cost and complexity of the probe.

"In many instances a logic probe provides enough information to locate a fault or at least localize it to a small part of the circuit," says Russell V. Filinger, manager of accessories engineering for Tektronix, Beaverton, Ore.

The least expensive type of logic probe is typified by the $19.95 Model 300 from Alco Electronic Products of North Andover, Mass. The unit is compatible with TTL/DTL logic levels, is powered by clipping to the 5-V logic supply and has a single LED that lights for the logic ONE state. The indicator is dark for logic ZERO, open-circuit or indeterminate states. The input impedance is 250 kΩ at dc, dropping to 40 kΩ at 100 Hz. The indicator dims at increasing pulse-repetition rates, extinguishing at 12 MHz. The logic probe is primarily an instrument for indicating static logic states, since it provides no pulse stretching; it will not show brief pulses.

Building on the basic concept is the $35 Model L-2000 probe from Aqua Survey and Instrument Co., Cincinnati, Ohio. This probe has two LED indicators—one for static state, the other for stretching pulses of 10 μs or longer to make them visible. At rates to 120 Hz, the LED shows the frequency divided by four, and it stays on at rates up to 1 MHz. The unit has a 40-kΩ impedance, and it takes 50 mA from the 5-V supply. Aqua Survey also makes several other probes, including a model that detects 40-ns pulses and a battery-operated model.

Digi-Tronix of San Jose, Calif., offers a $59 single-LED unit, the Model HS50A. It detects pulses as narrow as 20 ns, which are stretched to 90 ms. The indicator follows pulse rates to 15 Hz and flashes or remains lighted up to 25 MHz, depending on the symmetry of the pulse.

Two new products are expected soon from Digi-Tronix, according to Al Espinoza, president: "An eight channel monitor—equivalent to eight logic probes in one case—and a universal logic probe suitable for any of the current logic families."

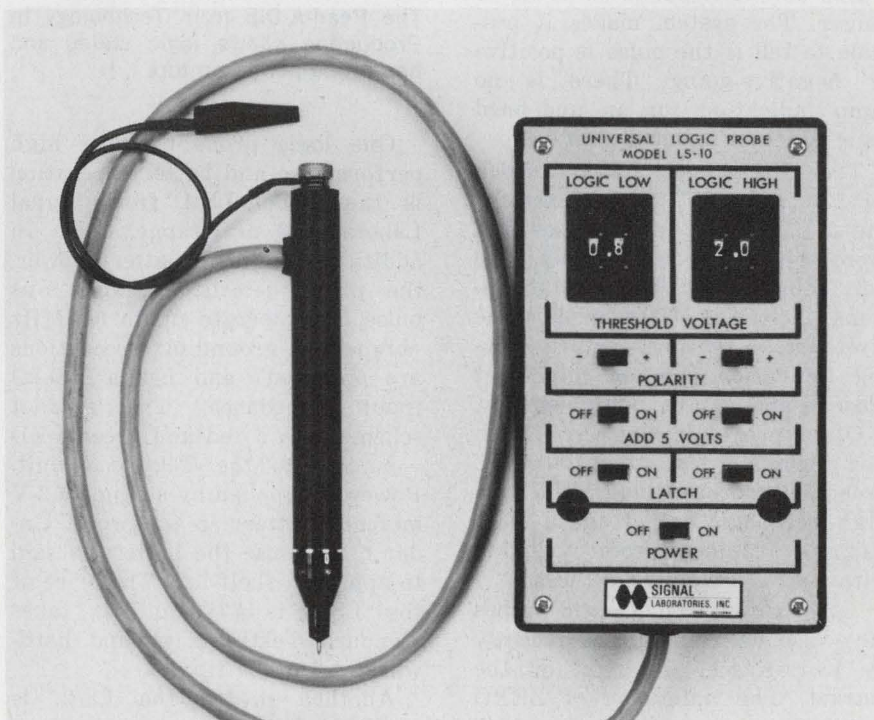
A TTL probe from Tektronix—the Model P6401—is not yet available but is expected soon. It uses two incandescent lamps, one red and one green. A steady high state is indicated by a steady red light and a steady low by a steady green. Pulse trains are shown by full-intensity blinking of both lamps. An important feature is that combinations of the lamp indications show excessive input voltage. The probe has a built-in pulse memory and will recognize pulses of 10 ns, and it also has an input impedance of 7.5 kΩ for all states. It sells for $75.

The first CMOS probe, the Kurz-Kasch LP-575, features digital readout of logic states.

Hewlett-Packard put the first logic probe on the market by introducing the Model 10525A in late 1968. Its current line now includes probes for TTL/DTL, high-level logic (HTL) and ECL. The units each require a power input that is compatible with the logic family, and each has input protection in case of contact with the ac line or with a supply that powers the Nixie tubes. The readout is a single incandescent lamp, mounted in a plastic band on the probe tip to permit viewing at all angles.

HP's readout shows full brilliance for logic ONE, half brilliance for open circuits or indeterminate logic levels, and it is extinguished by a logic ZERO or ground. Single pulses of 10 ns are stretched to 50 ms, and pulse rates of up to 50 MHz cause the lamp

(continued on pg. 28)



The first universal logic probe will be available from Signal Laboratories before mid-year. It's battery powered.

(continued from page 27)

to flash at a 10-Hz rate.

The HP TTL unit, designated Model 10525T, has a 25-kΩ input impedance for both logic states (many probes do not specify low-logic-state impedance). It sells for $95, and a $25 accessory memory is available for storing any pulse detected by the probe. The memory is connected between the probe power cable and the power source. An indicator on the memory shows any pulse detectable by the probe, and it remains lighted until reset. As one HP engineer explains: "The pulse memory does not interfere with normal probe operation in any way. Most built-in memories prevent normal operation of a probe when used."

The Hewlett-Packard HTL and ECL probes—Models 10525H and E, respectively—sell for $95 each, and accessories are available.

Kurz-Kasch Electronics, Dayton, Ohio, takes a different approach to probe readout with its 500 series. The Kurz-Kasch probes have three incandescent lamps in the transparent tip. A red lamp lights on steady logic ONE, a white lamp on steady logic ZERO and a blue lamp to indicate high-speed pulse trains or single pulses of 50 ns or longer. The system makes it possible to tell if the pulse is positive or negative-going. There is no lamp indication for an undefined logic state or open circuit.

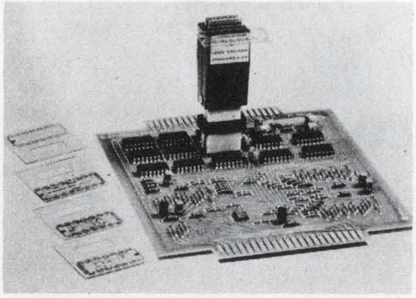
The Kurz-Kasch TTL model, LP-520, has a 35-kΩ impedance for the HIGH state, and is powered from the TTL power supply. The unit sells for $69.95, and $10 options include a latch mode/pulse stretcher, a gating feature—giving indication only on coincident pulses—and a 5-ns pulse detector.

Other probes in the Kurz-Kasch line include a less expensive TTL probe without the blue light, two high-level logic probes and a more rugged "student-proof" version with extra protective devices.

A pair of CMOS logic probes have also been announced recently by Kurz-Kasch, the first on the market. The indication of ZERO or ONE is based on a percentage of the supply voltage rather than on the detection of a fixed logic level.

Thomas E. Barth, general manager of the Kurz-Kasch Electronics Div., says: "Due to the variation in logic levels in the CMOS family, it was necessary to take a new approach in designing our CMOS probes. The range provided by our new probes gives good indication of CMOS levels regardless of the supply voltage."

The Model LP-575, which features a seven-segment LED readout of levels, operates on a supply voltage of 5 to 15 V at 25 mA. It has a 25-MΩ input impedance. The probe will indicate a logic ZERO at 30% of the supply voltage and a logic ONE at 80%, with a dead band from 30 to 70%. Pulses light a separate LED indicator. The unit sells for $89, and options include a memory-pulse stretcher and a coaxial power lead. The Model 579, using the conventional three-lamp display costs $79.



The Read-A-Dip from Technology In Production shows logic states and has probe points on top.

One logic probe offering high performance and battery operation is the Model LS-1 from Signal Laboratories of Orange, Calif. In addition to built-in battery power, the probe detects a single 5-ns pulse, will operate up to 50 MHz (higher if grounding precautions are observed) and has a 100-kΩ input impedance. The readout scheme uses a red and green LED —similar to the Tektronix unit. Power is supplied by a single 4.2-V mercury battery in the probe. Under normal use the battery is said to approach shelf life. The price of the LS-1 is $77, and it takes standard Tektronix ground hardware and probe tips.

Another model, the LS-2, is available for custom requirements. It can be preset at the factory to operate on HTL, MOS or ECL, but it requires external power.

Signal Laboratories may be the farthest advanced in the development of a universal logic probe. The unit will be called the LS-10, be packaged in a probe with separate control box and sell for about $250. The tentative specifications include the ability to test any logic family with thresholds in the range of −14.9 to +14.0 V, including TTL, RTL, DTL, HTL, CMOS and ECL. Power will come from internal batteries. The high and low thresholds will be selectable and accurate to ±50 mV, and the unit will have a standard pulse latch feature.

According to Ross, Signal Laboratories' president: "The LS-10 is breadboarded and performing to specifications. The remaining engineering work is primarily in packaging the unit. We expect to have it on the market sometime before the middle of the year."

A logic probe with an integral binary counter in addition to normal logic level indication is available from Zi-Tech of Palo Alto, Calif. The probe is said to be useful for checking multiple clock or trigger pulses in the count mode, which also serves as a pulse memory. The $66.50 TTL probe operates from a 5-V logic supply, detects 50-ns pulses, has a 50-kΩ input impedance and is fuse-protected.

In the normal logic mode, the Zi-Tech probe indicates high and low logic levels with LED indicators. In the count mode, it counts up to six pulses and holds the count until reset. If more than six pulses are received, it indicates this with an overflow light, which serves as a pulse memory.

Clips 'watch' whole IC

For monitoring all the input and output states of a digital IC at once, the easiest solution is the logic clip. It clips directly over the pins of a DIP IC and continuously shows the logic state on each pin. These units all indicate the logic levels with a LED for each pin on the IC, and they are equipped to work with 14 or 16-pin DIPs.

These units do not include the pulse-stretching or pulse-detection circuitry of logic probes. To see the logic states changing, the clock rate must be slowed down to about 15 Hz or less, or the circuit must be stepped through its cycle. All units have followed the Hewlett-

Packard example and provide automatic means to find the supply voltage and ground to power the clip from the circuit under test.

Some engineers feel that the logic clip is limited for troubleshooting applications. One engineer says: "Logic clips are actually tools for the designer rather than the field engineer. The designer has control of his circuit and can step it through to watch responses. The field serviceman is more interested in watching the dynamic response of a circuit without having to disable anything."

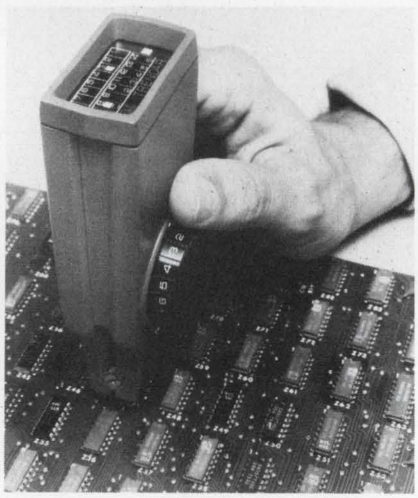
HP introduced the first logic clip in late 1969—the Model 10528A. The current HP clip is still called the 10528A, although present units have improved springs on the clip to make better IC contact. All circuitry and 16 LEDs are incorporated in the body of the clip. The input threshold is 1.4 ±0.6 V, making it TTL or DTL compatible. The input impedance is equivalent to one TTL load—sufficiently high to prevent excessive loading on all but circuits with inadequate fan-out. The power required is 120 mA, and it is taken from the IC power pin.

The HP clip is still the smallest available, making it the easiest to use in cramped boards, and it is relatively foolproof—it can be clipped on the IC without regard to pin numbers. The unit sells for $125.

Both Jermyn of San Francisco and Alco have imported logic clips that perform similarly to the HP unit and that contain a feature not available from HP—a supply of 24 plastic overlays with standard IC logic diagrams. The overlays are placed over the LED array and help the engineer follow the operation of the circuit. The Jermyn unit, Model A23-2086, sells for $85, and the Alco, Model 201, for $99.95.

Another logic clip, the Read-A-Dip, from Technology In Production, Danbury, Conn., has the V_{cc}-seeking ability and LED array in common with other clips, and logic symbol masks are available. Two versions of the Read-A-Dip are made—one for TTL/DTL and the other for high-level logic. In addition to being the only logic clip for high level, the unit has probe points on its top that connect directly to the IC pins. This aids in probing voltages or waveforms in crowded boards. The unit sells for $125—either TTL or HTL version.

The Logiscope from Rohde & Schwarz, Passaic, N.J. is used for the same tests as a logic clip, but the unit is in two parts. The IC clip is connected by cable to the instrument proper. The main advantage claimed for this technique is that the LED display is about 10 times larger than those on the clips. The instrument is supplied with 100 circuit overlay cards, which are used like those on the clips. In addition to the normal functions, an overvoltage LED indicator is included, which lights when the protective circuit is being activated by overvoltage. The unit is also capable of detecting a 1-ms pulse, and clock pulses as fast as 10 Hz can be followed. The Logiscope costs $225 and is a TTL/DTL unit.



Trendar's Testclip combines the functions of a logic comparator, clip and probe in one unit.

Pulses from a 'pen'

Still, in many cases the clock rate of a circuit is too fast or the activity too complex for the user to follow. The need then arises for an instrument either to slow the action or even force it to proceed one step at a time. A logic pulser is such an instrument. It is a pen-sized signal injector that can be used to stimulate digital circuits in either single steps or slowly enough so the circuit operation can be followed. To be really useful, you should be able to apply it to any point in the circuit, regardless of the original logic state of the circuit. If a circuit node is at ZERO, it will pulse any connected circuits with a ONE, and vice versa.

Two units are available that perform in this way. The Hewlett-Packard Model 10526T was the first pulser on the market. It produces two pulses—one over 2 V and a low pulse of less than 0.8 V —at currents of about 0.65 A, depending on load, each time the button is pressed. The active impedance is less than 2 Ω and the static impedance over 1 MΩ. The pulse width is nominally 0.3 μs—which limits the delivered energy to prevent any damage to components. The unit is powered from the 5-V logic supply and requires less than 25 mA to operate. According to one HP engineer:

"There are some circuit nodes on which the pulser will not work, just as there are some which make any logic probing difficult. Hopefully when most designers are aware of logic-testing techniques, they will eliminate the difficult nodes from the circuits, making testing and servicing much simpler."

The HP Model 10526T sells for $95. Special tips are available including a kit for multipin stimulation.

The comparable logic pulser, from Kurz-Kasch, has two operating modes. In the one-shot mode, it provides two 1-μs pulses—one 3 V minimum, the other 0.6 V maximum. In the continuous mode it produces similar pulses with a 5-Hz repetition rate. Like the HP unit, the HL-582 operates from the logic supply. It sells for $89.

A similar instrument, the P-2002 signal injector from Aqua Survey and Instrument Co., provides a much more flexible choice of test signals. The only disadvantage is that the outputs are standard TTL clock pulses rather than the "brute force" variety. The unit can be used to substitute for the system clock or drive unloaded circuits, but it will not overcome existing ONE or ZERO states on nodes.

A 10-position switch provides either 50% duty-cycle frequencies from 100 Hz to 1 MHz or single pulses from 1 μs to 10 ms. The

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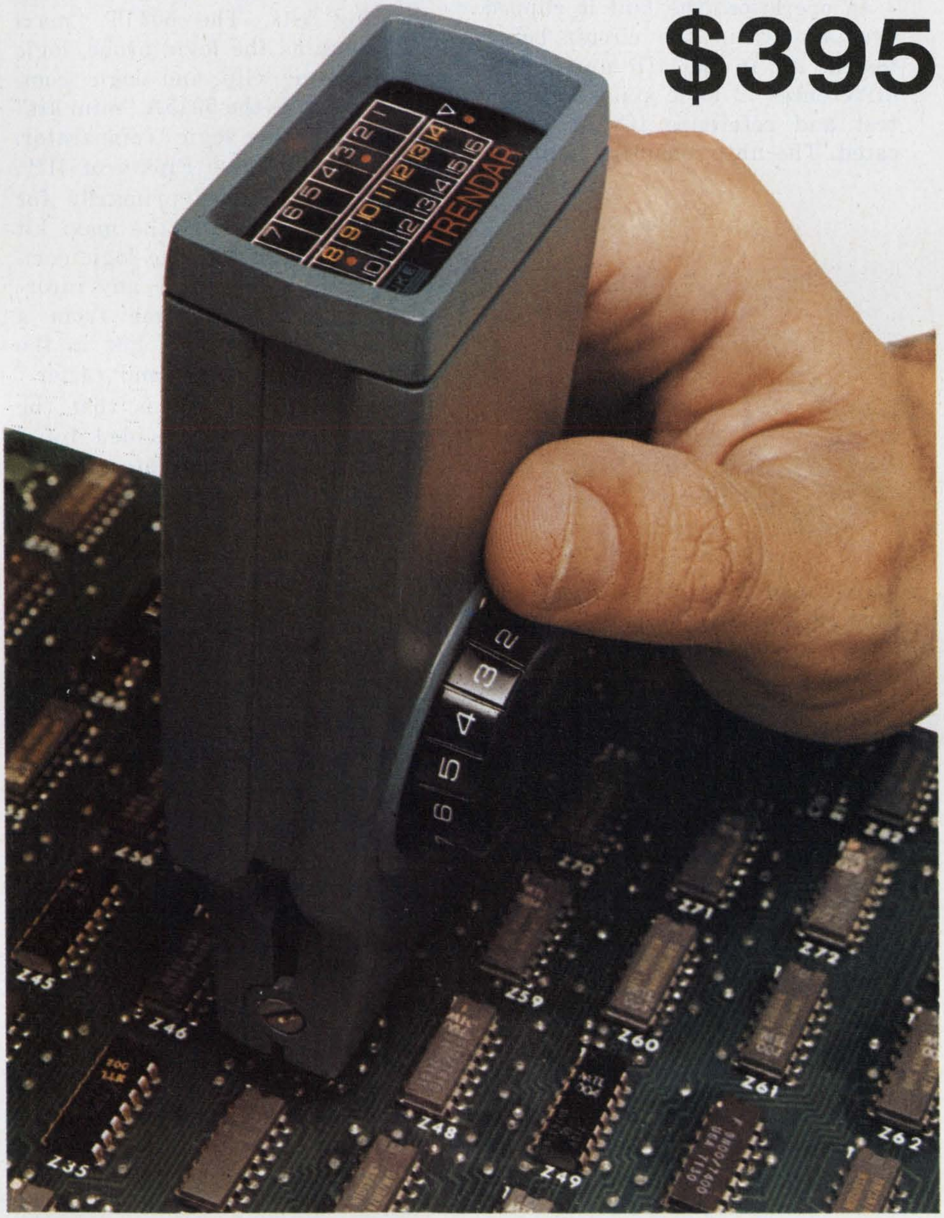

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output rise time is 20 ns, the output impedance 68 Ω, and the instrument draws 80 mA at 5 V. Useful for many applications, the P-2002 sells for $85.

Easiest in-circuit IC tests

A new concept for in-circuit TTL IC testing appeared in mid-1971 with the first logic comparator—the Model 10529A from Hewlett-Packard. The instrument clips onto the IC under test—powered and operating under dynamic conditions in the circuit. The logic states at the pins of the suspect IC are compared with those of a known good reference IC, and only the differences are displayed on a 16-LED array.

The logic comparator connects the inputs of the two ICs in parallel, so the reference IC is driven by the same signals as the IC under test. If any differences in output are detected that last longer than 200 ns, a failure is indicated on the array, and the malfunctioning pin is identified.

The reference IC is soldered to a board that fits inside the 10529A, and the V_{cc}, ground, signal input and output pins are programmed by soldering and use of a supplied tool to break PC conductors. The output from the tester loads the input of the tested IC with about two TTL loads, and the output of the IC is loaded by one equivalent TTL load. The 10529A will operate up to 2.5 MHz. It costs $375.

Mark Baker, product marketing engineer for HP, reports that his company, starting possibly next month, will deliver the 10529A with an additional switch-program reference board. The plug-in board will substitute for a regular programming board and will have a zero-insertion-force IC socket and small switches to permit testing of infrequently encountered ICs. A switch on the board will allow the comparator to be used as a logic clip. As such, it will accept 200-ns-to-200-ms positive or negative pulses. The new board will be included with the comparators and be available to users of older units. It will have automatic V_{cc} and ground-seeking and will protect the power supply from accidental shorting of the V_{cc} supply if the board is improperly programmed.

One unit, the Model 200 IC Testclip, manufactured by Trendar, a subsidiary of John Fluke, Mountain View, Calif., combines a logic comparator, test clip and logic probe in one compact instrument.

The Testclip looks like a rather large logic clip, with a LED-array readout on one end and a pin-selector switch on the bottom. For use as a logic comparator, a reference IC is inserted in a "programmed" replaceable pin socket. The programming is done by use of long and short pins in the socket—which is then inserted in another socket on the Testclip.

In operation, the unit is clipped over an IC in the circuit being tested. As in the HP units, only differences in logic states between test and reference ICs are indicated. The unit considers faults as differences in state lasting over 400 ns.

"Mini" and "maxi" logic test kits from HP combine the most essential testers in custom cases.

With the reference IC removed, the Testclip functions as a logic clip, indicating the logic states on each of the IC pins. Because of the comparator circuitry the states are shown inverted—a logic ZERO is lighted and a logic ONE is dark. While the IC is being observed, the switch on Testclip allows any of the pins to be selected and examined with a logic-monitor (probe) circuit. The logic monitor indication is on a separate LED and will detect 100-ns pulses, stretch pulses to 100 ms and flash at a 5-Hz rate for pulse-repetition rates through 1 MHz.

The Trendar Model 200 Testclip comes with the probe cable, 10 IC sockets and 40 programming pins. The complete package sells for $395. According to Noel P. Lyons, manager of marketing services for Trendar:

"The configuration of the Testclip is due to a number of engineering considerations. First, it eliminates the lead lengths between contact and circuit when used as a logic clip or comparator. Second, it can be programmed without having to solder anything, enabling new IC types to be tested in the field. Most importantly, it combines the most necessary digital testers into one instrument."

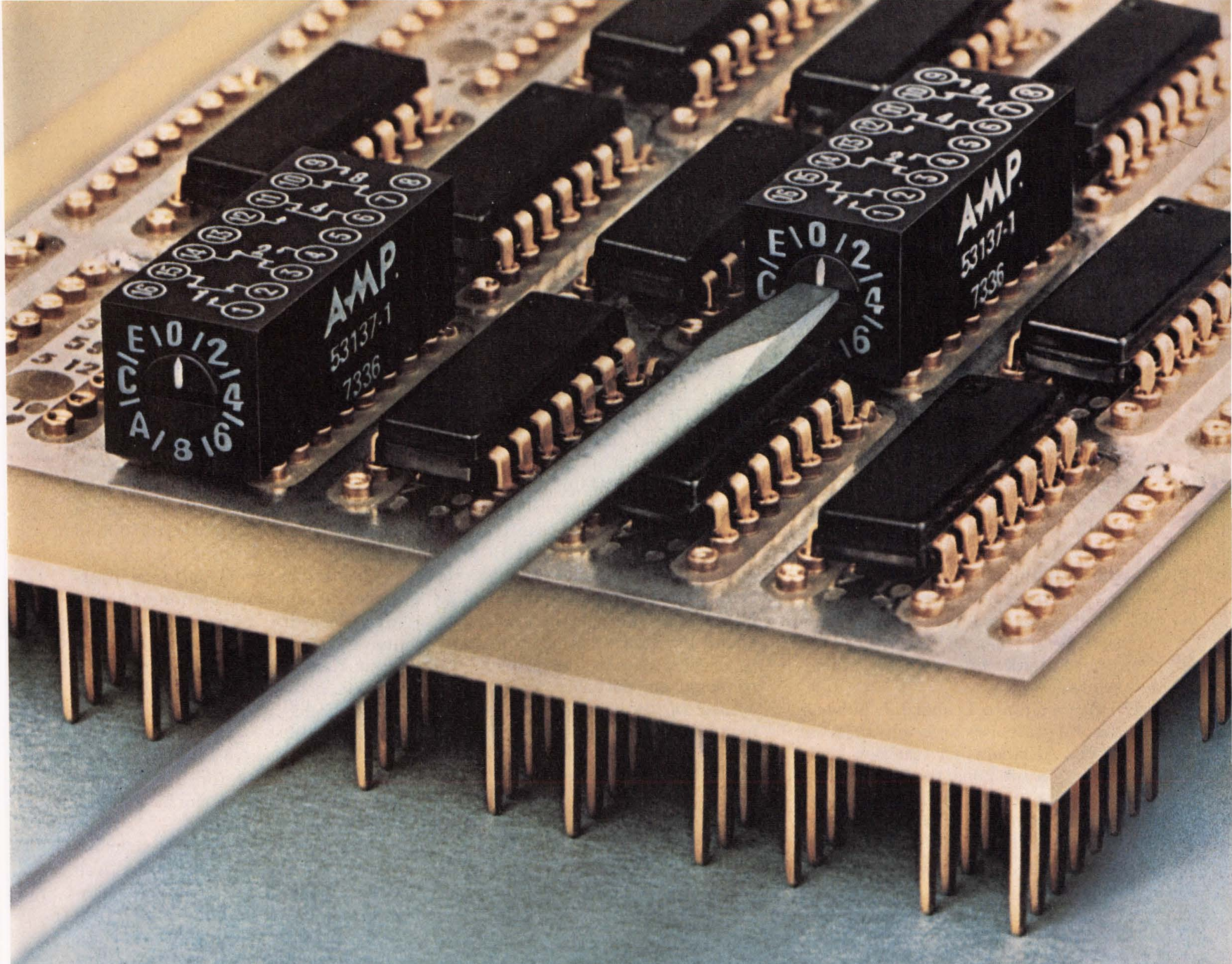
Hewlett-Packard has combined its line into a pair of logic troubleshooting kits. The 5011T "maxi kit" contains the logic probe, logic pulser, logic clip and logic comparator, while the 5015A "mini kit" eliminates the logic comparator. According to Jesse Pipkin of HP:

"The mini kit is primarily for circuit designers and the maxi kit for field engineers. The logic comparator doesn't provide any information that can't come from a probe, pulser and clip, but in the field it works faster and easier."

The feeling at HP is that the greater flexibility provided by a combination of separate instruments outweighs any advantages of combining functions. The mini kit costs $285 and the maxi kit $625.

The market future appears bright for small logic testers. Both field and design engineers who have used them have found that they can spot trouble easier and faster than with other methods. They are using troubleshooting techniques especially suited to digital rather than adapting techniques that are fundamentally analog.

According to Frank C. Partin, an industry spokesman for John Fluke in Seattle: "The number of digital IC packages in service is continuing to rise sharply, particularly in equipment such as industrial controllers and even game machines, where down time is very costly. The field serviceman traditionally went on a call with a truckload of spare boards; he had to get the equipment back in service fast, so he made repairs by board swapping. Now, with a few tiny instruments, he can go anywhere, even in out-of-the-way places and replace bad ICs. In these cost-conscious times such an ability is very valuable." ■■



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New memory, the crosstie, stores data in magnetic-domain walls

A new memory technology that combines the high speed of semiconductors with the nonvolatility of magnetic memories is being developed by the Naval Ordnance Laboratory in Silver Spring, Md., as well as several computer manufacturers.

Known as a crosstie memory, the technique is a radical departure from previous magnetic methods, in that the storage of information is in magnetic-domain walls rather than the domains themselves.

According to Leonard J. Schwee, a solid-state research physicist at the naval laboratory, the new technology is intended for applications requiring block-oriented, random-access memory or fast auxiliary memory. The advantages, Schwee notes, are high speed, high bit density, nonvolatility, low cost, low power requirements and a wide range of operating temperature.

What is it?

Like the magnetic-bubble memory, the crosstie is a serial type, and thus the basic building block is a shift register. The magnetic wall in a thin Permalloy film about 300 Å thick serves as a track for the shift register. ONEs in a crosstie shift register are represented by sections of wall that are opposite in polarity from the remainder of the wall. This is called a crosstie Bloch-line pair. ZEROs are represented by the absence of ONEs at periodic sites along the wall. The ONEs and ZEROs are introduced at one end of the wall, by application of a local magnetic field, and propagated along the wall without change in the distances between each pair. At the other end of the wall, the pairs are detected and read out in serial form.

One main reason why crosstie memories show promise, Schwee says, is that they appear to offer very high performance. With present techniques, it's possible to achieve data rates as high as 20 Mbits/sec. This can be speeded to about 125 Mbits/sec, Schwee says, by a decrease in the size of the propagation patterns and an increase in the anisotrophy of the magnetic film.

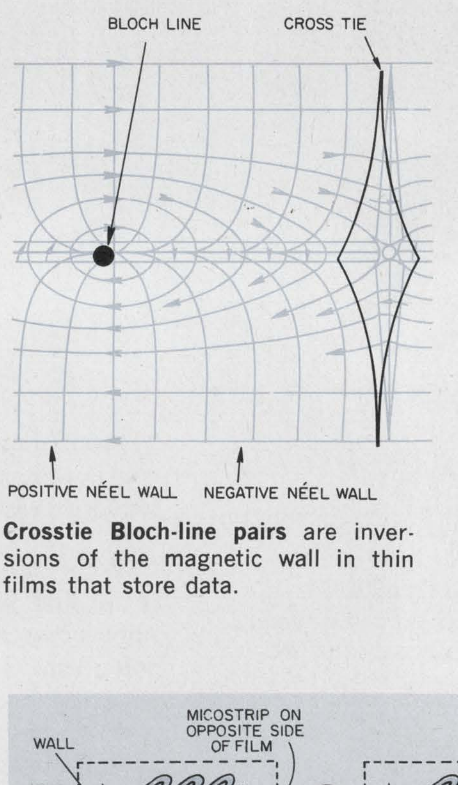
The crosstie memory also offers high storage densities, Schwee reports. Present technology can yield densities of about 1 million bits/in^2, he says, and this can be boosted to at least 70 million bits/in^2 by an increase in the anisotrophy of the film. Further improvements should raise that to about 1 billion bits/in^2, Schwee predicts.

One major problem to be overcome, he says, is detection of crosstie Bloch-line pairs. Since these pairs are local changes in the magnetic field, it's necessary to differentiate between at least two magnetic field conditions to sense information.

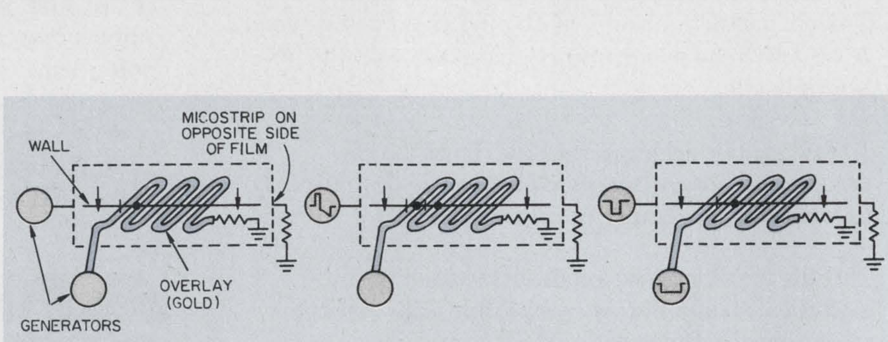
"Currently we're trying to adapt sensors developed for bubble sensing to crosstie-memory applications," Schwee notes.

Although much of the basic research on crosstie memories was done at the Naval Ordnance Laboratory, the technique is not limited to military applications. Both Honeywell and Sperry Univac are pressing crosstie-memory development programs.

A spokesman for Honeywell says the crosstie memory is a "longshot technology," because it is relatively new and there is very little in the way of feasibility studies. He notes, however, that it is based on the very well known Permalloy thin-film technology, and that is part of the reason Honeywell is looking into it. ■■



Crosstie Bloch-line pairs are inversions of the magnetic wall in thin films that store data.



Data are propagated by first entering it into the memory (left), duplicating it (middle) and then annihilating the original entry (right).

Jules H. Gilder
Associate Editor

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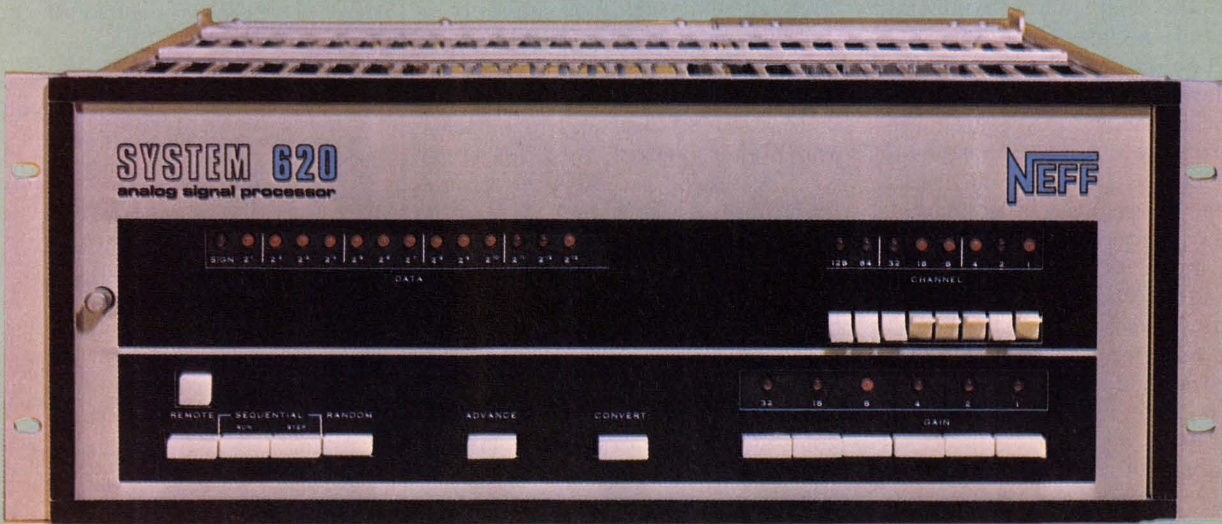

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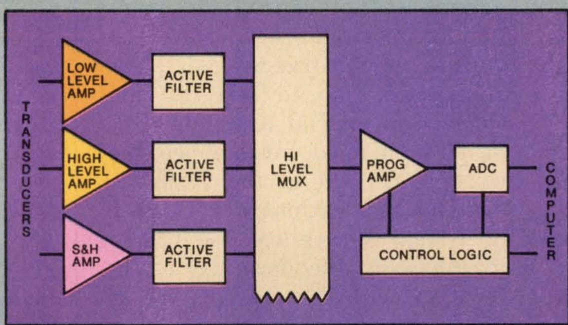

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Mini-laser techniques speed 3-dimensional X-ray imaging

With the help of a minicomputer and a laser, Philips Research Laboratory, Eindhoven, the Netherlands, has come up with two new methods for speeding the fabrication of three-dimensional X-ray images. In addition it has significantly reduced the amount of radiation to which a medical patient must be exposed.

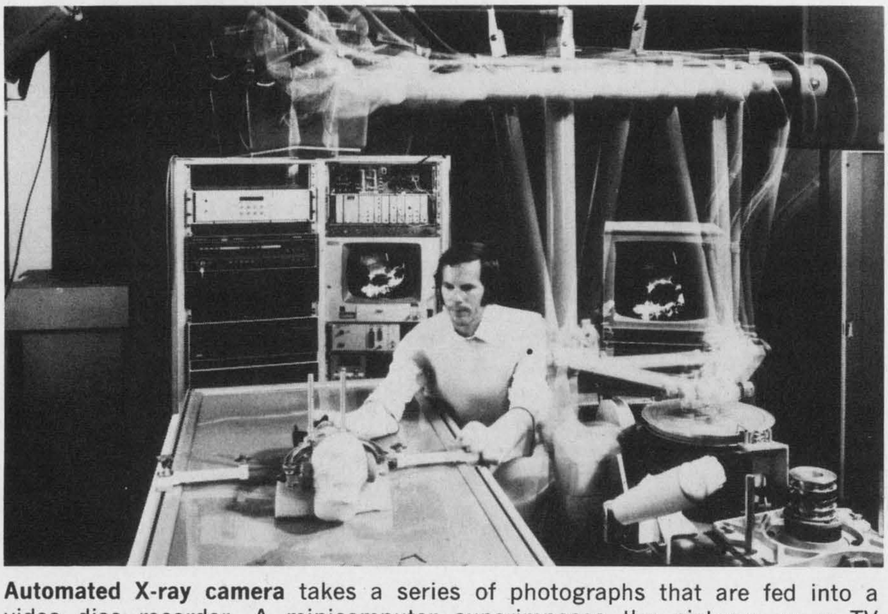
The two techniques include an electronic approach that yields images in minutes and an opto-holographic method that takes longer but produces images of higher quality.

To fabricate a three-dimensional X-ray picture, the Philips researchers first make a series of about 24 X-ray images. This takes only a few seconds. In the electronic technique, the images are stored in a video disc memory. For a sharp picture of a particular human organ or subject, the images are superimposed on one another in a storage tube. The correct position of each image is determined by a minicomputer.

The picture thus synthesized can be recorded on the video disc and displayed on a television screen. This technique can give images of 50 different layers with a single exposure cycle of only a few seconds. Obtaining the same results manually would require 50 X-ray exposures.

In a second method, which yields the higher quality, the first steps are the same as with electronic technique: A series of X-rays is taken. But instead of storing them on a video disc, the images are recorded on film. A hologram is prepared for each image in the series. The holograms are then arranged so their positions correspond to the position of the X-ray tube during the original exposure. By illuminating the entire series of holograms with a laser reference beam, the researchers get a three-dimensional image.

Three-dimensional X-rays are becoming more useful in medical diagnoses—for spotting early tumors or examining defective organs without surgery—but physicians have had to rely on time-consuming manual techniques that haven't changed much since they were first used in the 1930s. Industrial applications for three-dimensional X-rays are also stirring interest—in the locating of defects in critical materials, for example. ■■



Automated X-ray camera takes a series of photographs that are fed into a video disc recorder. A minicomputer superimposes the pictures on a TV storage tube to construct three-dimensional images.

BCD arithmetic, all in a single IC.

Figure on whopping savings in parts, design time, systems costs.

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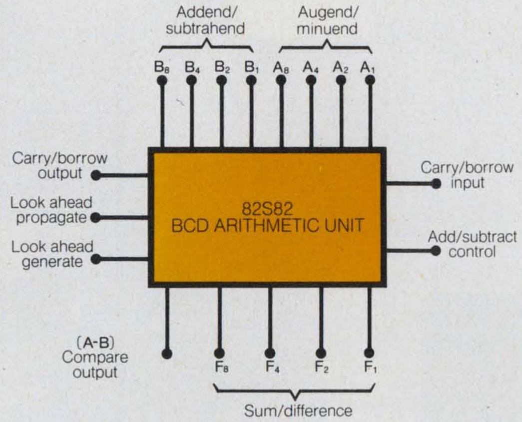
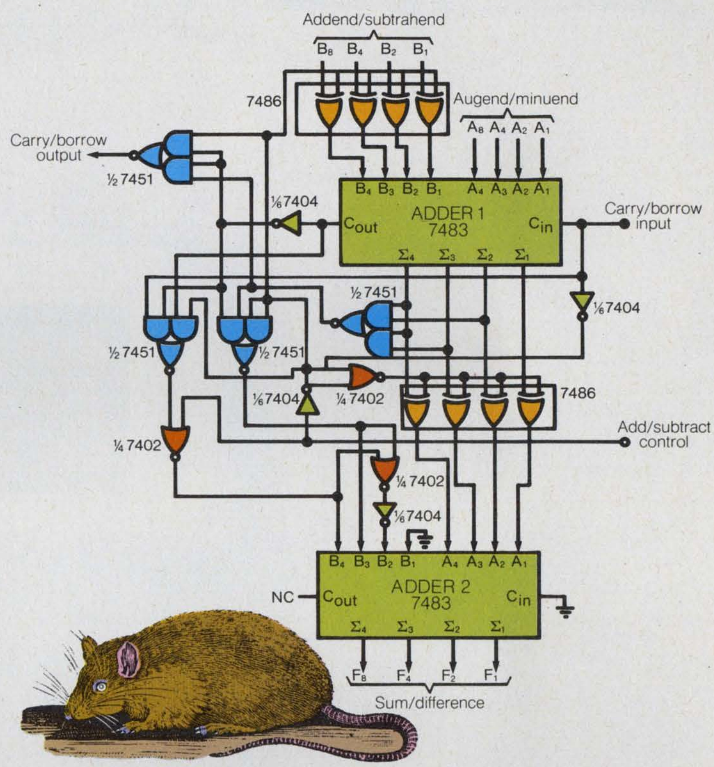


OLD MATH



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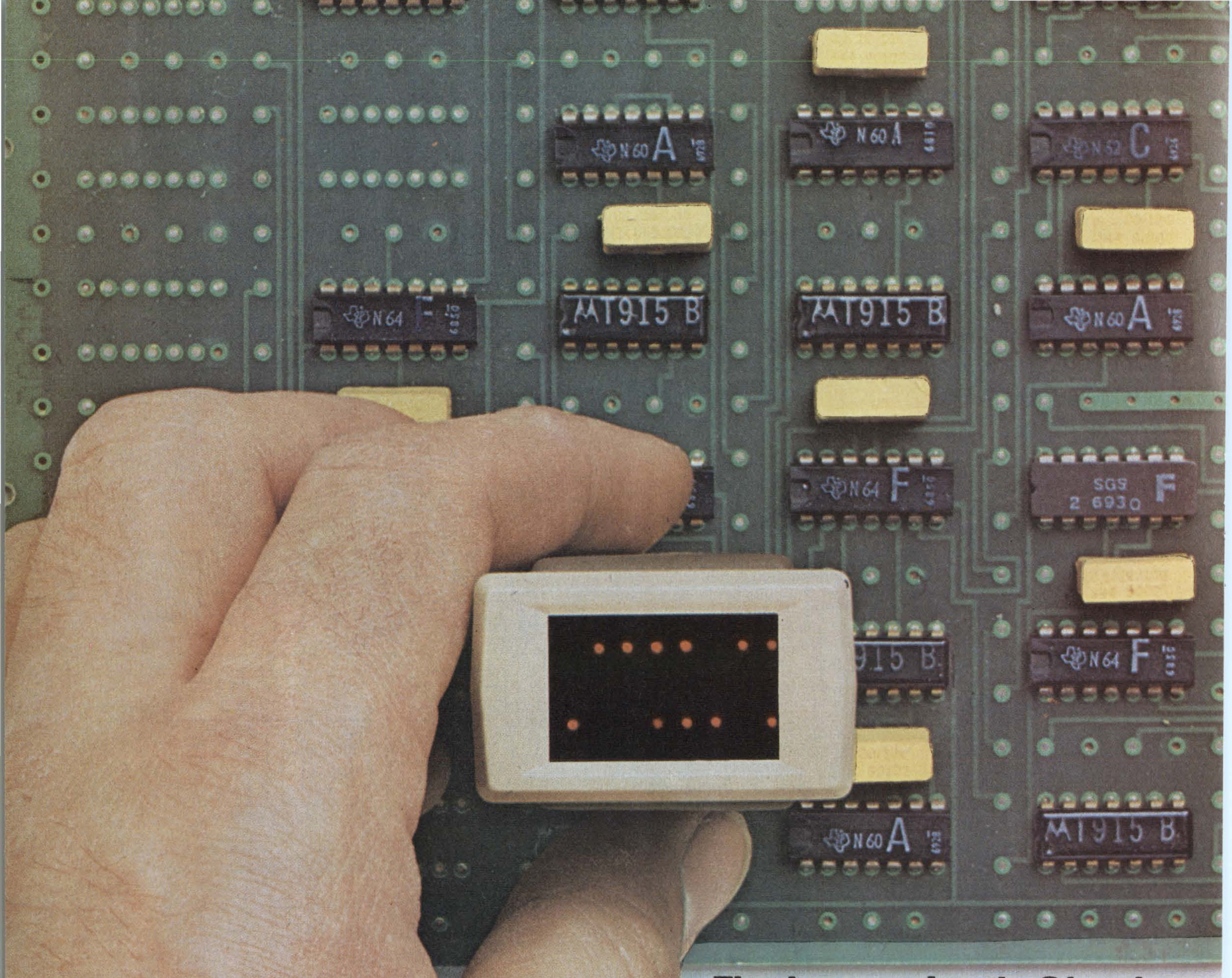

washington report

Heather M. David
Washington Bureau

Defense budget for 1975 climbs sharply

Stalwart Congressional defenders of the military are raising their eyebrows at the \$85.8-billion Pentagon budget for FY 1975. The size of the increase over this year's \$79.5-billion led Sen. John Stennis (D-Miss.), chairman of the Senate Armed Services Committee, to say he was "disappointed" the Pentagon could not keep its budget down. Defense Secretary James Schlesinger told Congress the boost is necessary to meet inflation and to hedge against technological achievements by the Soviets. Within that total is a \$1.4-billion increase for research and development, but Schlesinger said the \$8.4-billion R&D request actually contains a real increase of only \$900-million, the rest going to inflation. Intelligence and communications projects at \$6.5-billion represent a \$600-million increase over FY 1974, but Schlesinger said only \$200-million will go to actual program increases.

Drones, fighters, satellites and missiles

Remotely piloted vehicles and drone programs, which have been proposed for a variety of missions from high altitude reconnaissance to missile launching by all three services, will receive \$127.4-million, an increase of about 30%. The Air Force is planning design studies for modular RPVs with interchangeable body parts, subsystems and payloads, so that they could be adapted for a variety of missions. Some \$25-million in a separate account is also requested for work on a prototype Precision Emitter Location Strike System (Pelss), a system of receivers, beacons, ground control facilities and aircraft or RPVs designed to knock out enemy radars, with IBM as prototype contractor. The Pentagon will try again this year to get Congressional approval for a phased array radar system to provide early warning of a sea-launched ballistic missile attack against the continental U.S. The Air Force is asking \$49.7-million. The service is also seeking \$25.4-million for the NavStar navigation global positioning system and associated ground equipment and control stations.

Both the Air Force and Navy want to start work on new fighter aircraft prototypes. The Air Force, which is already conducting a competitive prototype program for a lightweight fighter (\$22.7-million requested in FY 1975), wants \$36-million for a new highly maneuverable air combat and air-to-ground fighter. The Navy is requesting \$34-million for a supersonic, carrier-based air superiority fighter. The Air Force is also asking \$20-million for a new tanker aircraft that could carry cruise missiles, and \$80-million for a long-range subsonic cruise missile apparently based on the Boeing SCAD. The Navy has earmarked \$45-million for a new strategic cruise missile, and \$33-million for a guidance system for that missile.

The Defense Dept. will devote some \$248-million to programs for increasing the accuracy of strategic ballistic missiles through improved guidance systems. This includes \$20-million for the new Maneuverable Reentry Vehicle (MaRV) system for the Trident missile: \$32-million for research on improved guidance for the Minuteman III missile system; \$25-million for a new higher yield Mark IIIA reentry vehicle for Minuteman III; \$32.5-million for a system to measure the accuracy of Minuteman's multiple reentry vehicles; \$5-million for an advanced ballistic missile reentry vehicle for a mobile missile, and \$19-million for a program to increase the number of reentry vehicles on Minuteman III. Some \$37.3-million is in the new budget for advanced development of a new generation of Air Force ICBMs, called the M-X.

NASA: \$3.3-billion, a few new starts

The National Aeronautics and Space Administration will start three new spaceflight projects with the FY 1975 budget. One, the Pioneer Venus mission, given top priority by scientists, will consist of two spacecraft to be launched in 1978. The first would send probes into the atmosphere of Venus at four locations, the second would orbit the planet to study the characteristics and temporal changes in the atmosphere. Hughes Aircraft has been selected contractor for the Pioneer Venus design. The second new project will be an experimental applications satellite called Seacat, to observe and measure physical characteristics of the oceans. Seacat-A would be launched in 1978 and carry instrumentation to remotely measure sea state, wave height, wind speed, ocean temperatures and other phenomena. The third would be another experimental applications project utilizing a small "Explorer" type satellite to make heat measurements of the earth's surface, for purposes of identifying areas with mineral resources, for construction projects, and for locating geothermal sources for energy. Launch is scheduled for 1977.

Space agency head Dr. James Fletcher said the space shuttle program will slip because of budget problems, which will mean a shift in the first manned orbital flight to the second quarter of 1979. NASA also plans a new earth-bound project with the FY 1975 budget, the construction and installation of the world's largest infrared telescope on Mauna Kea, Hawaii. The new three-meter (120-inch) telescope will be available in 1976. NASA's total funding request is \$3.3-billion, up an inflationary \$100-million from FY 1974. Subtotals in the budget include \$1.124-billion for manned space flight; \$547-million for space sciences; \$177.5-million for space applications; \$241.2-million for aeronautics and space technology and \$250-million for tracking and data acquisition.

DOT: More R&D

Research and development programs of the Dept. of Transportation will increase by 7% in FY 1975, if the Administration plan prevails. The Federal Aviation Administration will have \$70-million for intensified development of advanced aircraft radar beacons and automated flight service stations, as well as the continued development of a microwave landing system. The Federal Railroad Administration will have \$64.2-million for high speed ground transportation research. The Urban Mass Transportation Administration is requesting \$75-million for R&D, an increase of \$8.8-million over FY 1974. The Mitre Corp., under a prime contract from UNTA, will request proposals soon for development of a magnetic card transport to be used in an automatic fare collection system. DOT is also expected to award three contracts soon to define the concept and preliminary design of a new high-performance personnel rapid transit system, and will hold a bidders' conference Mar. 1 in Washington, D.C.

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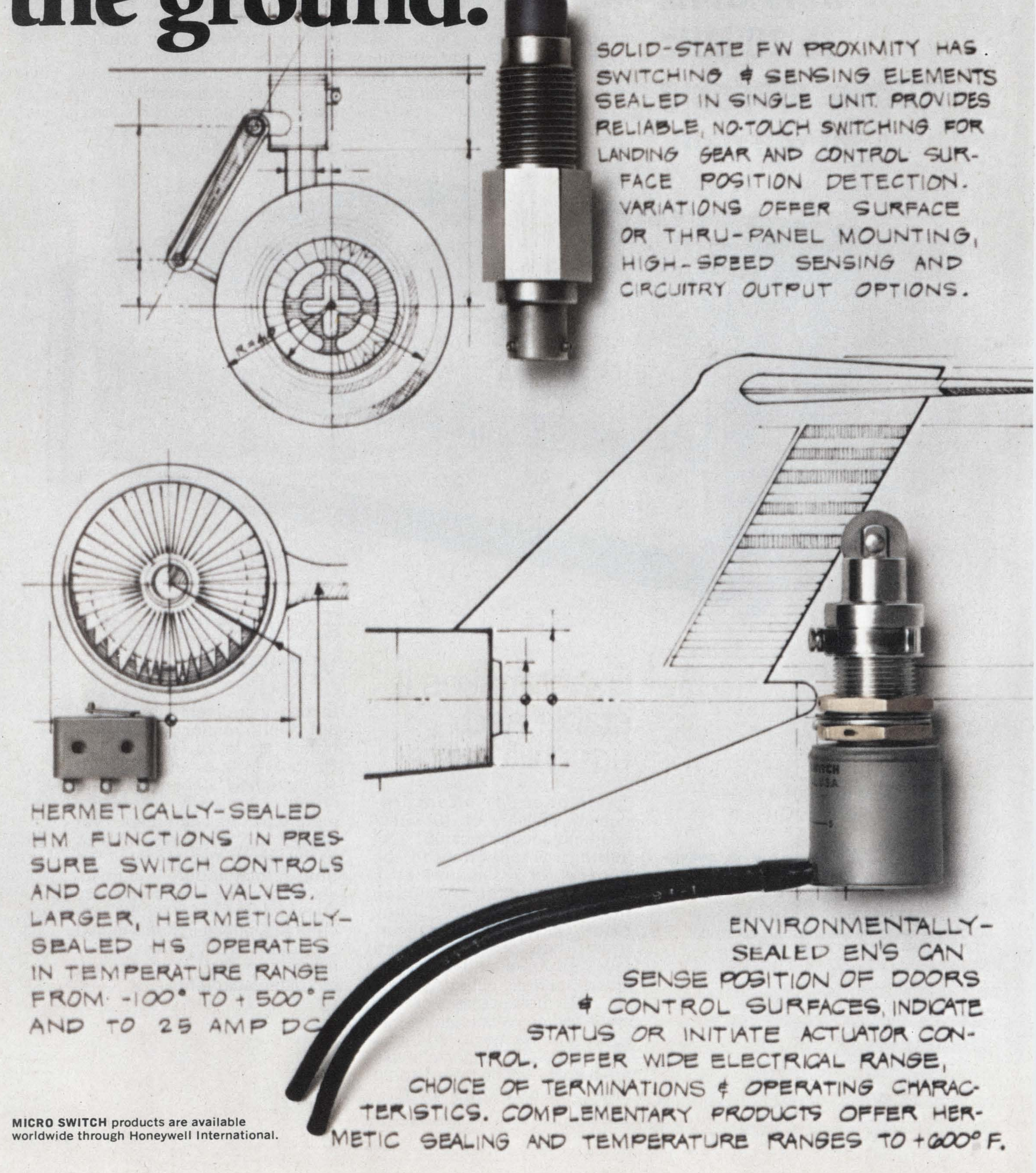

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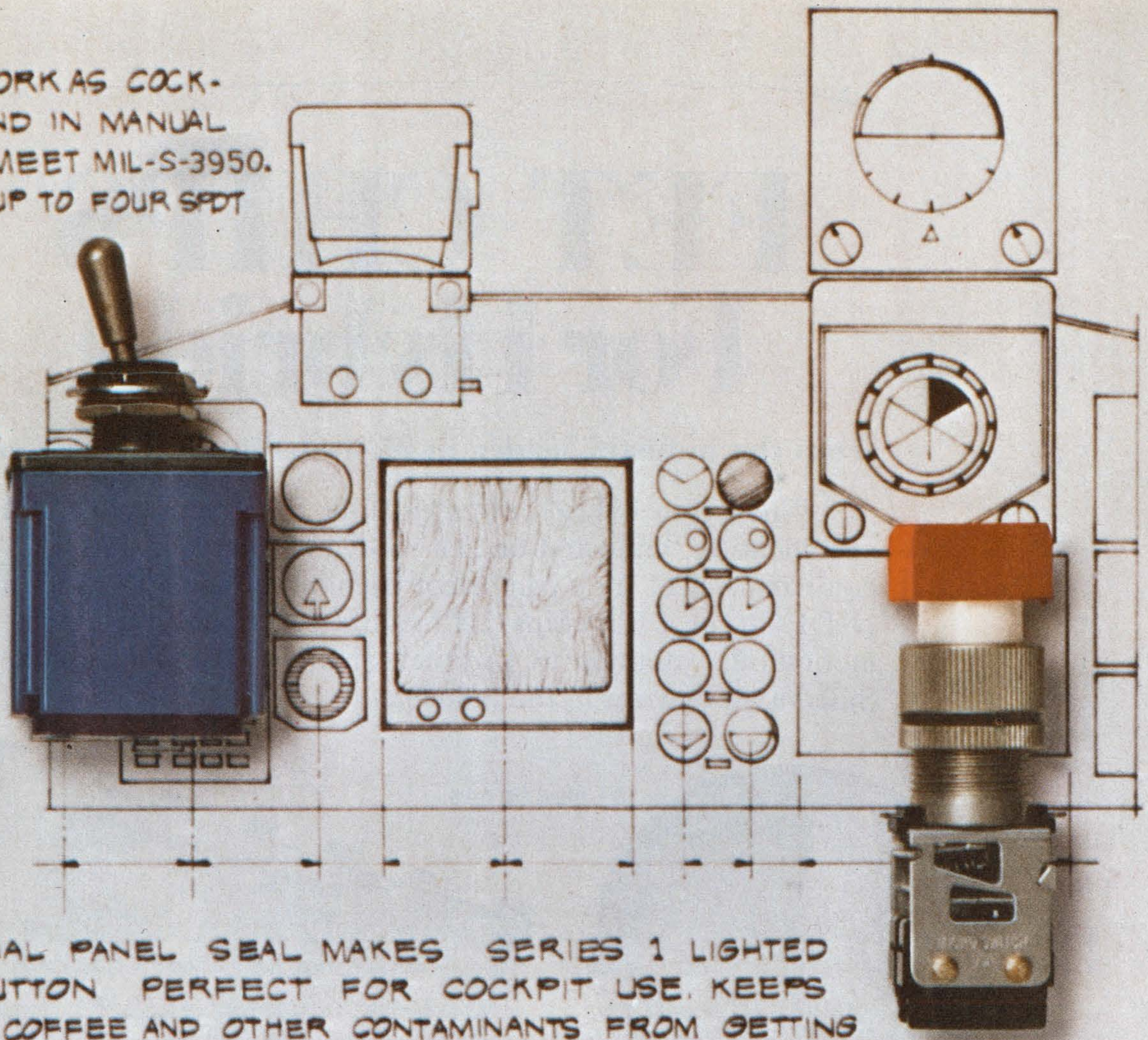

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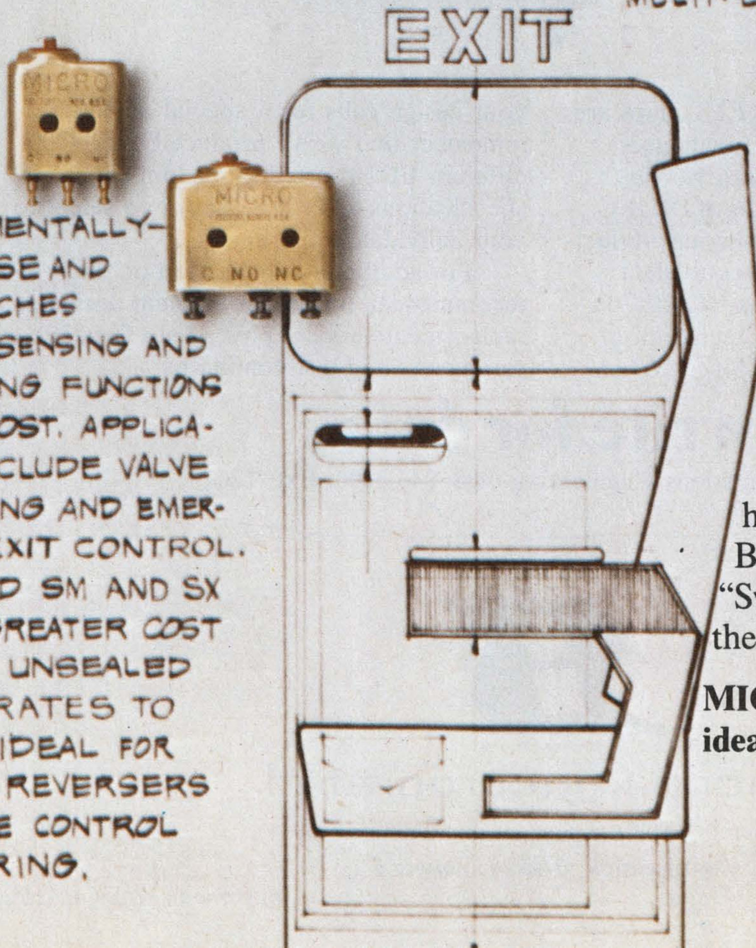

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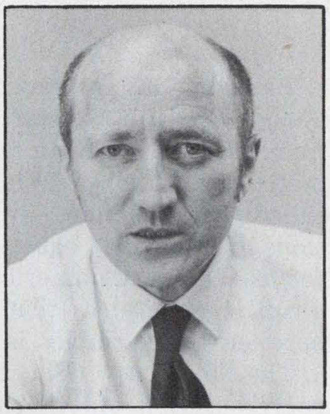
INFOMATION RETRIEVAL NUMBER 28

editorial

The mother-in-law



There's an old story about an executive who justified many of his decisions on the basis of surveys he had conducted. He was always secretive about the nature of the surveys and, particularly, about the group he had surveyed. But after a long succession of decisions proved to be bad he was forced to reveal that he had been surveying the opinions of his mother-in-law.

The story of that sorry executive was no doubt father to the many tales of the ad man who advertised the products of all his clients in *Advertising Age* because everybody he knew read that paper. It never occurred to him that a paper that's widely read and respected by advertising people might not be the best vehicle for selling detergent to housewives, fertilizer to farmers and razors to barbers.

With the wisdom that distance gives, we can all laugh at the myopic ad man who thought his colleagues in advertising were the universe. But in our own profession, how many of us are really free of equivalent decisions? How many of us have never based decisions on mother-in-law surveys?

I know an engineer in the consumer-electronics field who always tries his prototypes on his wife. "If she likes it," he said, "the public will love it." Another fellow I know—a test-equipment designer—would bring home a prototype of a new instrument, explain its function to his teen age daughter, then see if she could figure out how to use it. And dozens of engineers check their more subjective design decisions with their secretaries, girl friends, bridge partners and quaffing buddies.

There are some questions, of course, that don't have absolute answers. But all opinions aren't equal. If you want some worth while opinions on the relative merits of Enrico Caruso and Jussi Bjorling, you should survey opera lovers. If you want views on John Gielgud and Ralph Richardson, ask theater goers. And if you want ideas on a magnificent Bordeaux and a fabled Burgundy, check some wine buffs.

Decisions on which readout looks best, which panel color is most pleasing or which knob has the best appearance and feel will always involve some difference of opinion. But let's at least recognize the limitations of our research.

George Rostky
Editor-in-Chief

Match impedances accurately and easily.

The Mac chart gives quick approximate values, and an equivalent computer program adds numerical accuracy.

By using an interactive computer program—along with a McAlister chart—you can achieve numerical accuracy in the design of impedance-matching networks. While the chart—familiarly called the Mac chart[1]—provides easy approximations of network equations, the computer performs the exact numerical calculations. The program logic ensures that the proper relationship between the variables is maintained.

The Mac chart (Fig. 1a) provides a graphical representation of two-element series or parallel networks that have equal driving-point impedances (see box). The curves display the relationships between five quantities—R_p, R_s, X_p, X_s and Q. The location of any two variables on the chart yields values for the three others. Similarly the program (Fig. 1b) accepts any two quantities if they satisfy the same mathematical constraints, and it also calculates the three other quantities. No series-parallel calculations are necessary for an approximate solution with the Mac chart. However, if greater accuracy is required, the program, which uses the defining equations of the chart, can perform the required transformations.

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Consider, for example, the design of a π network that matches 500 Ω to 50 Ω with an overall Q of at least 10 (Fig. 2). Assume a Q of 10 and an R_p of 500 Ω. Enter the chart at A and find that R_s = 5 Ω and X_s = 50 Ω. And from point A, find that X_p = 50 Ω.

Now let's do the same step on the computer. Type NO to the two questions in Fig. 1b, then enter the same values for Q and R_p. Almost immediately you get the answer: R_s = 4.950 Ω, X_s = 49.505 Ω, and X_p = 50 Ω. To match the 5-Ω series resistor, use a parallel-to-series transformation on the left half of the network. Enter the chart at point B (R_s = 5 Ω, R_p = 50 Ω) and find that X_s = 15 Ω and X_p = 17 Ω. An answer of YES to the "parallel and series" mixture question shows that X_s = 14.933 Ω and furnishes values for X_p and Q of 16.574 Ω and 3.02, respectively.

Transformation equations

A series combination of resistance and reactance can always be found that exhibits the same equivalent impedance as any given parallel combination of resistance and reactance.

The transformations give the relationship between the elements of the series and parallel networks (shown below) when the driving-point impedances are equal. The equations for the respective impedances are

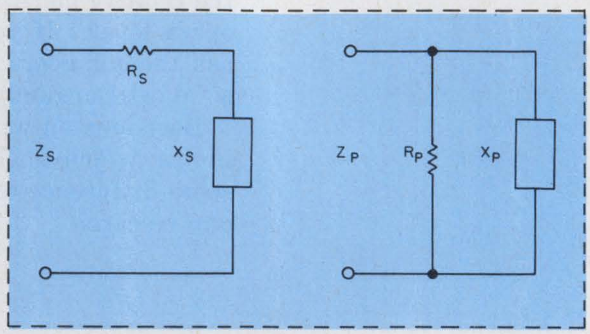
$$Z_p = \frac{R_p \cdot (jX_p)}{R_p + jX_p},$$

$$Z_s = R_s + jX_s.$$

Equating the real and imaginary parts of both expressions for network equivalency yields

$$R_s = \frac{R_p X_p^2}{R_p^2 + X_p^2},$$

$$X_s = \frac{R_p^2 X_p}{R_p^2 + X_p^2}.$$



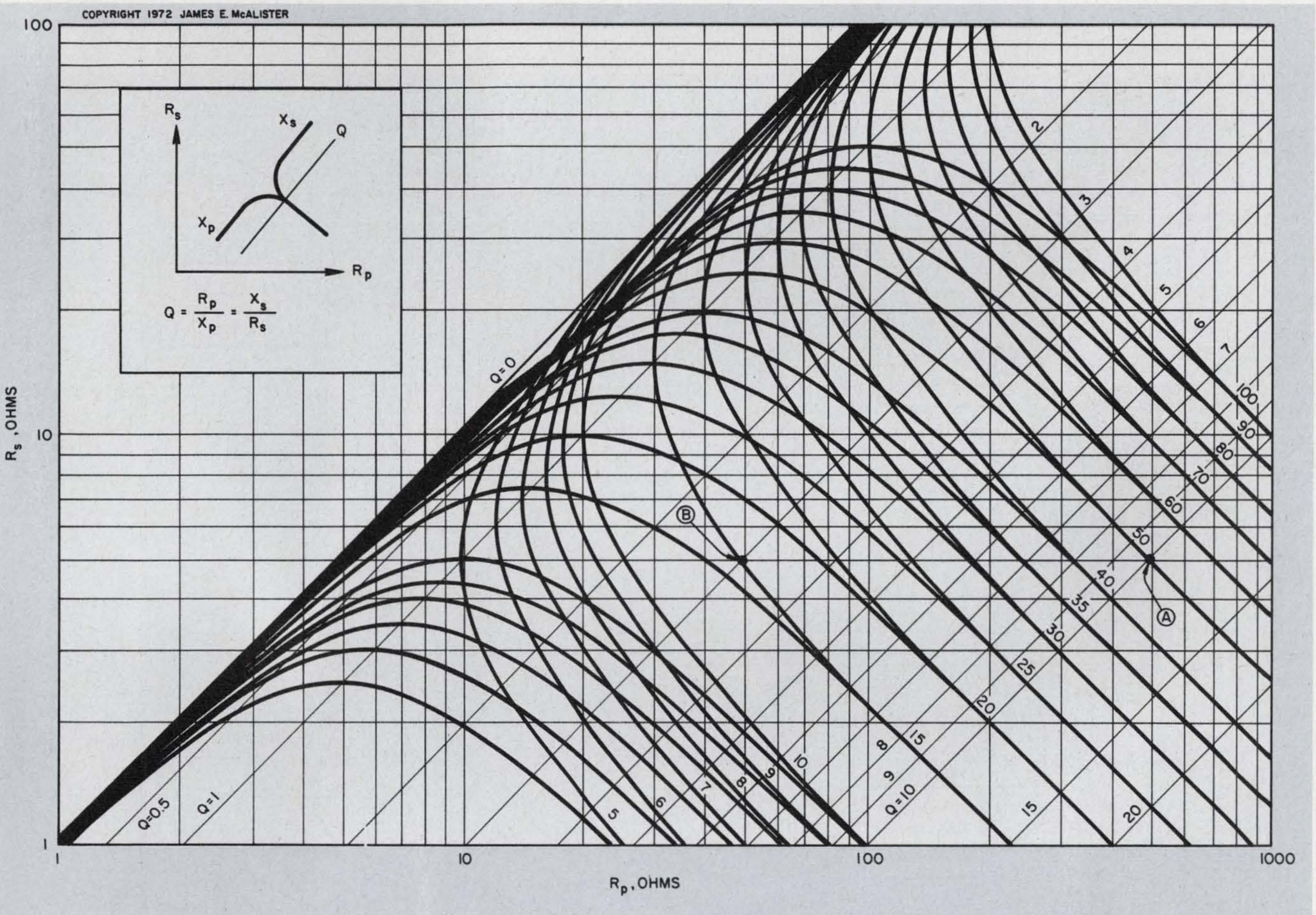
This simplifies to

$$R_p = R_s\,[1 + (R_p/X_p)^2],$$

$$X_p = X_s\,[1 + (X_p/R_p)^2].$$

It can also be shown that

$$\frac{R_p}{X_p} = \frac{X_s}{R_s} = Q.$$



(a)

CHART POINT Ⓐ

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?LØAD (EASY 42) EASY 41

DØ YØU WISH SERIES - PARALLEL TRANSFØRMATIØN ?! NØ

DØ YØU WISH TØ MIX PARALLEL & SERIES
RESISTANCES ØR REACTANCES ?! NØ

ENTER Q,RP,XP ENTER 0.0 IF NØT KNØWN!  10.0,500.0,0.0

RS=     4.950 ØHMS    XS=    49.505  ØHMS   XP=    50.000 ØHMS
STOP,   NORMAL
```

(b)

CHART POINT Ⓑ

```
?RUN EASY 42

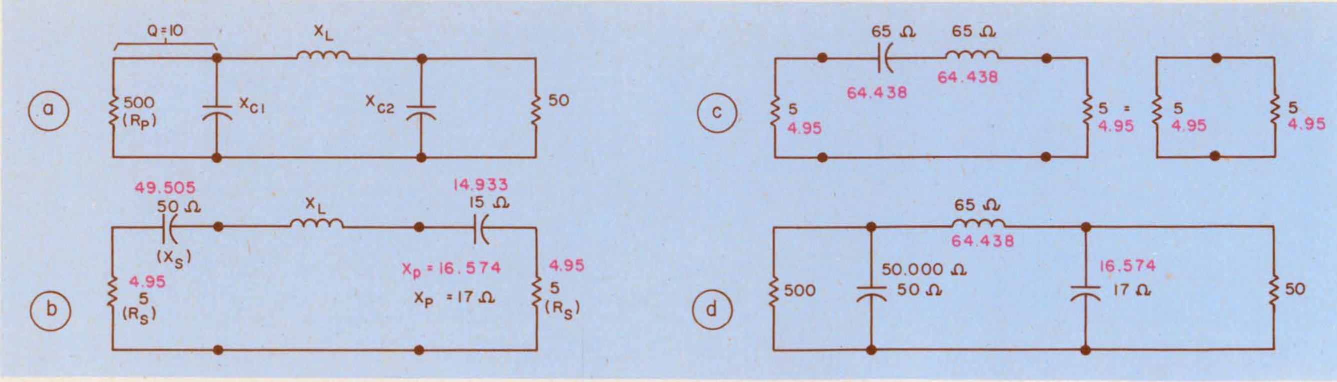
DØ YØU WISH SERIES - PARALLEL TRANSFØRMATIØN ?! NØ

DØ YØU WISH TØ MIX PARALLEL & SERIES
RESISTANCES ØR REACTANCES ?! YES

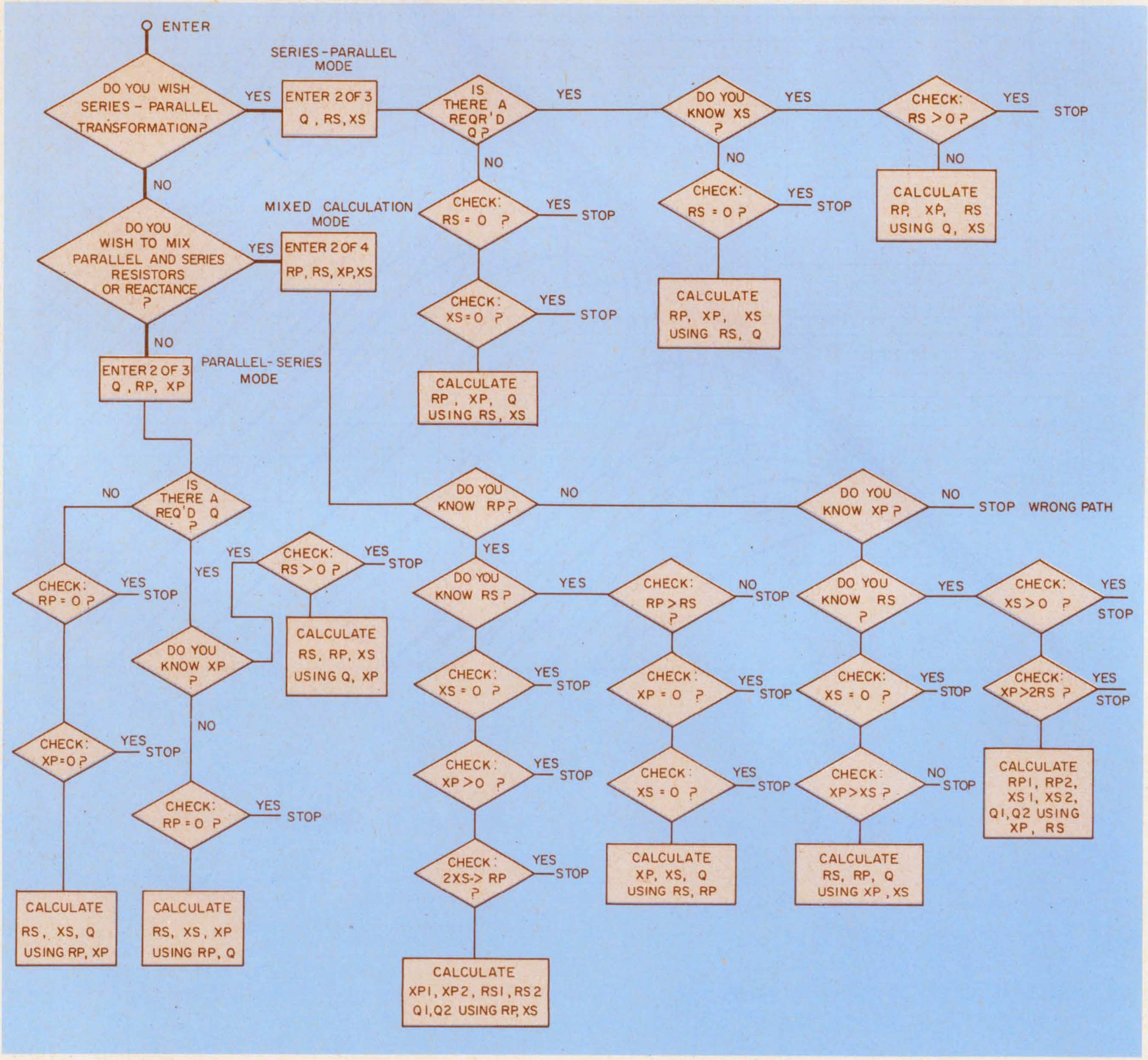
ENTER RP,RS,XP,XS ENTER 0.0 IF NOT KNOWN!  50.0,4.95,0.0,0.0,

XS=    14.933 OHMS   XP=      16.574 OHMS   Q=  3.02
STOP,  NORMAL
```

1. **Family of curves (a) represents** the transformation equations that give equal driving-point impedance for two-element series or parallel networks. The chart can be entered with any two circuit quantities and the three others can be determined. The computer program (b) provides exact values, instead of approximations, for the same input data. The program uses the defining equations of the chart.



2. **A π network problem** (a) is solved with two parallel-to-series transformations (b,c). The value of inductance is chosen to cancel the capacitive reactance (c). Values found from the chart are shown in black; computed values from the program are in color. Just two executions of the program solve this problem.



3. **The program subdivides the calculations** into three categories: series-parallel, mixed and parallel-series. The proper category is selected by typing YE or YES at the appropriate decision point. Extensive validity checks of the input data are made before the actual calculations are performed. All calculations use two input variables, and an input of zero designates an unknown variable to the program.

Last of all, the choice of 64.438 Ω for X_L cancels the equivalent reactance of the two capacitors and so completes the solution of the design problem.

The Fortran program offers the user three types of network calculation, series-parallel transformation, mixed calculation and parallel-series transformation. Either of the first two modes is selected by typing YE or YES when the corresponding two questions are printed out. The third mode occurs by default when anything but a YE or YES response is given twice. Once a particular mode is entered, the program performs a series of validity checks before the calculation is performed. An input of 0.0 informs the program that the value of the corresponding variable is unknown. Also, the program prompts the user with statements that define which variables are to be inputted.

A number of built-in safeguards cause the program to halt. Too much information is unacceptable, and certain interrelations between variables must be maintained. For instance, R_s must be less than R_p. The Mac chart displays these requirements, which are also designed into the program as "STOP ABNORMAL" statements. ■■

Reference:

1. McAlister, James E., "The Easy Way to Match Impedances," *Electronic Design*, Mar. 1, 1973, pp. 76-78.

Time-shared Fortran program for series/parallel impedance transformations

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FORTRAN FILE: EASY10/631       12/04/73     10:39 CT PAGE   1

* JOHN F STORM EXT 5867 A1681
* THIS PROGRAM PROVIDES SERIES - PARALLEL
* OR PARALLEL - SERIES TRANSFORMATION
      JA = 'YE'
      WRITE (9,1)
    1 FORMAT ('DO YOU WISH SERIES - PARALLEL TRANSFORMATION ?')
      READ (9,2) IANS
    2 FORMAT (A2)
      IF (IANS.EQ.JA) GO TO 100
*
      WRITE (9,19)
   19 FORMAT ('DO YOU WISH TO MIX PARALLEL & SERIES'/
     +'RESISTANCES OR REACTANCES ?')
      READ (9,20) IANS
   20 FORMAT (A2)
      IF (IANS.EQ.JA) GO TO 200
*
      WRITE (9,3)
    3 FORMAT ('ENTER Q,RP,XP ENTER 0.0 IF NOT KNOWN')
      READ (9,4) Q,RP,XP
    4 FORMAT (3F10.3)
      IF (Q.GT.0.0) GO TO 18
      IF (RP.EQ.0.0) STOP RP MISSING
      IF (XP.EQ.0.0) STOP XP MISSING
      RS=(RP*(XP**2))/((RP**2)+(XP**2))
      XS=((RP**2)*XP)/((RP**2)+(XP**2))
      Q=RP/XP
      WRITE (9,5) RS,XS,Q
    5 FORMAT ('RS=',F10.3,' OHMS',3X,'XS=',F10.3,' OHMS',
     +3X,'Q=',F6.2)
      STOP NORMAL

   18 IF (XP.GT.0.0) GO TO 7
      IF (RP.EQ.0.0) STOP RP MISSING
      XP=RP/Q
      RS=(RP*(XP**2))/((RP**2)+(XP**2))
      XS=((RP**2)*XP)/((RP**2)+(XP**2))
      WRITE (9,6) RS,XS,XP
    6 FORMAT ('RS=',F10.3,' OHMS',3X,'XS=',F10.3,' OHMS',
     +4X,'XP=',F10.3,' OHMS')
      STOP NORMAL

    7 IF (RP.GT.0.0) STOP ABNORMAL
      RP=Q*XP
      RS=(RP*(XP**2))/((RP**2)+(XP**2))
      XS=((RP**2)*XP)/((RP**2)+(XP**2))
      WRITE (9,8) RS,XS,RP
    8 FORMAT ('RS=',F10.3,' OHMS',3X,'XS=',F10.3,' OHMS',
     +4X,'RP=',F10.3,' OHMS')
      STOP NORMAL

  100 WRITE (9,9)
    9 FORMAT ('ENTER Q,RS,XS ENTER 0.0 IF NOT KNOWN')
      READ (9,10) Q,RS,XS
   10 FORMAT (3F10.3)
      IF (Q.GT.0.0) GO TO 12
      IF (RS.EQ.0.0) STOP RS MISSING
      IF (XS.EQ.0.0) STOP XS MISSING
      RP=((XS**2)+(RS**2))/RS
      XP=RP*RS/XS


FORTRAN FILE: EASY10/631       12/04/73     10:39 CT PAGE   2

      Q=XS/RS
      WRITE (9,11) RP,XP,Q
   11 FORMAT ('RP=',F10.3,' OHMS',3X,'XP=',F10.3,' OHMS',
     +3X,'Q=',F6.2)
      STOP NORMAL

   12 IF (XS.GT.0.0) GO TO 14
      IF (RS.EQ.0.0) STOP RS MISSING
      XS=Q*RS
      RP=((XS**2)+(RS**2))/RS
      XP=RP*RS/XS
      WRITE (9,13) RP,XP,XS
   13 FORMAT ('RP=',F10.3,' OHMS',3X,'XP=',F10.3,' OHMS',
     +4X,'XS=',F10.3,' OHMS')
      STOP NORMAL

   14 IF (RS.GT.0.0) STOP ABNORMAL
      RS=XS/Q
      RP=((XS**2)+(RS**2))/RS
      XP=RP*RS/XS
      WRITE (9,15) RP,XP,RS
   15 FORMAT ('RP=',F10.3,' OHMS',3X,'XP=',F10.3,' OHMS',
     +3X,'RS=',F10.3,' OHMS')
      STOP NORMAL

  200 WRITE (9,21)
   21 FORMAT ('ENTER RP,RS,XP,XS ENTER 0.0 IF NOT KNOWN')
      READ (9,22) RP,RS,XP,XS
   22 FORMAT (4F10.3)
      IF (RP.GT.0.0) GO TO 23
      GO TO 29

   23 IF (RS.GT.0.0) GO TO 24
      IF (XS.EQ.0.0) STOP XS MISSING
      IF (XP.GT.0.0) STOP ABNORMAL
      IF (RP-2.0*XS) 17,27,27

   24 IF (RS-RP) 25,17,17

   25 IF (XP.GT.0.0) STOP ABNORMAL
      IF (XS.GT.0.0) STOP ABNORMAL
      XS = SQRT (RP*RS-RS**2)
      XP = SQRT (RS*(RP**2))/(RP-RS)
      Q = RP/XP
      WRITE (9,26) XS,XP,Q
   26 FORMAT ('XS=',F10.3,' OHMS',3X,'XP=',F10.3,' OHMS',
     +3X,'Q=',F6.2)
      STOP NORMAL

   27 RS1 =RP/2.0 +SQRT(RP**2-4.0*(XS**2))/2.0
      RS2 =RP/2.0 -SQRT(RP**2-4.0*(XS**2))/2.0
      XP1 =((XS**2)+(RS1**2))/XS
      XP2 =((XS**2)+(RS2**2))/XS
      Q1 = XS/RS1
      Q2 = XS/RS2
      WRITE (9,28) RS1,XP1,Q1,RS2,XP2,Q2
   28 FORMAT ('RS1=',F10.3,' OHMS',3X,'XP1=',F10.3,' OHMS',
     +3X,'Q1=',F6.3/'RS2=',F10.3,' OHMS',3X,'XP2=',F10.3,' OHMS',
     +3X,'Q2=',F6.2)
      STOP NORMAL


FORTRAN FILE: EASY10/631       12/04/73     10:39 CT PAGE   3

   29 IF (XP.EQ.0.0) STOP WRONG PATH
      IF (RS.GT.0.0) GO TO 30
      IF (XS.EQ.0.0) STOP XS MISSING
      IF (XP-XS) 17,17,33

   33 RS=SQRT(XP*XS-XS**2)
      RP=SQRT((XS*(XP**2))/(XP-XS))
      Q=RP/XP
      WRITE (9,34) RS,RP,Q
   34 FORMAT('RS=',F10.3,' OHMS',3X,'RP=',F10.3,' OHMS',
     +3X,'Q=',F6.2)
      STOP NORMAL

   30 IF (XS.GT.0.0) STOP ABNORMAL
      IF (XP-2*RS) 17,31,31

   31 RP1=((XP**2)/2.0)*(1.0+SQRT(1.0-4.0*(RS**2)/(XP**2)))
      RP2=((XP**2)/2.0)*(1.0-SQRT(1.0-4.0*(RS**2)/(XP**2)))
      XS1=((RP1**2)*XP)/((RP1**2)+(XP**2))
      XS2=((RP2**2)*XP)/((RP2**2)+(XP**2))
      Q1=XS1/RS
      Q2=XS2/RS
      WRITE (9,32) RP1,XS1,Q1,RP2,XS2,Q2
   32 FORMAT ('RP1=',F10.3,' OHMS',3X,'XS1=',F10.3,' OHMS',
     +3X,'Q1='F6.2/'RP2=',F10.3,' OHMS',3X,'XS2=',F10.3,' OHMS',
     +3X,'Q2='F6.2)
   16 STOP NORMAL

   17 STOP ABNORMAL

      END
```

Try condition/action diagrams to lighten your design load. They can help you untangle complex interactions between system parameters.

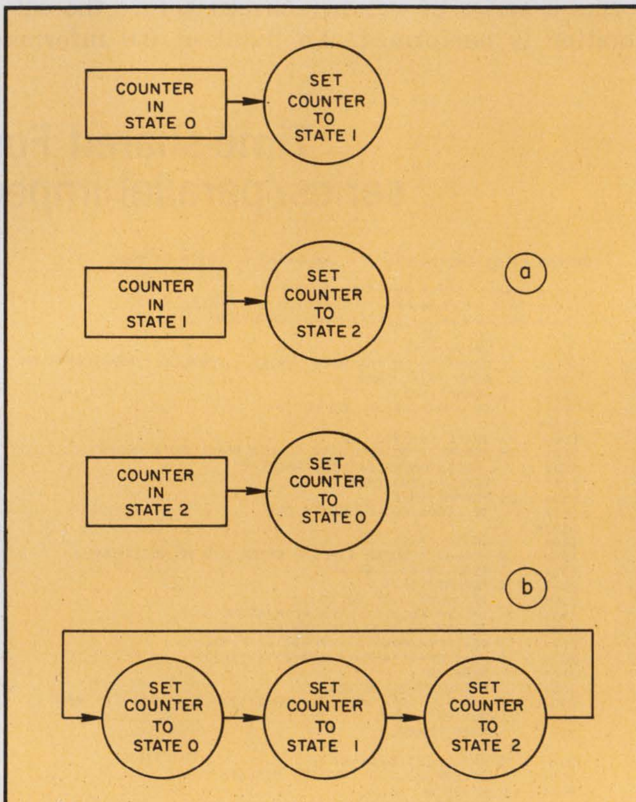
You're designing a complicated system, and you want to see how the various parts of the system interact. Don't start by trying to draw a detailed and confusing schematic. Instead, draw a condition/action diagram—also called a C/A diagram—and you've got the picture clearly, simply and rapidly. These diagrams are similar to—but more general than—the familiar flow chart used in computer programming.

Though the C/A's forte is its ability to portray the interactions of a large number of variables, it offers other advantages as well.

For one, C/A diagrams use standard English, so that you don't have to wade through detailed schematics or diagrams that overflow with unfamiliar jargon. For another, a C/A can often pinpoint troubles in a system. Perhaps more significantly, a C/A is useful when you try out new ideas, since it can accurately predict the consequences of making a change.

Furthermore, C/A diagrams find application not just in design but in the generation and portrayal of organizational procedures as well.

The diagrams have been used successfully to design digital voltmeters and MOS/LSI testers. And the diagrams have also helped in working out procedures in such areas as order handling, shipping, quality control, people-machine interfacing, and scheduling of R&D programs. Let's see how C/As are constructed.



1. **Condition/action diagrams for a simple counter** are drawn without circle outputs (a) and with circle outputs (b). The two methods are equivalent.

Conditions lead to actions

The operation of many systems—for example, digital computers—can be described in terms of two classes of parameters: conditions and actions. In these systems, conditions cause certain actions, which, in turn, bring about new conditions.

In C/A diagrams, condition statements are enclosed in rectangles, action statements are enclosed in circles, and lines are used to interconnect the two. Each line has one arrowhead; an arrowhead that bears against a rectangle or a circle denotes an input, while the end of a line opposite from the arrowhead denotes an output.

A rectangle may have no input at all, but is limited to no more than one input and one output. A circle, on the other hand, can have as many inputs as desired.

Rectangles connected in cascade denote the AND function, whereas rectangles connected in parallel denote the OR function. Multiple inputs to a circle also denote the OR, and any one of the inputs can cause the indicated action. Some elementary C/A diagrams, together with their meanings, are shown in the table.

Outputs from circles are not essential in C/As. Any set of conditions and actions can be dia-

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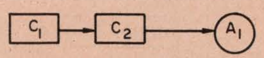
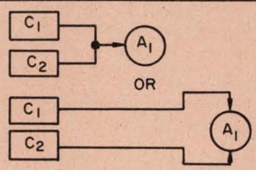
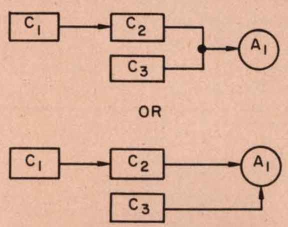
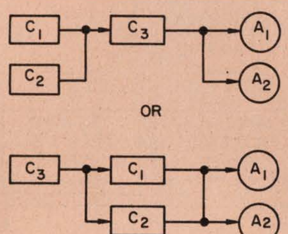
Table. Elementary condition/action diagrams and their meanings

	IF CONDITIONS C_1 AND C_2 EXIST SIMULTANEOUSLY, PERFORM ACTION A_1.
	IF CONDITION C_1 OR C_2 EXISTS, PERFORM ACTION A_1.
	IF CONDITIONS C_1 AND C_2 EXIST SIMULTANEOUSLY, OR IF CONDITION C_3 EXISTS, PERFORM ACTION A_1.
	IF CONDITION C_1 OR C_2 EXISTS SIMULTANEOUSLY WITH CONDITION C_3, PERFORM ACTIONS A_1 AND A_2.

grammed without them. However, defined in a special way, outputs from circles can save space, while clarifying the path to be followed in a sequence of events.

A circle can have no more than one output. And when an output is present, the output is treated as though it were attached to a condition rectangle. In this case, however, the condition is that which results from the action indicated in the circle. A simple example should clarify this concept:

Fig. 1a shows a C/A for a simple counter, in which outputs from circles are not used. Another C/A—for the same counter—does use outputs from circles (Fig. 1b), but is equivalent to the C/A of Fig. 1a.

These are all the rules needed to construct and interpret condition/action diagrams. To show how the rules are used in a practical application, let's look at a C/A for a digital voltmeter (Fig. 2).

C/A for DVM demonstrates technique

In this DVM, measurement is started in one of three ways, as determined by the setting of a front panel control:

If the control is set to INTERNAL, measurement starts internally. As soon as the measurement is complete, a new one starts. If the control is set to EXTERNAL, the user starts a measurement by supplying an external command signal. If the control is set to STANDBY, no measurement takes place. Finally, if the control is moved from STANDBY to SINGLE and back to STANDBY, a single measurement is made.

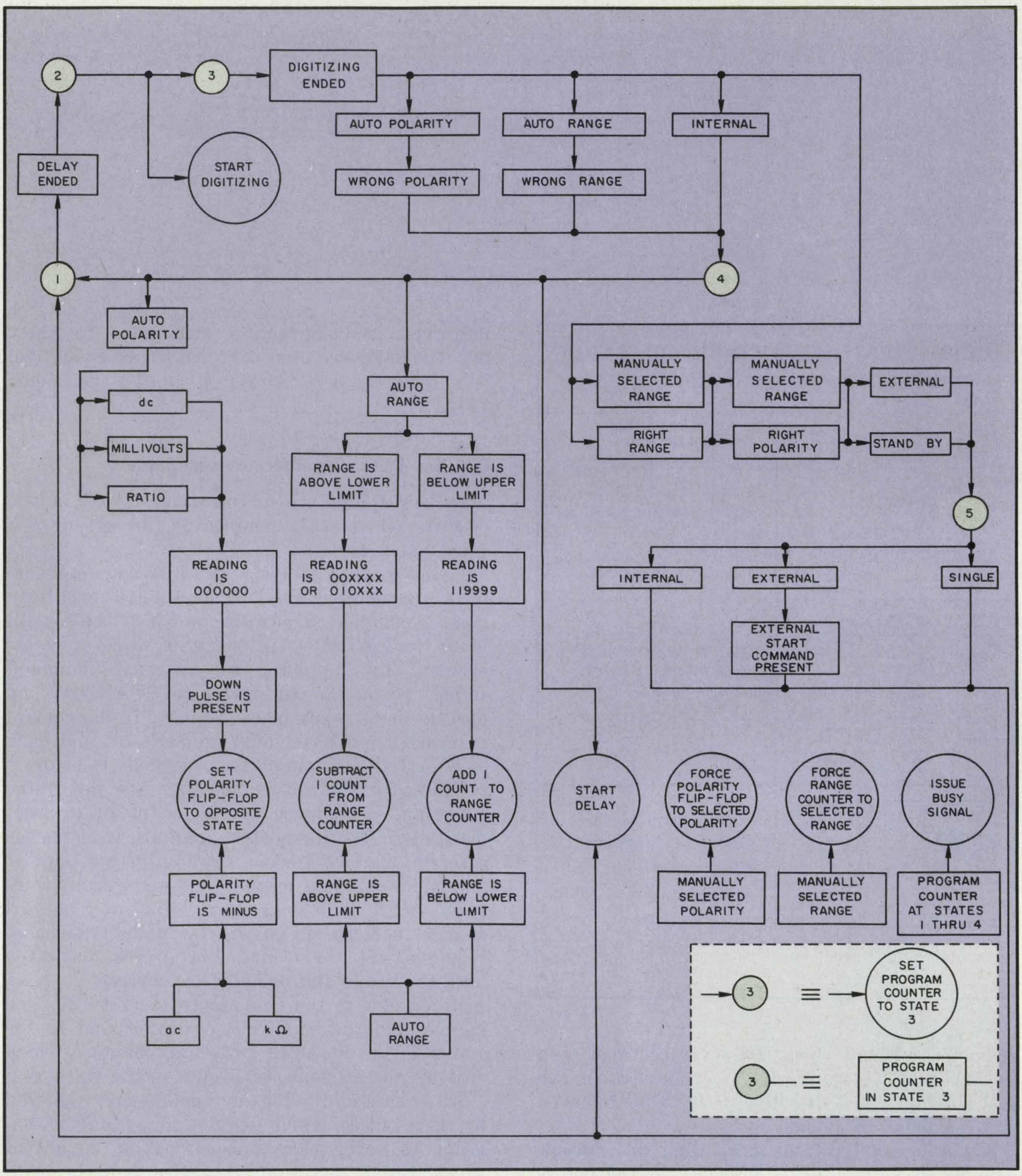
Other controls either let the user determine range and polarity or set the voltmeter to automatically make these determinations. In the latter case, the meter takes one reading upon receipt of a start signal. This reading is automatically compared with built-in criteria, and any needed change in range or polarity is made. Additional readings are taken and the process repeated until the range and polarity are correct.

Refer now to the C/A diagram (Fig. 2). The numbers in the small circles correspond to the states of a five-state program counter, which controls the sequence of events in the voltmeter.

All counters, flip-flops and delays are triggered by clock pulses, which are not shown on the diagram. However, clock pulses may be thought of as additional condition rectangles in series with each action-circle input.

Program states 1 through 4 are used when the voltmeter is started internally. On EXTERNAL or SINGLE, all five states of the program counter are used, where state 5 is the "home," or start, position of the counter. Let's begin at state 5 and use the C/A to run through all the meter sequences.

The conditions involved in the state-5-to-state-1 transition concern the ways in which a measurement is started. When the mode switch is set



2. **Digital voltmeter C/A diagram** portrays the instrument's operation and the various internal interactions in an effective and simple way. The figure in the corner illustrates equivalent diagram blocks.

to INTERNAL or SINGLE, the program counter immediately progresses to state 1. However, when the mode switch is set to EXTERNAL, an additional condition is required before the program counter can progress to state 1. This condition is the presence of the external start command.

Notice that in addition to the path from state 5 to state 1, there is also a path through the same conditions to an action circle entitled "start delay." This means that a delay will begin every time the transition from state 5 to 1 occurs. The purpose of the delay is to allow time for the signal-conditioning input buffer to settle. The transition from state 1 to state 2 occurs when the delay has ended.

The action circle in the lower right-hand corner of the diagram shows that a busy signal is issued whenever the program counter is in states 1 through 4. The busy signal indicates that a measurement is in progress but is not yet complete. As long as the busy signal is present, the DVM output should not be used to operate a recorder.

Since there are no conditions interposed between states 2 and 3, the program counter will progress immediately from 2 to 3. The same clock pulse that sets the counter to state 3 also starts the digitizing process.

When the program counter reaches state 3, a fork-in-the-road situation exists. Under some conditions, the counter is set to state 4. Under other conditions, it is set to state 5.

There are three paths through which the transition from state 3 to 4 can occur. All three include the condition "digitizing ended." If the polarity-selection switch is set to AUTO POLARITY, and if the polarity displayed in the readout is incorrect, the program counter will then be set to state 4.

If the range-selection switch is set to AUTO RANGE, and if the range displayed in the readout is incorrect, the program counter will again be set to state 4. Finally, if the mode switch is set to INTERNAL, the program counter will be set to state 4.

Any change required in range or polarity is normally accomplished during the state-4-to-state-1 transition. To allow the input buffer to settle, the delay also begins.

Notice that below the action circles associated with range and polarity changes are conditions that are not tied to the program counter. These make it possible to change range whenever the range limits for the function being measured are exceeded. When the function is either kΩ or ac, the polarity flip-flop is set to plus.

If the mode switch is set to INTERNAL, the program counter continues to traverse the loop consisting of states 1 through 4. If the mode switch is not set to INTERNAL, the counter traverses 1 through 4 until a condition path exists between states 3 and 5. This path must consist of all of the following conditions:

- Digitizing ended.
- Range counter set to the correct range, or range-selection control set to MANUAL.
- Polarity flip-flop set to the correct polarity or the polarity-selection control set to MANUAL.
- Mode switch set to EXTERNAL or STANDBY.

With the return of the program counter to state 5, the busy signal disappears, thus indicating that the measurement is complete and that the results are suitable for printout. ■■

Choose cleaning solvents carefully.

Engineers often use or specify chemical solvents for cleaning electronic equipment. But not all are mindful of the hazards.

Removing dirt from a switch contact, flux from a soldered assembly, grease from a machined part or etching residues from a PC board—all are common enough in electronic engineering. All are also potentially hazardous tasks—a fact that engineers often forget.

The hazard varies from comparatively great to minimal, depending on the cleaning agent used. It's important to understand, therefore, the nature and properties of the common agents to remove personnel hazards and avoid damage to the cleaned parts.

First check the contamination

There are two general types of contamination: ionic (or chemically polar) and nonionic (or nonpolar). Each requires different cleaning solvents. Examples of ionic contaminants include residues of plating salts, perspiration and skin salts from handling of parts and from acid-flux residues. Common nonionic contaminants include dirty grease and oil, and rosin soldering flux (Table 1). Some often overlooked sources of nonionic contamination are hair sprays and makeup, and hand lotions used by electronic assemblers and wirers.

Ionic contaminants, such as fingerprints that contain perspiration salts, can cause corrosion when combined with moisture. Such ionic solutions destroy metals, especially the more reactive ones like aluminum, and they may produce electrical shorts and elusive leakage paths.

Though nonionic contaminants like oil, grease and wax can cause problems by themselves, far worse is their flypaper-like attraction for lint, dirt and ionic contaminants. Combined with moisture, such trapped particles produce a nasty corrosive mixture and tricky electrical leakage paths.

The two types of contamination usually require a two-step cleaning process for thorough removal. Solvents for one type of contamination

are generally not effective on the other. Further, the sequence of cleaning is important.

Clean the nonionic before ionic

The nonionic cleaning step should be done first. Sticky nonionic contamination that traps ionic dirt can act as a barrier to an ionic cleaning agent. For instance, water, an ionic cleaning agent, can't penetrate a layer of grease. Application of an organic solvent to remove greasy contaminants should be followed by a water-detergent, or other ionic, cleaning step.

Thus in cleaning a PC board after soldering

Jeremy Agnew, Senior Engineer, Vicon Instrument Co., Colorado Springs, Colo. 80901.

with an activated rosin flux, first clean off the rosin residues with an organic solvent, such as isopropanol. Then remove the remaining flux and any ionic residues with deionized water.

Single-step cleaning is possible with azeotropes, or blends and emulsions of ionic and nonionic solvents. Blends of trichlorotrifluoroethane and isopropanol or emulsions of trichlorotrifluoroethane and a water-detergent are sometimes used.

What solvents are best? It depends on both the contaminants present and the materials that the assembly is made of (Tables 2 and 3). But take care. Test all cleaning agents for compatibility with the object being cleaned. Many plastics warp, swell, crack or dissolve in some solvents.

Of the organic solvents, the ketones and chlorinated hydrocarbons are popular. They are very effective and fast, but don't use them on the materials they can damage (see Table 2).

The simplest ionic solvent is water. But even water can damage some components and materials. One of the alcohols, such as ethanol or isopropanol, is often an effective substitute. But alcohols have a limited ability to remove ionic contaminants.

Other ionic cleaning solvents include acid and alkaline solutions and detergents in water. An acid or an alkaline bath is often used to remove stubborn residues of plating or etching salts.

Solvents must be pure

Ionic or nonionic, the solvent should be pure. Technical or industrial grades of some organic solvents can deposit more impurities than they clean off. And ordinary tap water can contain many impurities. They can range from dead bacteria to the chlorine disinfectants that killed them. Also, dissolved salts in hard water can contaminate instead of clean. Thus distilled or deionized water is generally recommended. Of course, the needed solvent grade, or quality, depends on the degree of cleaning required.

Particulate contamination is sometimes a prob-

Table 1. Typical contaminants

Ionic	Nonionic
plating salts etching salts perspiration salts fingerprints acid flux	oil grease wax gum rosin flux hair oil makeup hand lotion

Table 2. Effects of organic solvents on plastics

Solvents	Recommended for**	Not recommended for*
Alcohols	most plastics	—
Chlorinated Hydrocarbons	nylon polyethylene polypropylene fluoroplastics	polystyrene polycarbonate PVC ABS vinyl acrylic neoprene silicone } elastomers
Ketones	nylon polyethylene polypropylene fluoroplastics	polystyrene polycarbonate PVC ABS vinyl acrylic urethane
Fluorocarbons	most plastics	elastomers

*Can crack, craze, swell or dissolve these materials
**Recommend compatibility tests on actual materials to be cleaned

Table 3. Properties of common cleaning solvents

Solvent	Dissolves	Applications	Combustibility	Toxicity
Acetone Ketone group TLV = 1000 ppm	oils greases	ultrasonics general wash	highly flammable, explosive	low; irritating to eyes and respiratory tract.
Benzene (Benzol, coal-tar naphtha) Aromatic hydrocarbon group TLV = 1000 ppm	oils greases	ultrasonics general wash	flammable, very explosive	high; small quantities dangerous; cumulative.
Carbon Tetrachloride Chlorinated hydrocarbon group TLV = 10 ppm	oils greases	general wash	nonflammable	extreme; not recommended for cleaning; absorbed through unbroken skin.
Ethyl Alcohol (Ethanol) Alcohol group TLV = 1000 ppm	oils greases limited ionic	ultrasonics general wash	flammable	will irritate respiratory tract and cause headaches.
Isopropyl Alcohol (Isopropanol, 2-propanol) Alcohol group TLV = 400 ppm	oils greases limited ionic	drying agent ultrasonics general wash	highly flammable	low; irritating to eyes and respiratory tract.
Methylene Chloride (Dichloromethane) Chlorinated hydrocarbon group TLV = 500 ppm	oils grease solder-flux	general wash	nonflammable	high; damages internal organs.
Perchloroethelene Chlorinated hydrocarbon group TLV = 100 ppm	oils greases	general wash vapor degreasing (needs acid inhibitors)	nonflammable	low; avoid fumes.
Toluene (Toluol) Aromatic hydrocarbon group TLV = 200 ppm	oils greases	general wash	highly flammable	moderate; absorbed through unbroken skin; cumulative.
1, 1, 1-Trichloroethane (Methyl chloroform) Chlorinated hydrocarbon group TLV = 350 ppm	oils greases	ultrasonics general wash (needs acid inhibitors)	nonflammable	low; avoid skin contact and fumes.
Trichloroethylene Chlorinated hydrocarbon group TLV = 100 ppm	Excellent for oils greases works fast	ultrasonics general wash vapor degreasing (needs acid inhibitors)	nonflammable	moderate; absorbed through unbroken skin; causes dermatitis and kidney damage with cumulative exposure.
Trichlorotrifluoroethane (Freon) Fluorinated hydrocarbon group TLV = 1000 ppm	Moderate solvent for oil grease	general wash vapor degreasing particulate removal ultrasonics drying agent	nonflammable	low; can cause dermatitis; use good ventilation to prevent suffocation.
Xylene Aromatic hydrocarbon group TLV = 200 ppm	oils greases	general wash	highly flamable, explosive	high; absorbed through unbroken skin.

Note: TLV = threshold limit value, or the maximum safe concentration for human exposure. The values are periodically revised. The largest is 1000 ppm. Check manufacturer for latest data.

lem. Examples include metal filings, paper fibers, sand, lint, ash and dust. These particles are often held by grease or solder-flux residues in motor bearings, rotary switches, chassis slides and many other hard-to-reach places. An organic solvent, such as trichloroethylene or isopropanol, can dissolve the organic trapping agent and flush away the particles.

And to assist in the mechanical removal of the particles, ultrasonic cleaning or jet-spray washing can be helpful. The cavitation action of ultrasonic agitation is particularly effective in removing particles. However, not all components can withstand ultrasonic action without damage. Transistor and diode internal connections are often broken, and hermetic seals can be damaged.

The question is: How harmful?

In addition to damaging parts and materials, organic solvents can seriously hurt you. All are harmful to some degree, and some are very toxic. Most are highly flammable, and the vapors can form dangerously explosive mixtures with air. Care in working with all is advised.

All solvent work should be done under a fume hood or at least in a highly ventilated area. Avoid all skin contact and the breathing of fumes. Wear solvent-resistant gloves. Solvents in contact with the skin remove natural oils and fats, which at best can lead to skin irritation. At worst, some solvents are absorbed directly into the body, even through unbroken skin. However, the most common way of absorbing a toxic solvent is by breathing in the vapors. Many vapors attack the internal organs such as the kidneys, liver, lungs and the nervous system.

Wear safety goggles or a face shield to protect the face, especially the eyes. Many solvents are absorbed very rapidly, if splashed into the eyes.

Even if not toxic, solvent fumes can still be dangerous. Trichlorotrifluoroethane vapor, though not considered toxic, can displace enough room air to cause suffocation.

When heated, some solvents are especially dangerous. Chlorinated and fluorinated hydrocarbon fumes decompose into hydrochloric acid and phosgene. Both are highly toxic and corrosive to the eyes, throat and lungs.

One final note: With all chemicals, consult the manufacturer for full information, read the labels and instructions, and follow them. ▪▪

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2. MC/B Manufacturing Chemists: *Safety in Handling Hazardous Chemicals*, 1971.
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Prevent damaging overloads to dc-to-dc converters. Reflected noise, thermal changes and transients can strain capacitors. Don't exceed component ratings.

To extend the operating life of dc-to-dc converters, avoid overstressing the capacitor at the input of the pi filter that is usually found in these converters.

Converters, used to provide dc power isolation, have an ac ripple that is reflected back into the input. A pi input filter, using solid-tantalum electrolytic capacitors, is included within most converters and helps to reduce the input ripple. But stress on the input filter can cause premature failure of the converter. By understanding how the ratings are determined, you can extend the converter's operating life.

Tantalum capacitors are used because of their small size, wide temperature range and superior high-frequency characteristics. The reactance of a solid tantalum capacitor can generally be characterized by three ideal components in series: a capacitor, representing the capacitive reactance of the device; a resistor, representing the resistive loss term (called the equivalent-series resistance); and an inductor, representing the inductive reactance of the lead wires (Fig. 1).

If we assume that inductive component is negligible at the operating frequency, the current that will flow through the capacitor, if an ac voltage (E_s) is impressed across it, will be determined by the following:

- The frequency of the voltage (ω_s).
- The capacitance (C').
- The equivalent series resistance (ESR).

Calculate the filter dissipation

The magnitude of the current can then be calculated by

$$|I_s| = \frac{|E_s|}{\sqrt{R^2\, X_c^2}}, \text{ where } X_c = \frac{1}{\omega_s\, C'}. \qquad (1)$$

Since the capacitor has an internal resistance, R, the current, I_s, will produce a power dissipation of $P = I_s^2R$.

In the terms of Eq. 1, this would be

$$P = \frac{|E_s|^2}{R^2 + X_c^2} \cdot R = \frac{|E_s|^2}{R + X_c^2/R}. \qquad (2)$$

If we know the ac voltage across the capacitor terminals, the frequency of that voltage and the equivalent series resistance (R) of the capacitor, we can easily determine the resulting power dissipated in the capacitor. This power will heat the capacitor internally.

The added heat may cause excessive internal temperatures and result in premature failure of the capacitor. Most capacitor manufacturers specify a maximum power dissipation for a particular capacitor, with appropriate derating factors if the unit is to be operated at elevated ambient temperatures. A typical unit of the size and style that would commonly be employed for the input filter of dc-to-dc converters might have a power rating of 0.1 W at 25 C—which derates to 0.09 W at 85 C.[1]

When the dc-to-dc converter is used in an environment where excessive ac voltage is impressed upon the input, failures of the input-filter capacitor can result—especially if the dissipation levels are exceeded. A typical capacitor value might be 15 μF at 25 V dc. At 25 C, a dc-to-dc converter could have those voltage-frequency combinations listed in the table as a maximum to avoid premature failure. You derive the numbers from Eq. 2, when $P = 0.1$ W, and solve for E_s.

You can see from the table that even a comparatively poor capacitor has a high value of ESR. Thus it would tend to be less reliable than a unit of lower ESR, because the power dissipation (I_s^2R) would be higher. This assumes, of course, that the magnitude of the current, I_s, is determined by either the capacitive reactance or some other circuit component.

Start to analyze the application

Thus any system design for dc-to-dc converters should include an investigation of the dc input voltage to be applied. All equipment that would normally be powered from the same voltage source should be energized, and a wideband rms voltmeter (such as the HP 3400A) should be used to measure the magnitude of the ac voltage at the point where the converter is connected.

If an accurate measurement cannot be made

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because of reflected noise voltage generated by the converter, then dc isolate the converter input with a large value, low-impedance, capacitor. Now the converter itself is not operating, but it still shows the same ac impedance to the dc power line. Some error is introduced by doing this, but this is best accommodated by being overly conservative when interpreting the results (Fig. 2).

A measurement of 50-mV rms or less would be completely safe; if it is greater than 50 mV rms, investigate to determine if the voltage is predominantly at a single frequency or spread across the frequency spectrum. If the signal is less than 1 kHz, a voltage level of 0.5-V rms would seem very safe. Remember, of course, not to let the peak value fall outside the limits for the input voltage specified by the dc-to-dc converter manufacturer.

If the signal amplitude and frequency are considered unsafe for the converter, insert a current limiting impedance in series with the input. Simply use a series choke to provide sufficient reactance to limit the possible current to less than 50 mA at the frequency of the observed voltage. The value of inductance can be calculated from

$$L = \frac{E_s \times 10^3}{\omega_s \times 50} . \qquad (3)$$

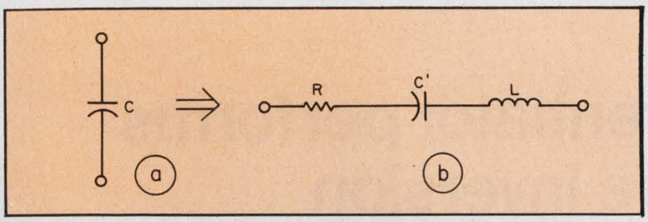
Other critical factors for this choke include these:

- Dc current rating.
- Voltage drop due to the dc current through the choke resistance.
- Resonant frequency.

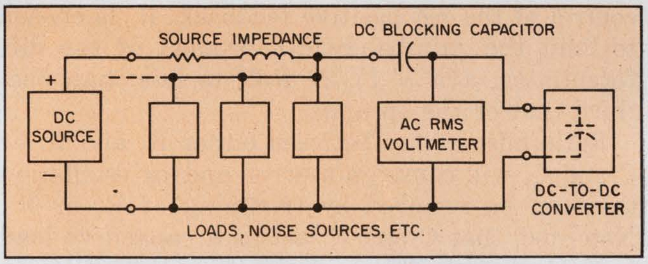
Also a clamping zener diode should be connected in shunt after the choke—at the input to the dc-to-dc converter—to absorb the released energy from the choke should the converter load be removed suddenly. Alternatively, a shunt aluminum electrolytic capacitor can be used. Its energy-storage capability should be at least 10 times greater than the choke, and its capacitance can be calculated from the following equation: $(1/2)\ (C)\ (V_{DC})^2 \geqq 10 \times (1/2)\ (L)\ (I_{DC})^2$, where V_{DC} = input voltage and I_{DC} = maximum input current to the converter (Fig. 3).

Remember that most dc voltage sources—including batteries—have output impedances that increase rapidly with increasing frequency. With any load that draws ac power, pulsed or transient currents can create a noise source—sometimes of surprisingly low impedance—close to the input of the converter.

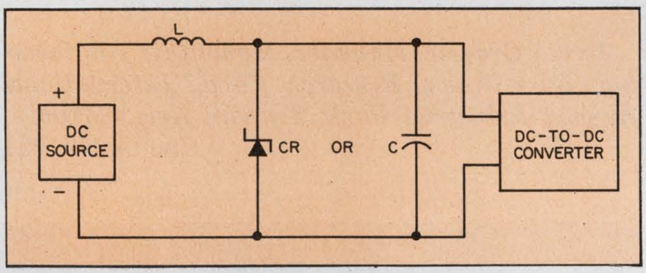
MIL Handbook 217A on "Reliability Stress and Failure/Rate Data for Electronic Equipment" recognizes this characteristic of solid tantalum capacitors. The handbook suggests that you multiply the failure rate by a factor of 0.07, when a circuit impedance of 3 Ω/V or greater is inserted (vs a reference multiplier of 1 for a circuit impedance of 0.1 Ω/V). This means that the mean time between failure of a dc-to-dc converter can be seriously degraded by just a few tenths of a volt of low-impedance ripple on the input. ■■



1. **The practical capacitor** (a) can be represented by a series R, L, C′ circuit (b), where R is the equivalent series resistance, L is the inductance of the leads and C′ is the actual capacitance.



2. **The ac rms voltage at the converter's input** can be measured if a dc blocking capacitor is added.



3. **To prevent overloads from reaching the converter** when the load is removed, a zener diode or large electrolytic capacitor can be placed in shunt across the input of the converter.

Table: Component parameters vs increasing frequency[2]

Frequency	Xc (Ω)	ESR (Ω)	E_s (max) V rms
120 Hz	90	1.5	27
1 kHz	11	1	3.5
10 kHz	1.1	0.6	0.52
100 kHz	0.11	0.4	0.21
1 MHz	negligible	0.25	0.16

References
1. "Applications Information," KEMET (Union-Carbide), type KGF solid tantalum capacitors, pp. 6-10.
2. Interpolated from the ESR-vs-frequency charts in Reference 1.

Bootstrapped RC differentiator performs accurately without phase inversion

An op amp differentiator can be built without the phase inversion of the usual circuit. As shown, the noninverting differentiator uses a simple RC high-pass circuit that is bootstrapped and buffered by an op amp.

By itself the RC network (R_2 and C) produces only a rough approximation of a differentiator response. However, positive feedback supplied through capacitor C_1 corrects the response. The op amp amplifies the corrected differentiator signal to produce the following output:

$$e_o \simeq (n+1)\, R_2 C \frac{de_i}{dt},$$

provided that

$$R_3 << R_2/n \text{ and } f << n/2\pi R_3 C.$$

The frequency response resembles that of a conventional differentiator. The response must deviate from the ideal prior to the intercept point with the open-loop response of the op amp. Otherwise the combined phase shifts of the op amp and the differentiator feedback would cause oscillation.

Stability is ensured by choice of R_3 and control of the net positive feedback. R_3 is chosen to limit the gain-bandwidth product of the differentiator, $n(n + 1)/2\pi\, R_3C$, to less than one-third that of the op amp.

Ratio mismatches between either R_1 and R_4 or C and C_1 will cause gain error and/or oscillation that can be removed by trimming of R_1 or R_4. Note, too, that C and C_1 act as a capacitive load to the op amp. This can also lead to oscillation (Tobey, G., Graeme, J. and Huelsman, L., "Operational Amplifiers; Design and Applications," McGraw-Hill Book Co., 1971).

Jerald Graeme, Manager, Monolithic Engineering, Burr-Brown Research Corp., International Airport Industrial Park, Tucson, Ariz. 85706.

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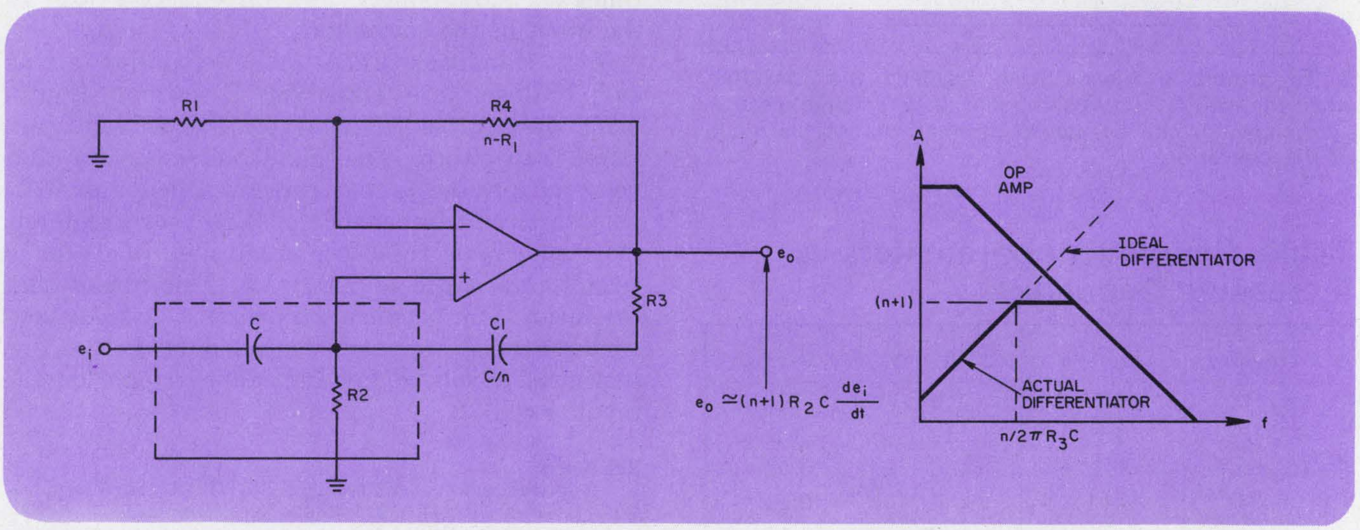

Precise differentiation without phase inversion is obtained from a bootstrapped RC high-pass circuit.

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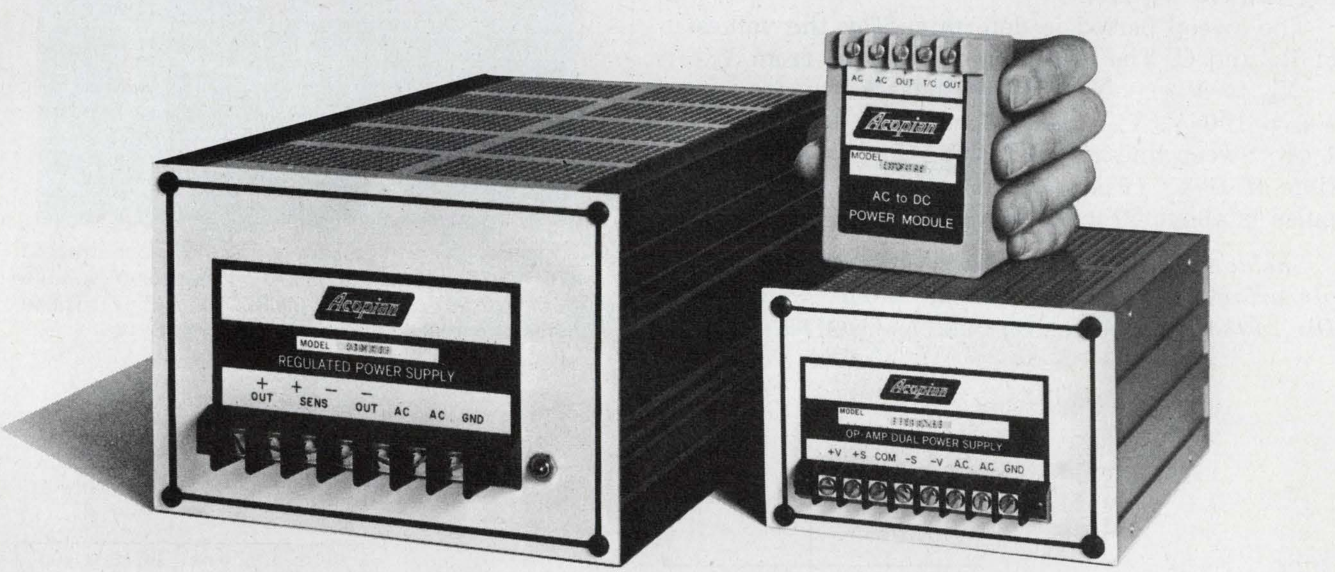

5 VOLTS

OUTPUT CURRENT AMPS	SIZE INCHES	PRICE	MODEL
.5	3.5 x 2.5 x 1.4	$55	5EB50
1.0	3.5 x 2.5 x 1.6	75	5EB100
2.0	3.5 x 2.5 x 2.4	115	5EB200
2.5	3.5 x 2.5 x 2.4	130	5EB250
5.1	3.4 x 5.1 x 6.6	150	A5MT510
9.0	3.4 x 5.1 x 9.3	180	A5MT900
12.0	3.4 x 5.1 x 13.3	200	A5MT1200
22.0	5.1 x 7.4 x 11.3	270	A5HT2200
32.0	5.1 x 7.4 x 16.0	320	A5HT3200

±15 VOLTS

OUTPUT CURRENT AMPS	SIZE INCHES	PRICE	MODEL
.1	3.5 x 2.5 x 1.4	$55	DB15-10
.15	3.5 x 2.5 x 1.4	65	DB15-15
.2	3.5 x 2.5 x 1.4	75	DB15-20
.4	3.4 x 5.1 x 5.1	85	TD15-40
1.0	3.4 x 5.1 x 5.1	125	TD15-100
1.6	3.4 x 5.1 x 6.6	150	TD15-160
2.5	3.4 x 5.1 x 9.3	160	TD15-250
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INFORMATION RETRIEVAL NUMBER 32

Single transistor circuit provides CRT-level sweep and blanking signals

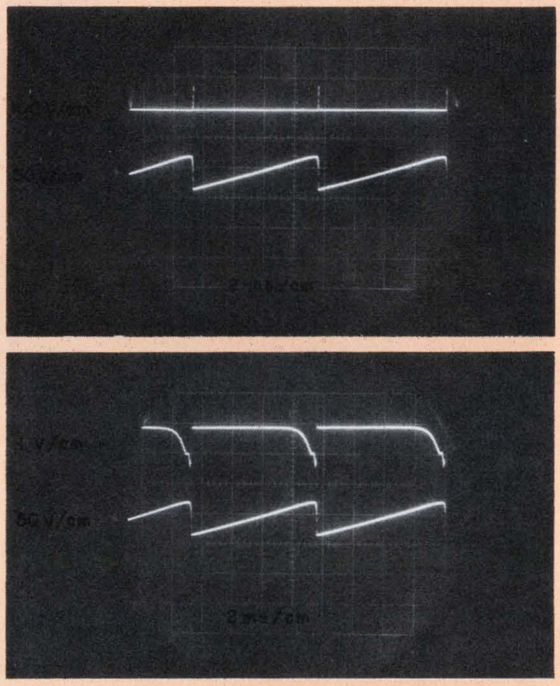
A circuit that uses a neon glow lamp and a transistor generates both a 47-V sweep signal and an 80-V blanking pulse. The entire circuit operates off a 200-V line—a voltage consistent with CRT circuit operation.

The transistor acts as a current source that allows capacitor C to charge toward the supply voltage linearity (Fig. 1). Once the lamp breakdown voltage, V_B, is reached, the lamp switches to the maintaining voltage V_M, and discharges the capacitor. The transformer couples the rapid discharge current to the base of the transistor. This "trigger" signal shuts off the transistor current and the lamp extinguishes. Then the cycle repeats, with the voltage across C increasing toward V_B from V_M.

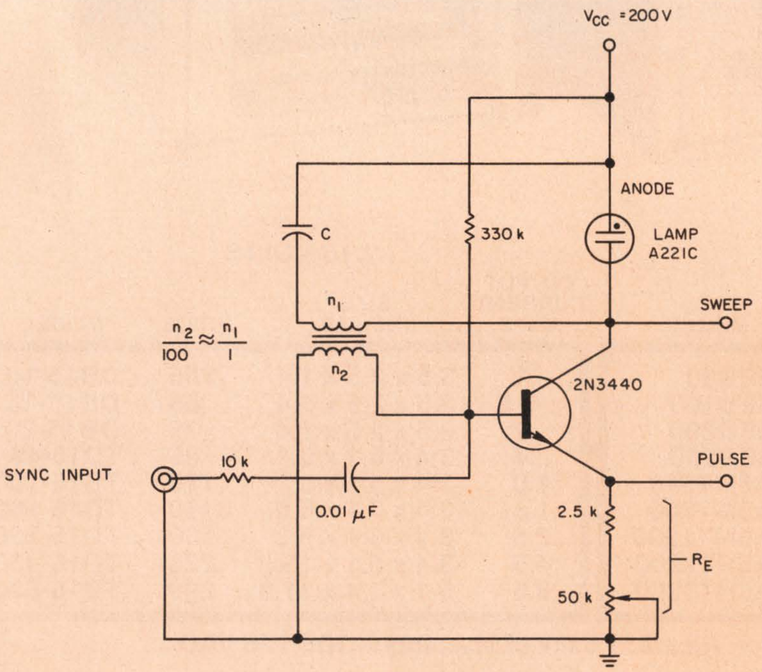
The sweep period is determined by the values of R_E and C. The sweep voltage varies from $V_{CC} - V_M$ to $V_{CC} - V_B$. The periods shown are for $V_B = 100$ V, $V_M = 52$ V and $C = 0.01$ μF or 1 μF. Sweep linearity is about 5% with a retrace time of 10 μs (Fig. 2). The width of the trigger pulse is about 50 μs with a rise time of 18 μs.

Sheldon G. Rabin, Manager, Applications Engineering, General Instrument Corp., Signalite Div., 1933 Heck Ave., Neptune, N.J. 07753.

CIRCLE NO. 312



2. **Positive-going blanking pulses** (upper traces) have heights of about 80 V. The sweep voltage (lower traces) varies from 88 to 135 V. These photos are reversed from left to right.



C	R_E (kΩ)	SWEEP PERIOD
0.01 μF	3	17 ms
	6	35
	12	70
	24	130
	48	220
	60	250
1 μF	6	1.25 sec

1. **Periodic sweeps and blanking pulses** are generated each time the glow lamp fires and discharges capacitor C. An inexpensive audio output transformer couples the discharge pulse to the base of the transistor to extinguish the lamp. The transistor also supplies constant charging current.

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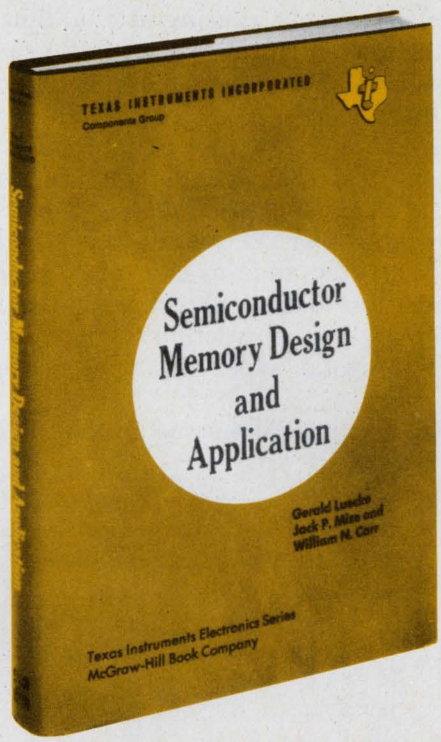

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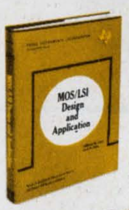

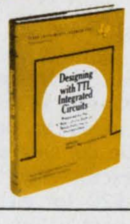

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The circuit shown allows measurement of wiper noise to test the potentiometer as well as to provide a clean signal output.

Buffer amplifier A_1 passes the wiper signal to both the filter and inverter A_2. Amplifier A_3 sums the filter output signal with the inverted wiper signal. The subtraction of the filtered signal from the total wiper signal leaves the wiper noise.

The RC network filters the spikes to give their average dc value for the recorder. The nonlinear filter provides the clean signal for further processing.

Potentiometer R_1 is adjusted for maximum signal cancellation. The test potentiometer wiper is set to the supply side and a 20-V pk-pk, low-frequency sine wave is injected. R_1 is set for minimum output from A_3.

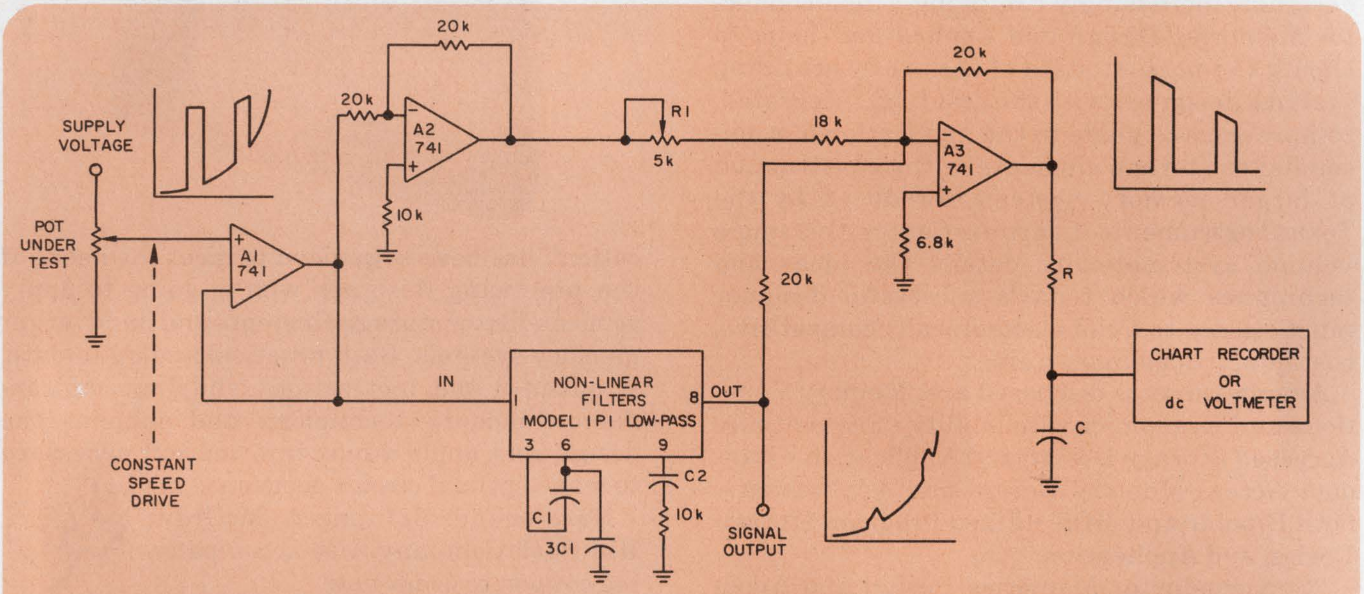
The values used for C_1 and C_2 depend on the maximum slope of the signal. The values in μF are calculated from

$$C_1 = C_2 = 1.65/\text{max slope}.$$

The slope is measured in terms of V/s.

Ray Mittenthal, Professional Engineer, 6 Crossland Pl., Norwalk, Conn. 06851.

CIRCLE NO. 313



Nonlinear filter removes spikes from output of potentiometer function generator. Amplifier A_3 sums the filtered signal with the actual inverted signal to allow measurement of the average spike value.

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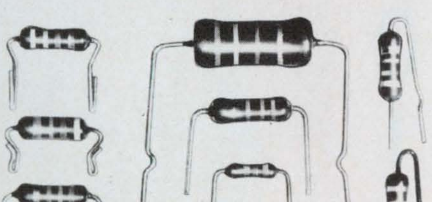
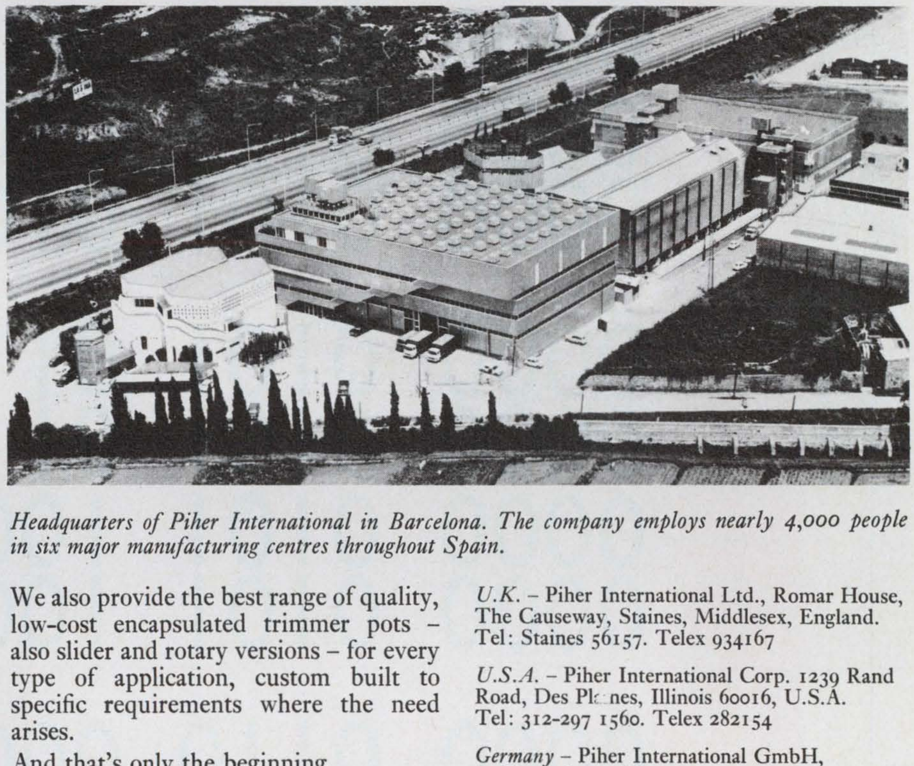
We design all our own production machines to ensure quality and reliability. We have no licence agreements, no subcontract working. From start to finish we are in control of every product that goes out to a customer. And we have a lot of customers.

We produce 8 million carbon film resistors *a day* to meet world demand – and we have the largest variety of quality preformed resistors available anywhere.



Piher output of carbon film resistors is a staggering 8 million a day.



Headquarters of Piher International in Barcelona. The company employs nearly 4,000 people in six major manufacturing centres throughout Spain.

We also provide the best range of quality, low-cost encapsulated trimmer pots – also slider and rotary versions – for every type of application, custom built to specific requirements where the need arises.

And that's only the beginning.

Our small signal and medium power transistor range is growing fast.

Our ferrites are in the forefront of magnetic ceramic technology.

And we have just laid down the most modern ceramic capacitor line in Europe.

Apart from our six manufacturing centres we have a world-wide distribution network backed by five Piher companies in the USA, Germany, Great Britain, France and Italy. They are only a 'phone call away if you need details on the best components in the business.

Or write to us for data sheets on the product area you are interested in.

Find out more about us. It pays.

U.K. – Piher International Ltd., Romar House, The Causeway, Staines, Middlesex, England. Tel: Staines 56157. Telex 934167

U.S.A. – Piher International Corp. 1239 Rand Road, Des Plaines, Illinois 60016, U.S.A. Tel: 312-297 1560. Telex 282154

Germany – Piher International GmbH, 85 Nuremberg, Westtorgraben, 5. Germany. Tel: 0911 260 469. Telex 623354

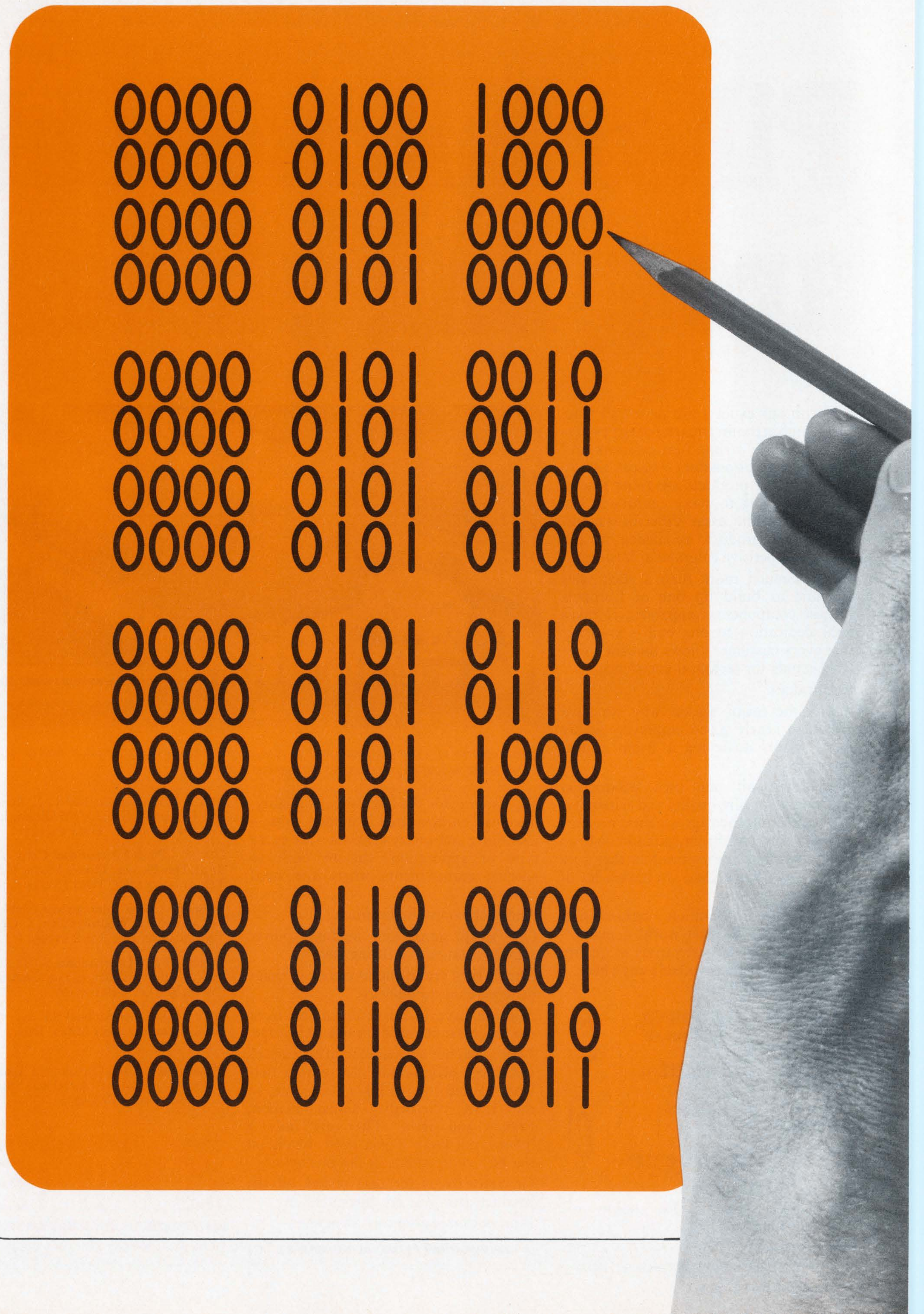
France – Piher International SARL, 83 Rue Etienne Dolet, 94230, Cachan, France. Tel: 656 26 07. Telex 27107

Italy – Piher International S.P.A. Via Cenisio 34, 20154 Milan, Italy. Tel: 314532/316213

Head Office – Riera Cañado, s/n Apartado de Correos 53 Badalona (Barcelona) Spain. Tel: 389 03 00. Telex 59521

PIHER

INFORMATION RETRIEVAL NUMBER 82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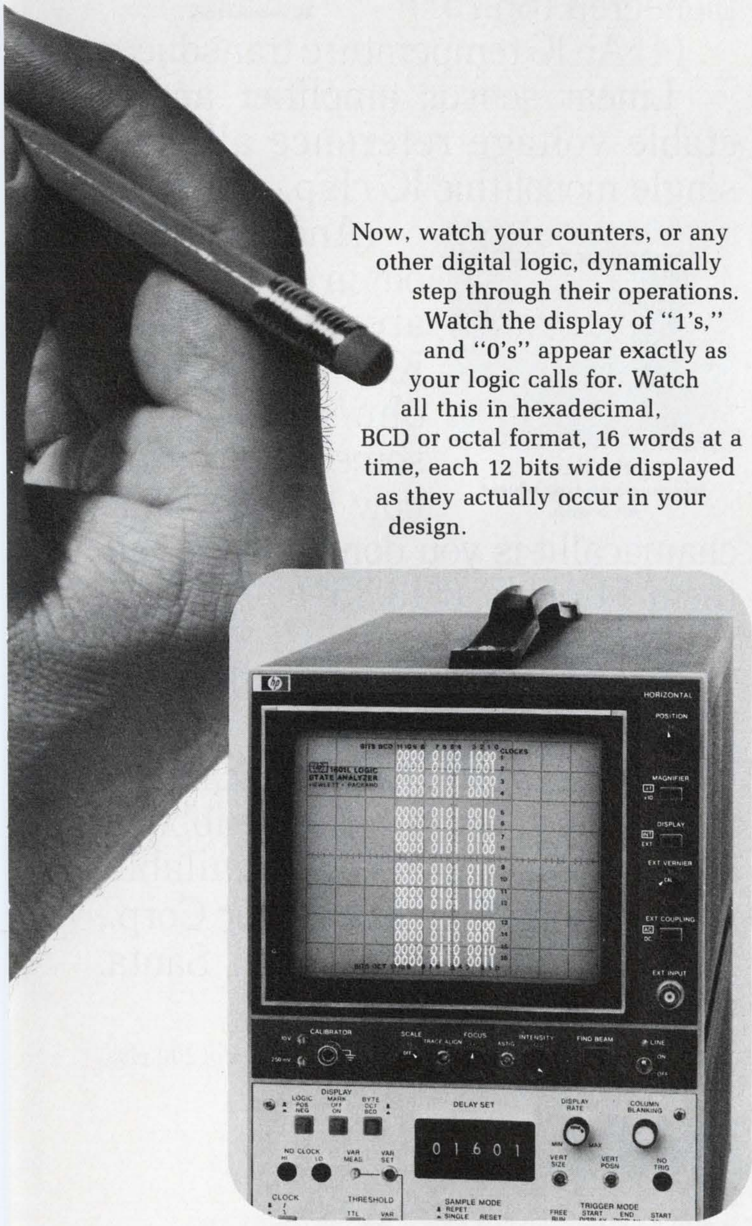
Can You Spot This Counter Problem?

With the new HP-1601L Logic Analyzer it's just as easy.



Now, watch your counters, or any other digital logic, dynamically step through their operations. Watch the display of "1's," and "0's" appear exactly as your logic calls for. Watch all this in hexadecimal, BCD or octal format, 16 words at a time, each 12 bits wide displayed as they actually occur in your design.

See negative time. Think of the time you can save with this breakthrough in performance capability. You can trigger the display on the first word or the sixteenth word to look ahead, or look back in time (negative time). **See dynamic data flow, much more.** Because the 1601L operates from your strobe signal (up to 10 MHz), delay can be conveniently dialed in up to 10^5 bits. Select positive or negative logic display depending on the type of circuitry you're working with, and adjust threshold over the $\pm$ 10V range provided. If a problem should occur, it's easy to select a window in time to help you diagnose the cause of your problem...quickly. And once the problem is isolated with the 1601L Logic Analyzer, your oscilloscope will help you to locate the component or circuit at fault. The 1601L provides a trigger for your scope making fault isolation even faster. **See things you've never seen before.** See those digital events you've always wanted to see. For all this capability the 1601L is priced at only \$2650*. Or consider the 5000A with LED display, two channels, thirty-two bits that sells for only \$1900*. Your local HP field engineer will be happy to arrange a "hands-on" demonstration in your office or lab.

*Domestic U.S. prices only.

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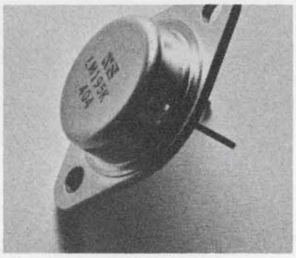
BREAKTHROUGHS. $1.50 AND UP.

(1) The universe's very first and only transistor that's an IC.

Old style power transistors join the buggy whip because LM 195/295/395 are blow out proof. (just $4.95 for the LM 395—all prices in batches of 100 plus.)

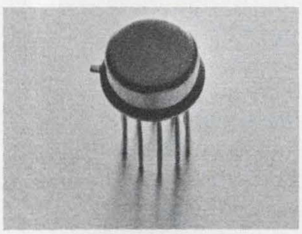


The first transistors that are blow out proof and short circuit proof.

And if that doesn't blow your mind, how 'bout...

(2) A proprietary timer in which the output is short circuit proof.

The output state of LM 322 can be inverted, eliminating the need for external circuits. Another thing that should have an effect on you is that inputs on the trigger terminal after it's triggered have no effect on the timer output. ($1.50*)

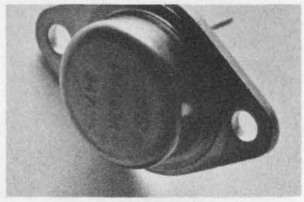


The first timers with a short circuit proof output.

(3) A 3-amp IC regulator.

Another first.

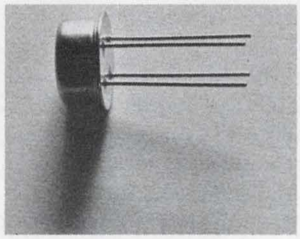
The number is LM 323, and it's a logical extension of the self-protected 3 terminal regulator field which guess-who has pioneered. ($6.75*)



The first 3-amp positive IC regulator.

(4) An IC temperature transducer.

Linear sensor, amplifier and a stable voltage reference all on a single monolithic IC chip.



The first temperature transducer on a chip.

And they read out in real temperature (degrees Kelvin) instead of ohms. So when someone asks you how hot the whatchamacallit is you don't have to tell them 14 ohms. ($13.35*)

Pens ready?

LX5600AH/LX5600H and LX5700AH/LH5700H.

Buy 'em quick 'cause we can use the money. Or, for the stubborn among you, details are available from National Semiconductor Corp., 2900 Semiconductor Drive, Santa Clara, California 95051.

*In batches of 100 plus.

NATIONAL

National Semiconductor Corp., 2900 Semiconductor Drive, Santa Clara, Calif. 95051; Scottsdale, Ariz. (602) 945-8473; Mountain View, Calif. (415) 961-4740; Sherman Oaks, Calif. (213) 783-8272; Tustin, Calif. (714) 832-8113; Miami, Fla. (305) 446-8309; Chicago, Ill. (312) 693-2660; Indianapolis, Ind. (317) 255-5822; Lenexa, Kan. (816) 358-8102; Glen Burnie, Md. (301) 760-5220; Burlington, Mass. (617) 273-1350; Farmington, Mich. (313) 477-0400; Minneapolis, Minn. (612) 888-4666; Englewood Cliffs, N.J. (201) 871-4410; Syracuse, N.Y. (315) 455-5858; Dayton, Ohio (513) 434-0097; Dallas, Tex. (214) 233-6801.

DigiTec introduces another product in the HT SERIES (a breakthrough in High Technology) a new, portable Digital Multimeter.

DigiTec's new Model 2110, 3½ Digit Multimeter is the latest product in the new HT Series (High Technology). This new family is the realization of a long term R & D program producing digital instrumentation with the ultimate in reliability and performance. These demanding standards have been achieved by using field proven technology combined with proprietory design, state-of-the-art components and advanced production techniques. The application of human engineering principles, enables simple and self evident use of the instrument. Our proudest achievement, the HT series instruments are housed in attractive, designer-styled, enclosures that protect and enhance the advanced technology they contain.

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Booth 2531-33

Model 2110 Digital Multimeter

$219.

Features: DC ranges to 1000 volts with autopolarity, sensitivity 0.1mV / AC ranges to 500 volts, sensitivity 1mV / Ohms ranges to 20MΩ, sensitivity 0.1Ω / Monsanto, easy-to-read, long life LED's / 115/230VAC, 50 to 400Hz line operation or self-contained batteries yielding 8 hrs. continuous operation / Built-in automatic battery charger / Batteries optional $35.00 / Compact, lightweight and rugged / Ideal for bench or field operation / "Off-the-shelf" availability from your local Digitec Representative.

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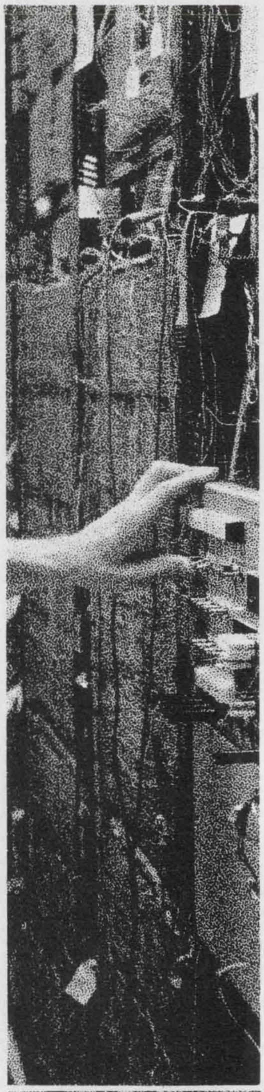

ELECTRONIC TELECOMMUNICATION EMPLOYMENT OPPORTUNITIES

We are a leading innovator of electronic communications systems supply to the telephone industry. Telephone communications are growing at an accelerated pace to meet the ever increasing demands for service by industry, commerce, government and the general public.

As a result, we require increasing numbers of creative, skilled and responsible people who desire even greater opportunities for achievement. We are particularly interested in individuals with experience in telephone development, manufacturing or service companies, similar electronics manufacturers, or computer corporations.

SYSTEM HARDWARE AND/OR TRUNK DESIGN

We have openings available in the hardware design and development of medium and large scale electronic switching systems. You must have the ability to comprehend the system as a whole and make the appropriate trade-off decisions. You will be involved in originating, planning and designing circuits for new systems or modifying existing systems. This entails the design of electronic logic and the interface with previous electromechanical designs. Requirements: A BSEE or MSEE degree with several years of relevant design experience.

SOFTWARE DESIGN

We have opportunities available in the software programming area. You will be involved in the development of system software beginning with the project configuration stage; designing and developing executive control programs, man-machine interface routines and billing type programs for toll and central office electronic switching systems. Requirements: A minimum of three years design experience in the development of Call Processing and Executive Control Programs. An MSCS degree is also desired.

DIAGNOSTIC DEVELOPMENT

You will be responsible for the design of fault recovery and diagnostic programs for the computer controlled hardware of electronic switching systems. This involves the implementation and development of maintenance facilities to detect and correct present or latent hardware and software faults within the system. The system must be developed to handle calls during fault conditions and during system growth. Abundant man-machine communication must also be designed into the system. Requirements: These positions require a BS or MS in Electrical Engineering, Computer Science or Physics and at least 2 years experience in Software and Hardware design of large realtime systems with automatic malfunction detection, recovery and diagnostics.

KEY TELEPHONE SYSTEM DESIGNER

You would be responsible for the design and development of new equipment and techniques, in the areas of telephone signalling and transmission, as applied to Key Telephone Systems. You must be familiar with integrated circuit technology, relay technology and semiconductor devices. We are seeking an individual with a B.S.E.E. and two years relevant experience.

SUPPLY PRODUCTS EVALUATION

We have specific assignments available for engineers who will be responsible for providing technical support and guidance in the procurement of a wide range of supply items utilized by telephone operating companies. You will be required to prepare specifications defining performance, quality and endurance requirements in order to determine the applicable test methods that confirm the products acceptability. Additional responsibilities will be performing laboratory and field tests when necessary and dealing with vendors regarding specifications and the qualification of their products. Requirements: A broad technical education coupled with a minimum of 2 years related experience.

PCM SYSTEMS ENGINEER

We have openings available for those that have experience with Stored Program Systems Control. You will be responsible for the evaluation of Control System Techniques for future generation switching systems. You will be working in the early conceptual stages of systems development with a small systems group. An MSEE degree, or equivalent degree in Computer Science, is required plus real-time control experience in the Telephone or Computer Industry.

DESIGN AUTOMATION PROGRAMMER

Our Design Automation staff is looking for a Programmer who will be responsible for the definition and development of programs to aid in the design, engineering and production of electronic switching systems. Program development areas include computer-generated logic diagrams, printed wiring card artwork design, automated wiring, circuit logic, load analysis and logic simulation. Requirements: Experience in 360/370 OS-MUT, Cobol and Assembly language programming plus a BSEE or Computer Science is desirable.

MINI-COMPUTER PROGRAMMERS

We have specific assignments available on project development teams responsible for the design and implementation of various telecommunication processing utilizing Min-Computers as the processing element. Responsibilities will include the development of software programs for real-time operating systems as well as unique hardware elements incorporated into the system. Requirements: A minimum of 2 to 5 years experience in the development of assembly language programs for mini-computer processing systems is desirable, plus a Bachelors degree in Electrical Engineering or Computer Science.

You'll find the salary range open plus a liberal compensation along with full fringe benefit package. Confidential resumes outlining experience, education, salary history and goals should be submitted to: Christine Rosenbach, GTE Automatic Electric Laboratories, Professional Employment, 400 North Wolf Road, Northlake, Illinois 60164.

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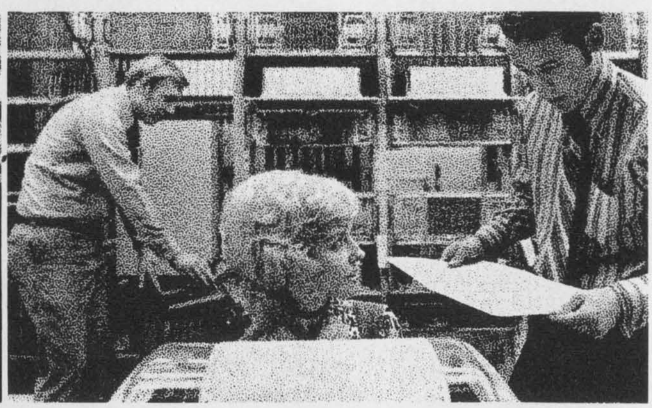


INFORMATION RETRIEVAL NUMBER 901

international technology

Digital transmitting tests to use phone system

The British Post Office plans to install six high-speed multiplexers for experiments in digital transmission via the trunk-telephone system. Built by the General Electric Co. Ltd. in England, each multiplexer can combine four separate streams of electrical pulses into a single stream—equivalent to 120 simultaneous telephone conversations.

Each unit combines four independent inputs at 2048 kilobits/sec into a single output at 8448 kilobits/sec. The multiplexers also separate a received input of 8448 kilobits/sec into four individual pulse streams at 2048 kilobits/sec.

During the next stage of development the multiplexers will be tested for performance and reliability. The units will then be linked to experimental digital-transmission systems that are to be available early in 1975 between Guildford, Portsmouth and Southampton, in southern England. The Post Office announced last March that contracts had been placed with Standard Telephones and Cables Ltd., GE and Plessey for two separate designs of line-transmission equipment.

The experimental transmission systems will provide digital transmission at 120 Mbits/sec over 1.2/4.4-mm coaxial-cable pairs. Signals at 2048 kilobits/sec will be assembled into a 120-Mbits/sec stream in two stages. The first will use the GE multiplex units. The second will use equipment that combines 14 inputs at 8448 kilobits/sec to produce an output of 120 Mbits/sec. The latter units are being developed for the Post Office by another English company, Pye TMC Ltd.

Equipment for the Guildford-Portsmouth-Southampton experiment will also include a group encoder. An interface will be provided between the analog and digital systems by conversion of frequency-division multiplexed signals from 60 telephone circuits into a digital signal. The signal can be transmitted over a path of 8448-kilobits/sec.

Tests of second-order digital multiplexing will also be carried out by use of a variant of the GE 2048/8448-kilobits/sec multiplexer which combines three 2048 kilobits/sec inputs into a 6336 kilobits/sec output. Tests will take place over a lower 6-GHz digital radio system (also developed by GE), which is being evaluated on an existing microwave radio path.

Thick-film hybrid unit is TV focus control

A thick-film hybrid focus control module for use in solid-state color TV receivers has been developed by the EMI Microelectronics Div. in Middlesex, England.

The compact and highly stable unit can be operated at up to 10 kV. The module has been designed so that under limiting conditions, with 8.3 kV applied, the focus voltage range is 3.7 to 5.7 kV.

The ink pattern of the resistive element is printed onto a 2 × 1-in. alumina substrate, and the unit is enclosed in a case that measures about 2-1/2 × 2 × 1/2 in., molded in flame-retardant, thermoplastic polypropylene.

The control element consists of three resistors in series, with the center resistor the variable component that provides the focus adjustment. The contact arrangement uses a steel spring that is rolled round the thick-film potentiometer track. The spring provides contact between the track and the center conductor.

CIRCLE NO. 318

CAD system gives optimum PC designs

A computer-assisted design system for the manufacture of printed-circuit boards has been developed by Quest Automation Ltd. of England. With the computer's help, the designer creates the optimum layout while the equipment automatically checks the work, carries out calculations, draws and executes modification instructions.

The designer works freehand at a digitizer that is designed to look and feel like a conventional drawing board. The integral Nova 1200 minicomputer checks clearances and other limitations and stores design information. Incorrect patterns are indicated immediately on a solid-state display. Standard layout features need be drawn only once and can be called up after that when required.

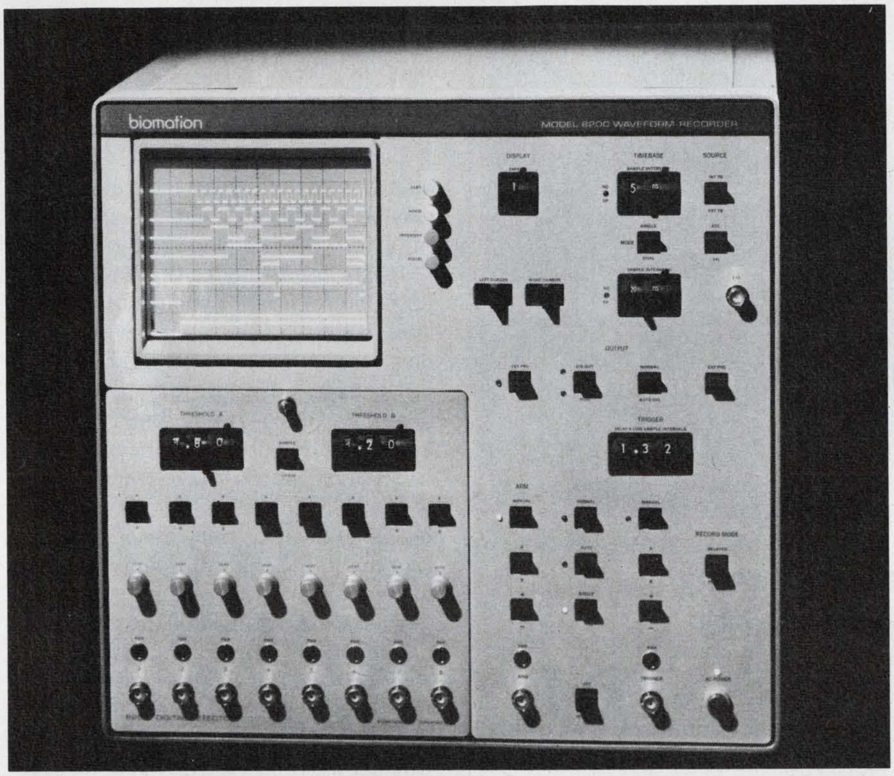
The designer can stop work at any time and obtain a tape of the design details so far. Modifications and deletions can be carried out at any stage, and special software can make minor adjustments that may be needed in the final stages of design.

Multilayer boards can be laid out either on a single sheet that uses different colors or on individual drawings, and numerical-control drilling and component-insertion data can be included.

The system's output is a punched tape, suitable for direct input to an off-line precision photoplotter called EMMA. The photoplotter equipment—also made by Quest—can generate plots up to 23 × 29 in. with an accuracy of ±0.001 in.

CIRCLE NO. 319

Fastest logic scope captures 8 data streams at 200 MHz



Biomation, 10411 Bubb Rd., Cupertino, Calif. 95014. (408) 255-9500. See text; 90 days beginning May, 1974.

Although Biomation's Model 8200 digital logic analyzer is the third such instrument to be unwrapped recently by as many vendors, the 8200's 200-MHz input data rate catapults it to the lead position as the fastest unit of its class.

The other neophytes—Hewlett-Packard's 1601L Logic State Analyzer and E-H Research Laboratories' AMC 1320 Digiscope—handle data rates of 10 Mb/s and 50 MHz, respectively.

Thus the Biomation 8200 is the first logic scope to enter the superfast world of ECL logic. If you need this speed, however, be prepared to pay for it. The 8200 costs $14,200—without probes.

This contrasts sharply with $2650 for the HP unit and about $9800 for E-H's Digiscope, both of which include the probes in the cost.

Other features and specs give each of these store-and-display analyzers its own "personality," as well as tradeoffs to the specifier.

For example, both the Biomation and the E-H are eight-channel, stand-alone instruments that can accept various plug-ins. The HP unit has 12 inputs and is itself a plug-in for the company's 180-series scopes (the price, however, includes a 182 mainframe).

And while the displays of the 8200 and the AMC 1320 are similar—both show timing diagrams—the 1601L displays a numeral one or zero to represent the logic ONEs and ZEROs of 16 consecutive 12-bit words.

Other significant differences exist. With respect to bit capacity, Biomation leads the pack with a memory of 8 bits by 2048 words; E-H follows with 8 by 100 and HP brings up the rear with 12 bits by 16 words.

The 8200, as well as E-H's Digiscope, provides an alphanumeric readout along with the timing relationships. In the 8200, two vertical cursors—superimposed on the display—can be moved along the screen. Numeric characters then show the number of bits between cursors, as well as such items as the time between samples (inverse of clock selected) and the horizontal expansion factor, which goes to ×50 on the 8200.

The information display on the Digiscope goes one better: The unit provides an alphanumeric display of many of the important settings of the instrument, such as time scale, trigger modes, logic thresholds and delay. Joystick-type controls replace the familiar multiposition rotary switches found on most scopes, and settings are read on the screen.

Logic thresholds are settable on all three units, so various types of logic can be handled. Both the Biomation and the HP 1601L are single-threshold devices—that is, a single level (externally variable) is used within a comparator to decide whether an input is a ONE or ZERO. (With the Biomation, you can select either of two levels for each channel.)

On the other hand, the E-H AMC 1320 provides a double threshold—two levels, one each for ZERO and ONE—and it uses fairly complicated logic criteria to decide whether a ONE or ZERO should be displayed.

The advantage of the double

(continued on page 70)

(continued from page 69)

threshold is this: With it, you won't miss low ONEs, high ZEROs, ringing and glitches—as you may with just a single level.

All three units offer a number of triggering options and delays to let you "look" anywhere within a data stream to see both pretrigger and post-trigger events.

In the Biomation 8200, which updates the stored data synchronously with the internal or external clock, the trigger can be derived from one of the input signals or from an external signal. The HP 1601L does the same, except that the clock is external only. By contrast, the E-H AMC 1320 operates asynchronously only and can be triggered from a logic combination of the input signals.

In its latch mode, the Biomation 8200 can capture glitches or single-shot events. Thus narrow spikes down to 1 ns are detectable. The E-H unit also grabs glitches—down to 10 ns—and displays them as a one-bit-wide transition.

Though the HP unit can't directly show glitches, a trigger-out signal is provided that can be used to trigger an analog scope. Hence glitches are "indirectly" spotted.

The Biomation 8200 is programmable, as is the E-H AMC 1320. The HP 1601L is manual only.

For Biomation **CIRCLE NO. 254**
For E-H Research **CIRCLE NO. 255**
For Hewlett-Packard **CIRCLE NO. 256**

Portable recorder consumes just 8 W

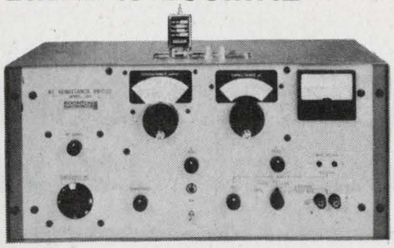
Astro-Med, Atlan-Tol Industrial Park, West Warwick, R. I. 02893. (401) 828-7010. $395; 30 days.

Model 101-DC OEM recorder operates on a 12-V battery and weighs only 4 lb. Power consumption is just 8 W. A single-channel unit, the recorder features a channel width of 50 mm, with automatic chart threading. Recordings are made without ink by a heated stylus on a new type of heat-sensitive paper that is 50% less costly than conventional heat-sensitive papers.

CIRCLE NO. 257

Advertisement

RF Admittance Bridges 1MHz to 100MHz

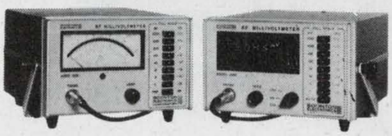


MODEL 33

Boonton Model 33 bridges measure two-terminal capacitance and conductance of high-Q diodes, varactors, and capacitors at 7 crystal-controlled frequencies from 1 to 100MHz, and provide accurate, high resolution balance at the low signal levels necessary for testing solid-state devices. Both internal and external DC bias facilities are standard. Contact: Boonton Electronics, Parsippany, N.J. 07054.

INFORMATION RETRIEVAL NUMBER 91

Full Programmability is standard on RF Millivoltmeters 10kHz to 1.2GHz

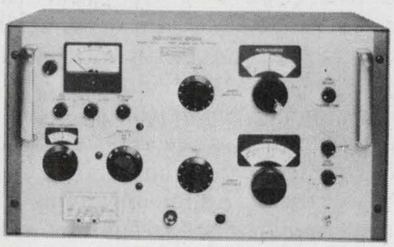


ANALOG 92B DIGITAL 92BD

Boonton rf millivoltmeters offer state-of-the-art sensitivity, accuracy, and bandwidth with an unrivaled choice of features and options. Analog or digital versions, both with linear dc outputs. Digital version has ancillary analog dBm meter and BCD outputs, optional autoranging and dB display (0.01 dB resolution). Contact: Boonton Electronics, Parsippany, New Jersey 07054.

INFORMATION RETRIEVAL NUMBER 92

Inductance Bridges measure nanohenries to henries



MODEL 63

Boonton Model 63 direct-reading inductance bridges have extremely wide useful ranges for both series L and R. Internal wide-range oscillator provides constant current, independent of balance condition. Three versions span 0.2nH to 11H, 0.4kHz to 500kHz. Contact: Boonton Electronics, Parsippany, N.J. 07054.

INFORMATION RETRIEVAL NUMBER 93

INFORMATION RETRIEVAL NUMBER 94 ▶

Who said a digital-readout signal generator has to be hard to handle, hot and heavy, and cost $4,450?

Not us! Our Model 102A, at $2,975, has everything you need for just about any AM/FM application — *plus* seven performance and convenience features you won't get in the $4,450 design.

What did we leave out?

Phase-lock synchronization, for one (but our dc-coupled FM channel can be externally locked if you need better stability than our typical 4 ppm); and narrow-pulse modulation (belongs in a different class of generators).

What did we add?

Four different signal-generation techniques — for optimum performance in *each band,* from 4.3 to 520 MHz, without the usual compromises in noise, stability, or residual-distortion characteristics.

The most logical panel layout and convenient control setup you've ever seen. And a unique adjustable "feel" main drive mechanism for narrow-band receiver setting with ease — even without our electrical vernier.

Separate meters for modulation and output — no annoying autoranging or out-of-range annunciators . . . we don't need them.

15 minute warmup to typically meet 10 ppm/10 minute stability — made possible by low internal dissipation (only 30 watts; no fan!)

Wider FM deviation at low carrier frequencies than any other design in this class (how does 2 MHz peak-to-peak grab you?)

A detected-AM-output option, to verify our negligible phase-shift for VHF-omni testing.

Versatile modulation features — like five internal frequencies, 30% and 100% AM scales, and true-peak-responding AM and FM metering.

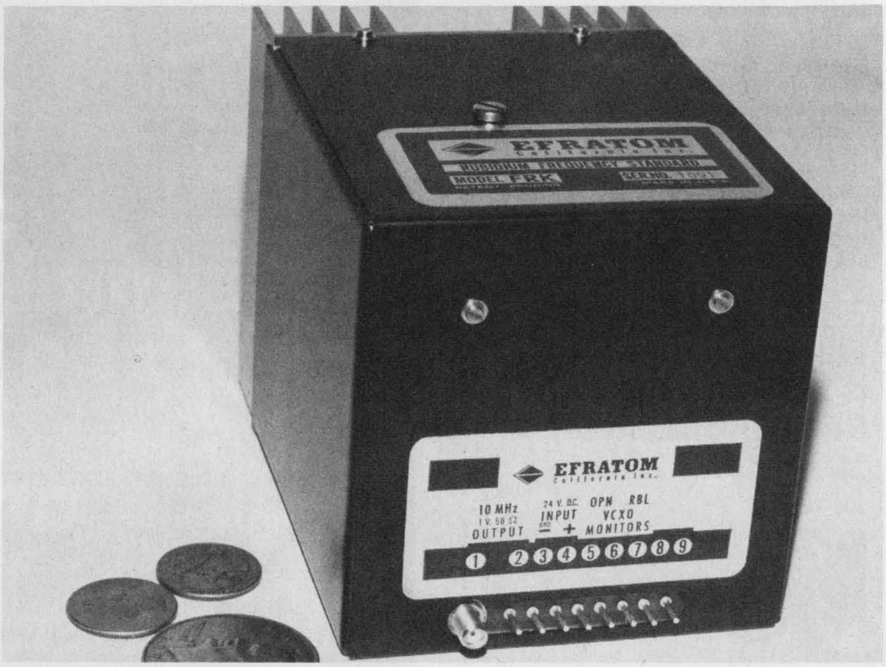
All these performance pluses are coupled with low spurious and close-in noise, excellent low-frequency phase integrity, really effective leveling, a low and flat VSWR curve, accurate wide-range attenuation, high output power . . . all of it buttoned up tight for low leakage in a lightweight 30 pound package.

. . . and it's all yours for $2,975. Get the full specs today — before you spend 50% more.

For complete data or a demonstration write or call Boonton Electronics Corp., Rt. 287 at Smith Road, Parsippany, N. J. 07054, (201) 887-5110.

BOONTON

2.2-pound rubidium standard for systems uses only 12 W



Efratom California, Inc., 3303 Harbor Blvd., Costa Mesa, Calif. 92626. (714) 556-1620. $5100. 4 wk.

A rubidium frequency standard that weighs only 2.2 lb. consumes just 12 W. It is the smallest, lightest and lowest in power consumption of any on the market. Known as the model FRK, from Efratom, the standard has a long-term stability of less than 1 part in 10^{-10} for a month and short-term stability of less than 5×10^{-11} for 1 s.

The standard measures 3.9 × 3.9 × 4.4 in. The company has achieved the small size by building the resonant rubidium cell into a microwave cavity. In most other standards, the cavity is a separate component that follows the cell as an output filter.

The output frequency of the standard is a 10-MHz signal. The trim range of the output is 2×10^{-9}, controlled by a 25-turn potentiometer. The level of the output is 1-V rms from a 50-Ω source impedance.

At frequencies more than 200 Hz away from the nominal frequency of the standard, the signal-to-noise ratio is greater than 120 dB in a 1-Hz band.

Rapid warm-up is a feature of the FRK. In 10 min. a stability of 2×10^{-10} is achieved. Supply voltages of 23 to 32 V can be tolerated with a nominal 24 V dc. An internal diode protects the standard against reversed polarity connection. The output connector is an OSM 211 jack.

The operating temperature range of the standard is −25 to +65 C, with a maximum frequency drift of less than 1×10^{-9} over the whole range. For airborne applications the drift with altitude is less than 5×10^{-13}/mbar.

In comparison with other low-cost rubidium standards, such as the Tracor Instruments Model 308-A, the Efratom unit wins all spec comparisons except for stability. The Tracor standard has long-term stability of better than 3×10^{-11}/month and short-term stability of better than 2×10^{-11}s. However, the Tracor unit requires a 19-in. rack, weighs 31 lb. and has a 50 W power dissipation.

For Efratom **CIRCLE NO. 250**
For Tracor **CIRCLE NO. 251**

WESTON for frequency counters you can really count on.

Weston—the nation's oldest name in test equipment—presents its newest line of high-reliability frequency counters.

For the engineer, service technician or serious hobbyist, there's the new Model 1252, an auto-ranging crystal-clock counter, 5 Hz to 30 MHz range, 6-digits, and all solid-state circuitry. With four autoranging gates plus two pre-set gates, automatic blanking of leading zeroes, at an unbelievably low price.

Those wanting more capacity in a counter can find it in Model 1253, a 1 Hz to 200 MHz instrument with separate 1-megohm and 50 ohm inputs, 7-digit LED with overrange indicator, 1 MHz time base, and external clock input. Great for precision work. Comparably low priced.

Scientists, lab technicians and experimenters requiring the utmost from a counter, can find it in either Model 1254 or Model 1255. Both have high-stability TCXO time bases, 1 Hz to 200 MHz range, BCD output, push-button re-set (first display is always correct), and remote programming capability. Model 1255 also has a pre-scaled 600 MHz capability.

To complement these fine counters, Weston also offers the Model 1251, a programmable 20 MHz time with 100 nsec. resolution. It provides time interval, period, time average, event and ratio measurements in a 5-digit LED display. And, there's also Model 1259, a 600 MHz scaler which will extend the range of any counter to 6 MHz-600 MHz, automatically.

All of these ultra-reliable Weston Frequency counters are lightweight, compact, and easy to use. Each has a lockable, multi-position handle which serves as a tilt-stand. See them at your Weston distributor today. Or, write Weston Instruments, Inc., 614 Frelinghuysen Ave., Newark, N.J. 07114.

We're either first or best. Or both.

WESTON® WESTON Schlumberger

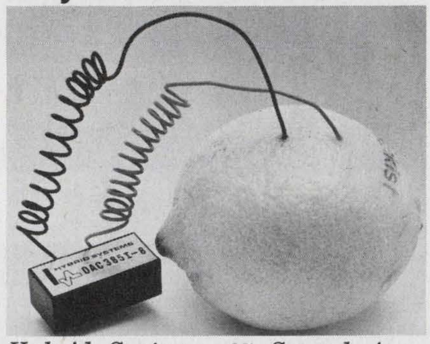
Xtal oscillator output has high spectral purity

Damon Corp., 80 Wilson Way, Westwood, Mass. 02090. (617) 449-0800.

Overtone voltage-controlled crystal oscillators provide high spectral purity at output frequencies ranging from 36 to 150 MHz. They have a linear deviation capability up to ±0.025% of center frequency. Temperature stability is typically ±10 ppm from 0 to +50 C. The Model 6897WXA has the following characteristics: Center frequency of 114.008 MHz, with a ±1 kHz adjust; frequency deviation of ±20 kHz at 4 kHz/V; linearity of ±1% of best straight line; output power of 0 dBm into 50 Ω and harmonically related components are a minimum of 30 dB down, none within 72 MHz of cf. The power supply requirements are ±12 V dc at approximately 50 mA. The case size is 4 ×2 × 1 in.

CIRCLE NO. 258

CMOS DAC uses only 15 mW and is small



Hybrid Systems, 87 Second Ave., Burlington, Mass. 01803. (617) 272-1522. $19 (1 to 9); stock to 6 wk.

The DAC385I-8, 8-bit CMOS d/a converter needs something stronger than a lemon to power it. It draws only 15 mW of power from a single +15 V power supply—less than half the power of a TTL gate. The DAC385I-8 plugs into a single 16-pin IC socket and is only 1.3 × 0.6 × 0.48 in. The unit is complete with its own internal reference, precision resistor ladder network and network switches. Its output may be converted to voltage by means of a simple resistor to ground. Other key specifications: Accuracy vs temperature is 200 ppm/°C, linearity is 1/2 LSB. The unit settles to 0.1% in 1 μs, it has binary coding and its full scale output current is 0.67 mA.

CIRCLE NO. 259

Vibration detector responds to 5000 Hz

Columbia Research Labs, MacDade Blvd. & Bullens Lane, Woodlyn, Pa. 19094. (215) 532-9464. 1 to 2 wk.

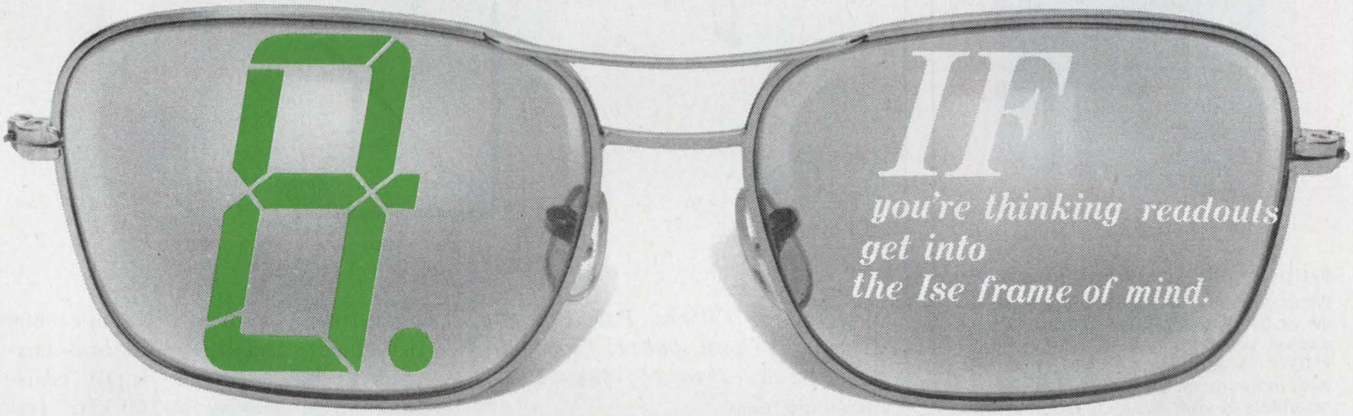
The CV-104 series of vibration detectors provides automatic warning or shutdown due to excessive vibration. The basic vibration detectors are available in all types of enclosures, including miniature cases, JIC enclosures and explosion proof types. They can have built-in time delays that eliminate false shutdowns caused by accidental high level short duration vibration or impacts, an on-off trigger output and an adjustable alarm-set-level. Frequency response is from 2 to 5000 Hz with an operating temperature range from −40 to +170 F. Repeatability is within 1% of set value. Operation is from 115 V, 60 Hz, or 28 V dc.

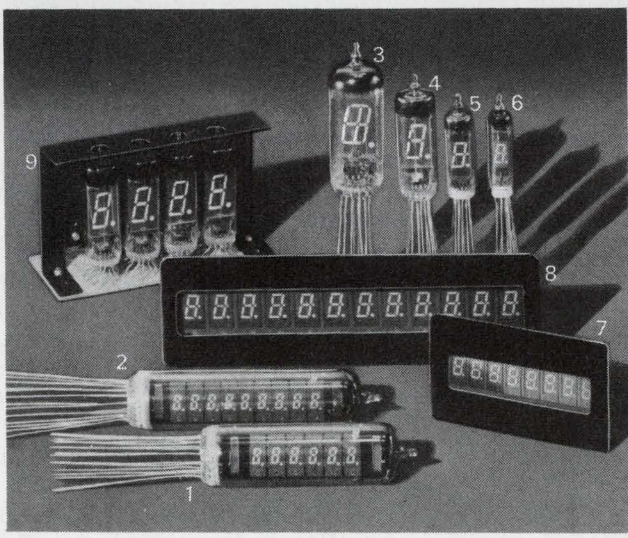
CIRCLE NO. 260

Frame them any old way

Or any new way.

Then sit back and watch your Ise display electronics get your ideas across. Beautifully.
In an eye-easy fluorescent green glow.
At the same time, they're low on voltage and current drain.
High on stability.
Pick the readouts that offer more of everything, including variety, for a whole host of digital display ideas.
They're a difference you can see





1. DP60A
2. DP90A
3. DG19E
4. DG12H
5. DG10F1
6. DG 8F
7. DP 89A
8. DP127F
9. DMCL12H (NEW)

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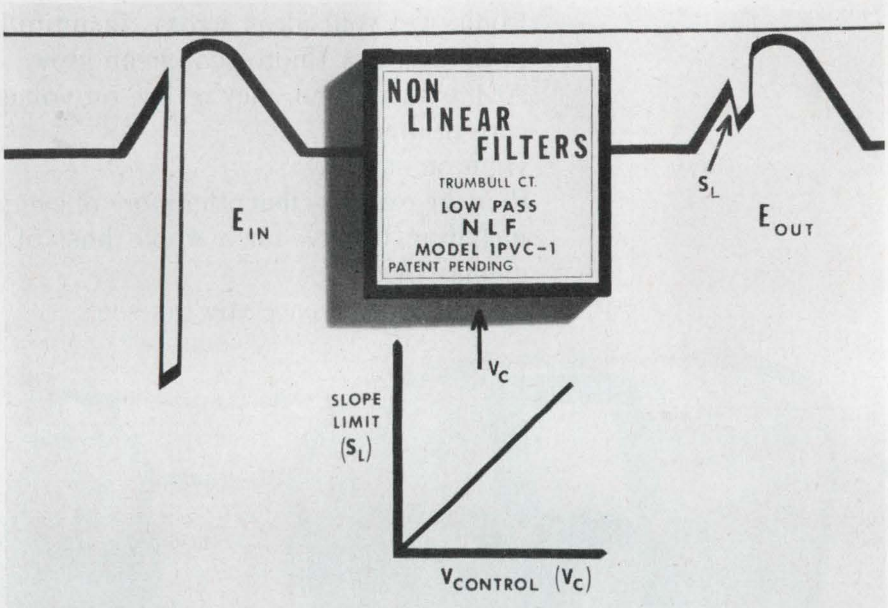
INFORMATION RETRIEVAL NUMBER 42

Voltage control is featured in zero-phase-shift filter



Non Linear Filters, P.O. Box 338, Trumball, Conn. 06611. (203) 268-6309. $125 (1 to 9); $88 (100s); 30 to 60 day.

The Model 1PVC-1 voltage-controlled low-pass nonlinear filter attenuates noise spikes without introducing any phase lag into the signal above or below the corner frequency.

The ability to control the corner frequency, by changing a few component values, makes this unit from Non Linear Filters useful in a variety of applications. The control-voltage input "instantaneously" (within 0.1 μs) controls the value of the limiting slope over a 500-to-1 range (54 dB).

With the control voltage set at a particular value, a constant-frequency, low-amplitude sine wave passes through the filter undistorted. As the amplitude is increased, the output becomes a triangular wave. But if the control voltage is also increased, the sine wave again passes through undistorted (without slope limiting).

The 1PVC-1 operates from dual 15-V supplies with a current drain of 20 mA max. The input-to-output offset is typically 200 mV (600 mV max), and the input bias current is below 2 nA. Input resistance over the dc-to-100-kHz frequency range is 3.6 kΩ max.

Output voltage swing with a load resistance of greater than 2.5 kΩ is ±10 V or more, while the input voltages are limited to ±11 V max. The slope-limiting is determined by the external components and can be calculated from a simple equation.

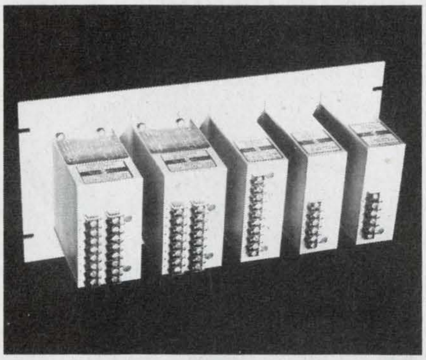
The corner frequency can be set externally by use of two approximately equal capacitors. You calculate their values by dividing a circuit constant by the corner frequency required. The answer is in microfarads.

The filter operates over a 0-to-70-C temperature span. It is housed in a 2.56-in.-square-by-0.88-in.-high encapsulated module that weighs 7 oz.

Typical uses for the filter include phonograph record surface and scratch noise rejection, phase-locked-loop FM detection, nonlinear autocorrelation, shot-noise filtering and digital communications.

CIRCLE NO. 253

Signal transducers handle V, I, W or VARs

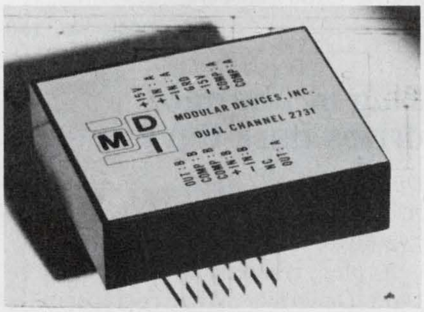


The Arnold Engineering Co., P.O. Box G, Marengo, Ill. 60152. (815) 568-2000.

The R-2000 series of transducers measures power, voltage or current. It offers accuracies of 0.5% of rated output across a broad range of operating conditions. Dielectric insulation and surge limit capabilities exceed proposed IEEE standards. Outputs are isolated low-ripple dc signals proportional to the ac quantities being measured. The units use modular circuit board construction, have IEEE standardized dimensions and terminal placement all in one plane.

CIRCLE NO. 294

Dual audio op amp delivers 2 W per channel



Modular Devices, 1385 Lakeland Ave., Airport International Plaza, Bohemia, N.Y. 11716. (516) 567-9620. $39; stock to 30 day.

The Model 2731 is a dual, low noise, audio operational amplifier. With the addition of an output transformer the module can drive a speaker with 4-W continuous peak power. Model 2731 has an output power of 2 W per channel. Other features include: Output short-circuit protection, small size of 1-1/2 × 1-3/4 × 1/2 in., dual in-line 14-pin configuration for PC board mounting and simplified system wiring.

CIRCLE NO. 295

Cassette recorder offers 9-hour play time

Answer Line Associates, Inc., One Northern Blvd., Great Neck, N.Y. 11021. (516) 466-9333. $99.50.

A cassette recorder designated the Long-Play gives nine hours of recording time on a single cassette. According to the manufacturer, specially selected heads and sophisticated circuitry provide excellent frequency response at a 5/8-in/s tape speed. Suitable for voice recording and many data logging applications where a minimum of operator handling is desirable, the instrument comes with an ac adaptor or can be operated in the field with five inserted "C" batteries. The suggested list price of $99.50 includes remote control microphone, carrying case, ac adaptor and a C180 cassette.

CIRCLE NO. 261

Plug-in interface drives desk-top printer

Data Interface Inc., 4 W. Kenosia Ave., Danbury, Conn. 06810. (203) 792-0290. $650; 30 days.

A plug compatible interface for Data General's Nova computers is available for Data Interface's non-impact printers. Occupying one I/O slot position in the Nova computer, the interface can be connected either directly to the printer or to one of the output connectors on the computer frame. The interface occupies only two of the eight card positions in the plug in assembly. The combination of printer and interface is compatible with Nova line-printer software. The small desk-top printer may be located up to 20 feet from the computer, and prints the full 96 character ASCII font at rates up to 180 lines/min.

CIRCLE NO. 262

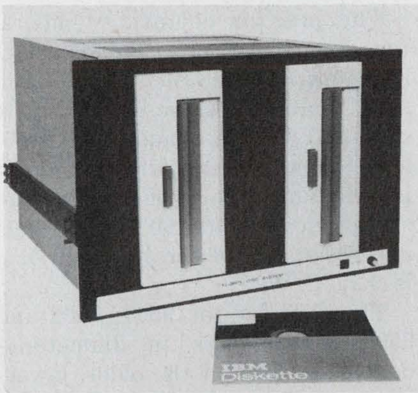
Intelligent terminal contains own mini

Megadata Computer & Communications Corp., 10 Evergreen Pl., Deer Park, N.Y. 11729. (516) 667-2900.

The SiR-1000 terminal can be thought of as a general-purpose minicomputer attached to a CRT and selectric-type keyboard. Seven circuit modules that use MOS/LSI comprise the entire system. The CPU portion uses eight-bit words and is expandable from 4 k to 10 k of memory. The keyboard is completely programmable and includes 51 function keys. The terminals handle a wide variety of interfaces including serial data ports (75 to 13,500 baud) and parallel eight or 12-bit ports. Standard terminal capabilities include code conversion, text editing and format control.

CIRCLE NO. 263

Floppy-disc drive is IBM 3740 compatible



Applied Data Communications, 1509 E. McFadden Ave., Santa Ana, Calif. 92705. (714) 547-6954. $3750; 45 days.

The Series 61 Floppy Disc System is IBM 3740 compatible. The controller installs in a small peripheral controller slot or wired system unit. A rack mounted enclosure contains one or two drives, power supply, and formatting electronics. Up to eight drives may be operated for one controller-formatter. Diskette capacity is 242-k bytes in IBM compatible format; transfer rate is 242-k bits/s. The system is supplied with all necessary hardware, basic software and support documentation needed for installation and operation with DEC PDP-11, PDP-8/e and Data General processors.

CIRCLE NO. 264

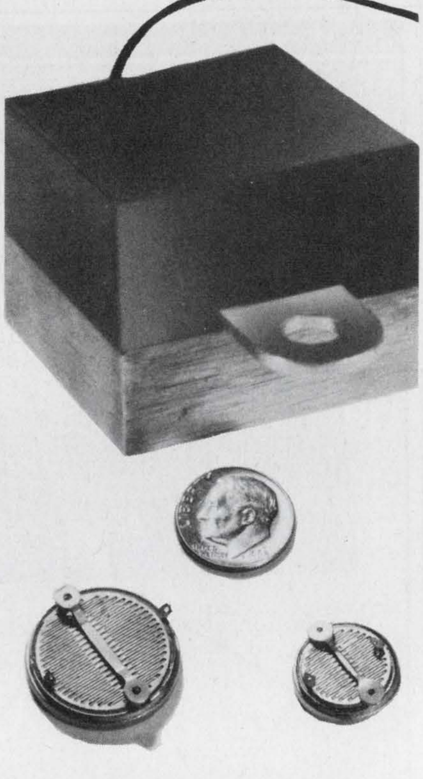
Modem speed increased with digital techniques

Timeplex, Inc., 65 Oak St., Norwood, N.J. 07648. (201) 767-1650. From $205; 30 days.

Designated the "202 Compatible Modem System," the unit provides 1800 baud communications over unconditioned lines and 2000 baud over C-2 conditioned leased lines. A digital filter system is said to provide the increased data rate over regular 202s. Options include a 5 or 150 baud reverse channel and a four-wire polling section. The modem is available in stand-alone form or as a card.

CIRCLE NO. 265

500-A one chip transistors have super-low V_{CE}(sat)



PowerTech Inc., 9 Baker Court, Clifton, N.J. 07011. (201) 478-6205. P&A: See text.

Single-chip transistors that can handle 500 A? It's true. PowerTech's Models PT-9501, 9502 and 9503 are the largest available silicon npn transistors, and they can control currents up to 500 A or voltages up to 120 V at 400 A.

The 9501 and 9502 can handle 500 A at 60 V and 80 V, respectively. The 9503, though, can pass only 400 A—but at 120 V. All three transistors have a V_{CE} (sat) max of 0.5 V at 300 A, and except for the 9503, they have a V_{CE} (sat) max of 1 V at 500 A.

Power dissipation for the units is 625 W at a case temperature of 25 C, with derating down to 400 W at 100 C. Transistor beta at an I_C of 300 A is 10. When the current is increased to 500 A, the beta drops to 5. Switching speed at a current level of 75 A is a combination of 3-μs rise time, a 3-μs storage time and a 3-μs fall time, for an absolute max switching frequency of 10 kHz.

All transistors are housed in a PB-500 Power-Block case 1.5-in. square by 1.1-in. high. Other case styles are available upon request. Each unit is subjected to a power test at 40 V, 10 A and a 100-C case temperature for preliminary reliability burn-in.

The junction operating-temperature range is from −65 to 200 C, although the case epoxy can withstand ambient temperatures up to only 150 C. This causes no problems, though, since when the unit is heat-sunk, the case temperature stays below about 100 C. The thermal resistance of the junction Θ_{j-c}, is 0.25 C/W.

The chip for the 9501, 9502 and 9503 is 820 mils in diameter—double the area of the older, lower-power modules. The chips can also be packaged in a power-system array that can switch currents of up to 3500 A. Collector capacitance is 5000 pF when tested at a V_{CB} = 10 V and when f = 100 kHz.

Competing units from other companies use a multchip approach for the high current—paralleling as many as 10 lower current transistors.

The 100-up price for the 9501 and 9502 is $123.50 each, while the price for the 9503 is $138 for the same quantity. All devices are available from stock.

Applications for these transistors include high-current switching for motor controls, battery-test equipment, dc-to-ac inverters for auxiliary power sources and solid-state relays.

CIRCLE NO. 252

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1 CASE of Mail-Lite FREE when you buy my $50 table model heat sealer.

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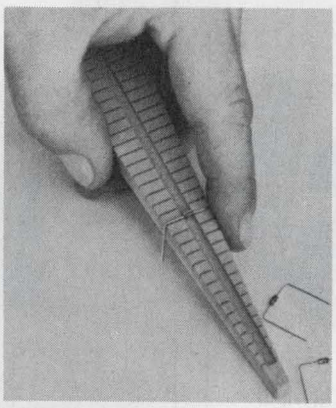
INFORMATION RETRIEVAL NUMBER 49

CUT PRODUCTION TIME WITH THESE

LOW COST COMPONENT LEAD BENDERS



Up to 1200 component leads per hour may be formed with these simple, precise units. They cut production time and eliminate damage to components and leads. Designed primarily for resistors and diodes, MARK Series Component Lead Benders produce perfect bends. Tantalum capacitors, axial lead components, jumper wires, and other similar parts may also be formed easily and efficiently. Ideal for both prototype and production situations.

Bends are made rapidly with gentle finger pressure and meet N.A.S.A. Specification MSFC-PROC-256. No other tools are required. The aggravation and component damage associated with the long-nose plier "free bending" technique is completely eliminated. Industry proven since 1959, the MARK Series offers 5 models for forming 1/8 watt, 1/4 watt, 1/2 watt, 1 watt, and 2 watt size component leads. Priced under $5.00, these quality tools are available for off-the-shelf delivery. For complete information write or call:

RG ENTERPRISES, INC.
P.O. BOX 667
SCOTTSDALE, ARIZONA 85252
TELEPHONE (602) 948-9888

INFORMATION RETRIEVAL NUMBER 50

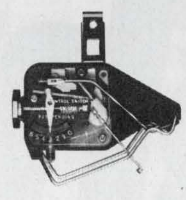
STILL LOOKING FOR A SPECIAL COMBINATION OF SWITCHING ACTIONS? ...YOU WOULDN'T BE IF YOU'D CHECKED OUR INVENTORY OF SWITCH DESIGNS FIRST!

. . . we've been making special pushbutton, toggle, and limit switches for over 35 years!

Typical CSI Switches with Unusual Features:

INDUSTRIAL
Limit switch designed to operate underwater for long periods without maintenance. For use in harsh environments such as machine shops, oceanography, etc.

COMMERCIAL AVIATION
Low cost, airline, lighted hostess call switches chime only once when depressed, but can be actuated many times without resetting. For use in commercial aviation.



TEXTILE MACHINERY
Yarn detector switches sensitive enough to detect fine yarn breakage or over tension and facilitate smooth operation of knitting machines in the textile industry.

MEDICAL ELECTRONICS
Lightweight miniature switch for use in electronic heart pacer applications features high reliability operation in medical equipment.

Write For Technical Bulletins, or send us the specs of the switch they said couldn't be made . . . we'll send you a quote!

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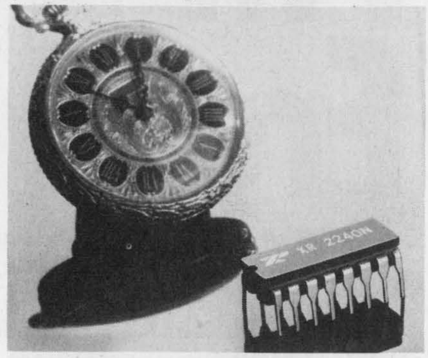
INFORMATION RETRIEVAL NUMBER 51

INFORMATION RETRIEVAL NUMBER 52

INFORMATION RETRIEVAL NUMBER 53

Counter/timer IC has μs-to-5-day delays

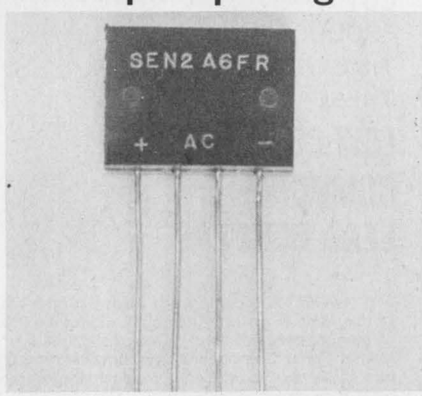


Exar Integrated Systems, 750 Palomar, Sunnyvale, Calif. 94086. (408) 732-7970. $5.75 (100); stock.

A monolithic counter/timer generates precise, very long time delays with an external RC setting. It can be used to obtain programmable time delays from microseconds up to 5 days with an accuracy of 0.5% and a temperature stability of 40 ppm/°C. Because of the binary counting method, it is also possible to cascade two XR-2240 timers to generate programmable time delays up to three years. The circuit combines an analog timebase oscillator with a programmable 8-bit counter on the same chip.

CIRCLE NO. 266

Bridge rectifiers come in compact package



Sensitron Semiconductor, 221 W. Industry Ct., Deer Park, N.Y. 11729. (516) 586-7600.

A single-phase subminiature 2-A fast-recovery bridge rectifier series comes in a compact epoxy case. Continuous current rating is 2 A at 55-C ambient temperature. Surge rating is 50 A for 8.3 ms. The series lists voltage ratings of 50 through 800 V.

CIRCLE NO. 267

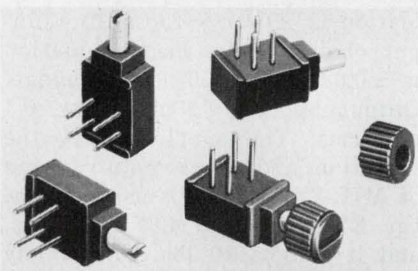
Linear-motion pot has 0.1% linearity

Computer Instruments Corp., 92 Madison Ave., Hempstead, N.Y. 11550. (516) 483-8200. 8-10 wks.

A miniature but rugged linear-motion potentiometer, the Model 120, has a 1-in. stroke and is furnished in an aluminum housing 1/2 × 5/16 × 2-in. long. Clearance holes are provided for mounting. Plain, threaded or slotted shaft endings are available. The unit uses a conductive-film resistive element that is suitable for ac or dc operation without amplification. Maximum linearity is 0.1% and maximum resistances from 500 Ω to 100 kΩ are standard. Wattage rating is 1 W and the operating temperature range is −55 to 125 C.

CIRCLE NO. 268

Switches solder directly to PC board

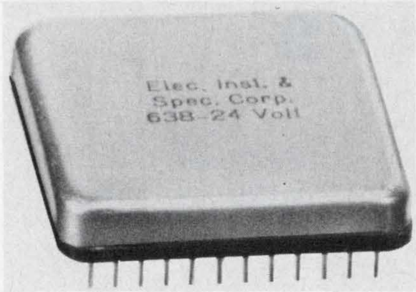


Control Switch, Inc., 1420 Delmar Dr., Folcroft, Pa. 19032. (215) 586-7500. $1.25: pushbutton; $0.95: toggle (unit qty).

Pushbutton and toggle switches are designed for solder-pin insertion into 1/16, 3/32, and 1/8-in. thick PC boards. They are also available for thru-panel mounting. Only 0.6 in. in length, the switch body requires no mounting hardware. Terminals are 0.13 in. long. Two and three-position toggles and momentary action or latch-down pushbuttons are available. All switches are two circuit with a mechanical life in excess of 500,000 operations. Resistive load is rated from 0.01 A, 6 V dc, to 0.5 A, 28 V dc and ac. Cases and actuators are molded of impact and heat-resistant plastic. Terminals and contacts are gold-plated silver for long shelf life and minimum resistance.

CIRCLE NO. 269

Multipole reed relay features low profile



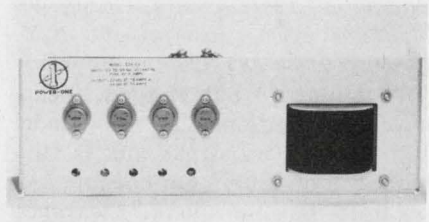
Electronic Instrument & Specialty Corp., 42 Pleasant St., Stoneham, Mass. 02180. (617) 438-5300. Typical $12.30 (500 up); 4-6 wk.

This multipole (4 to 8 contacts, Form A) flat-pack reed relay needs only a 0.5-in. height and mounts on a PC board into standard contact strips. Specifications of the relay include 0.5-A, 200-V and 10-W maximums. Multiple coils and a variety of contact forms are also available.

CIRCLE NO. 270

INFORMATION RETRIEVAL NUMBER 54

Series pass supply is more than 50% efficient



Power One, 6324 Variel Ave., Building E., Woodland Hills, Calif. 91364. (213) 887-5730. $98.95 (1 to 9).

The Model E5-18, a 5 V (±5%) 18 A series pass, dc power supply, provides greater than 50% efficiency. The supply incorporates an adjustable current foldback, 0.02% regulation and reverse voltage protection as standard features with overvoltage protection available as an option. Input power is 105 to 125 V ac, 47 to 440 Hz while the operating temperature range is 0 to 50 C at full output but can be derated at 70 C to 40%. Line regulation is ±0.01% for a 10 V input change while load regulation is ±0.02% for a 50% load change. Output ripple is 1.5 mV pk-pk, 0.4 mV rms. The supplies meet the vibration and shock requirements of MIL-STD-810B. Over-all size of the E5-18 is 3 × 4.87 × 14 in. and it weighs 10 lbs. The supply is also available in 15 and 24 V output models.

CIRCLE NO. 271

Modular supplies come in many standard sizes

Air Design Inc., 3824 Terrace St., Philadelphia, Pa. 19128. (215) 483-1383. From $26.75; stock.

Series AD modular power supplies can be powered by an input voltage of 115±10 V ac at 50, 60 or 400 Hz. Regulated dc outputs are available up to 200 V at 2 A maximum, although models at 3.6, 5, 6, 10, 12, 15, 18, 20, 24 and 28 V are standard. Output currents range from 250 to 2000 mA. Line and load regulation (NL to FL) is 0.02% within specified range. Ripple is less than 0.5 mV maximum within specified range. Options include programmable or field-adjustable output models.

CIRCLE NO. 272

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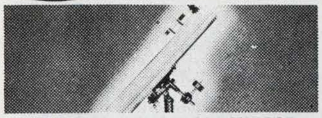

SUPER 6" SPACE CONQUEROR

Superb Astronomical Reflector includes electric drive w/manual slow-motion control, setting circles, heavy-duty equatorial mount, pedestal base. Features aluminized, overcoated 6" f/8 ground + polished Pyrex(R) parabolic mirror accurate to 1/4 wave, 48" F.L., 6X achromatic finder, 4 eyepieces—48X Kellner, 1/2" 96X, 1/4" 192X Ramsdens, & a Barlow to double or triple power—rack & pinion focusing mount. 47-3/4" aluminum tube.

No. 85,086DA (Shp. Wt. 68 lbs.) ....$259.59 FOB
6" Without Clock Drive No. 85,187DA ....$222.50 FOB
4-1/4" Reflector (48X to 275X) No. 85,105DA ....$115.00 FOB
4-1/4" Reflector W/Clock Drive No. 85,107DA ....$149.95 FOB
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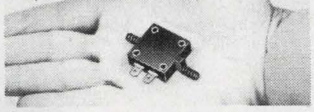
Stock No. 79,050DA ....$150.00 Ppd.
3.0mW min—DEPENDABLE HI-POWERED LASER: 1.0mm beam dia., 0.8mRad beam Diverg.
Stock No. 79,052DA ....$325.00 Ppd.



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C&K COMPONENTS, INC., 103 Morse Street, Watertown, MA 02172. Tel: (617) 926-0800 TWX: 710-327-0460.

"See us at IEEE"

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TOOL KITS

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Write for brochure!

More than 100 fine tools used for maintenance and adjustment of electronic equipment, computers and office machines. Small tools are held securely on two removable pallets. Three roomy compartments in the bottom of the deluxe attaché case hold larger tools, optional test meter and parts boxes. A space for service manuals and schematics is provided in the cover.

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Jensen attaché cases provide a convenient way to carry a large number of tools. Three models are offered: thin-line, standard and extra deep. All cases feature solid wood frames with mahogany paneling and dovetail corners, solid brass hardware and anodized aluminum partitions. Covering is scuff-proof Marvelon. Removable small-tool pallets and partitioned compartments in bottom of the case hold tools securely in a well organized manner. Write for brochure giving dimensions and full details.

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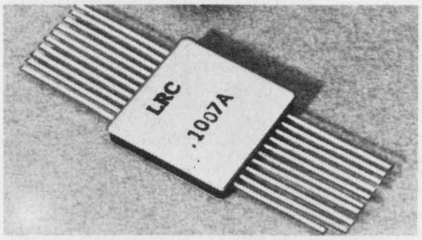
10-ns SW driver comes in flatpack



LRC, Inc., 11 Hazelwood Rd., Hudson, N.H. 03051. (603) 883-8001.

An rf switch driver can provide current from either positive or negative 12-V supplies, depending on the input from a TTL gate. Called the Model SD-1007A, the switch drivers have a total switching time of 10 ns maximum, with typical delay and rise time of less than 5 ns. The drivers are compatible with both TTL and DTL circuits and contain a pull-up circuit built into the input to provide for dc testing.

CIRCLE NO. 275

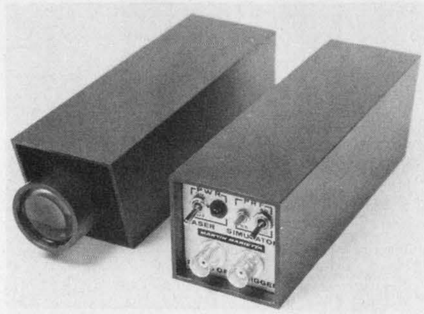
BNC termination priced at $4.50

Elcom Systems, Inc., 127F Brook Ave., Deer Park, N.Y. 11729. (516) 667-5800. $4.50 (100); stock to 30 day.

A 50-Ω coaxial BNC termination sells for $4.50 in 100-piece quantities. The termination has an average VSWR of 1.1:1 over the frequency range of dc to 4 GHz; maximum VSWR is 1.3:1. Dissipation is spec'd at 1/2-W cw and 1 kW peak over the −25-to-85-C temperature range.

CIRCLE NO. 276

Simulators speed laser tests

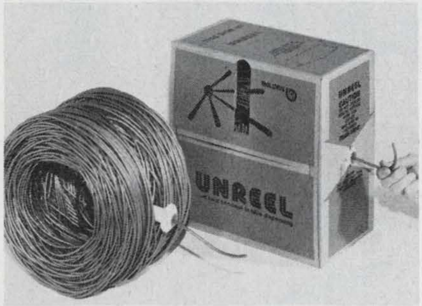


Martin Marietta Aerospace, P.O. Box 5837, Orlando, Fla. 32805. (305) 855-6100. LS-1: $650; LS-2: $450; LS-3: $425.

A compact laser simulator, for rapid checkout of laser seekers and receivers, weighs only 1 lb, and uses a 9-V battery that provides over 10-hours continuous operation. Three models are available: The LS-1 provides 3-mW peak output and 20-ns pulse width at 1.06 μ. The LS-2 offers a 3-W output at 0.905 μ. The LS-3 lists a 3-mW peak output and 60-μs pulse width at 0.660 μ. All models have a selectable PRF.

CIRCLE NO. 296

Wire dispenser uses no reels



Belden Corp., 415 S. Kilpatrick Ave., Chicago, Ill. 60601. (312) 378-1000.

Unreel is Belden's new packaging innovation that greatly simplifies the dispensing of wire and cable and substantially cuts user handling costs. The packaging method provides virtually inertia-free payout of wire and cable from a stationary, self-supporting, reel-less coil contained within a rough paperboard carton. The wire, or cable, may be drawn from the package at high speeds with essentially no drag and with instantaneous start and stop. This eliminates tangles, which result from reel inertia that must be overcome on starting or stopping. For wire installers, the Unreel package means that neither a pipe-rack stand nor an assistant to tend reels during pulling is necessary. The new package thus saves space at the job site, reduces the load the installer must carry and eliminates set-up time when reels are changed. For the manufacturer, Unreel eliminates the need for tensioning equipment, when used with discontinuous, start-stop wire and cable processing equipment.

CIRCLE NO. 277

Blower motor controlled by solid-state circuit

McLean Engineering Laboratories Inc., 70 Washington Rd., Princeton Junction, N.J. 08550. (609) 799-0100.

A solid-state motor control permits this line of blowers to operate at low audible-noise levels. A thermostatic probe senses outlet air temperature to operate the blower at full volume only when the temperature rises above 90 F.

CIRCLE NO. 278

Magnetic fluids that don't settle out

Ferrofluidics Corp., 144 Middlesex Turnpike, Burlington, Mass. 01803. (617) 272-5206.

Ferrofluidics' magnetic fluids are a new class of materials that can solve ink settling and clogging problems in traditional as well as new printing techniques. The non-settling and stable behavior of these magnetic fluids produce magnetic inks that have long storage life both in the printing machine and on the shelf. Ferrofluids contain particles in the 0.01-μ range and they do not require mixing or stirring. The fluids are available in a wide range of carrier liquids to allow printing on many different surfaces. They are particularly applicable to ink-jet printing systems, which spray ink from tiny orifices, and they also enable the magnetic control of the printing jet.

CIRCLE NO. 279

DIP socket wire-wraps on component side

Robinson Nugent, Inc., 800 E. Eighth St., P.O. 470, New Albany, Ind. 47150. (812) 945-0211.

The A-OK/U-Type socket allows wire-wrapping on the same side of the board on which packages are mounted. Body height of the U-Type is just 0.175-in. over-all. All contacts and terminals are of spring-tempered beryllium copper in a one-piece configuration with contact lead-in arms angled at 30 degrees to provide for easy automatic or manual IC insertion. Terminals are 0.025-in. square to allow for either wire-wrap or soldered connection. Socket body ends are notched for individual or series mounting with #2 screws.

CIRCLE NO. 280

INFORMATION RETRIEVAL NUMBER 62

GET READY

In a few months *Electronic Design's Master Directory* — the GOLD BOOK — will be rolling off the presses and moving on to desks, lab benches, reference shelves, and information centers throughout the U.S. and Europe. It's the directory that will change your thinking about directories . . . the most massive compendium of product information ever compiled . . . a one-step reference source for the data you need to specify, select and buy.

Recognizing potential paper shortages, rising printing, postage and mailing costs, many manufacturers have taken action to be sure their catalog material will reach you no matter what happens. They're choosing the GOLD BOOK to be their personal industry representative.

CONTENTS INCLUDE:

- PRODUCT DIRECTORY (Lists the manufacturers of each product.)
- DIRECTORY OF MANUFACTURERS AND SALES OFFICES (Includes company profiles.)
- DIRECTORY OF DISTRIBUTORS
- DIRECTORY OF TRADE NAMES
- CATALOG DATA AND TECHNICAL INFORMATION SECTION (A massive compendium organized by product category.)

design aids

English-metric converter

The hand-held circular Anglo-Met is a convenient tool for accurate English-metric conversions. It gives conversions of length, weight, area, volume and dry or liquid measurements. The 6 in. diameter converter is constructed of heavy-duty plastic and is laminated to prevent wear on lettering. Telex.

CIRCLE NO. 281

Wire and cable kit

A design kit enables users to specify the information required for development of "special" wire and cable products. The kit includes a specification/quotation form that organizes and identifies design parameters, a design guide that outlines basic factors affecting performance and a reference catalog. Belden.

CIRCLE NO. 282

Breadboard kits

A miniature cable chain and belt breadboard development kit consists of grilled breadboard plates, assorted shafts, rotating component hangers, dials and over 650 associated parts for building a complete test system. Winfred M. Berg.

CIRCLE NO. 283

Filter reference table

An easy-to-use reference table lists several liquid and gas filter variables including materials of construction, dimensions, port size, pressure rating and flow capacity and cross-references them with the company's filters. Balston.

CIRCLE NO. 284

Clock display readout

An actual-size printed version of a clock display readout is ideal for use on equipment mock-ups and other preproduction applications. The orange-and-black strip has a pressure-adhesive backing. Sperry Information Displays Div.

CIRCLE NO. 285

new literature

OEM modems and dialers

A four-page short-form catalog covers OEM and end-user modems and automatic dialers. The Vadic Corp., Mountain View, Calif.

CIRCLE NO. 286

Ferrofluids

A 16-page handbook contains data on today's state of the art for ferrofluids as well as typical areas of application. Ferrofluidics, Burlington, Mass.

CIRCLE NO. 287

Interconnections

Adapta-Con electrical connector series for dual-contact PC and I/O interconnecting packaging designs is described in a 12-page brochure. ITT Cannon, Santa Ana, Calif.

CIRCLE NO. 288

Magnetic iron oxides

Updated data on general-purpose magnetic iron oxides are contained in two bulletins. Hercules, Wilmington, Del.

CIRCLE NO. 289

Selector switches

The 223 series 1-inch selector switches are detailed in a catalog. CTS Keene, Paso Robles, Calif.

CIRCLE NO. 290

Power supplies

Power supplies for OEM systems and general-purpose slot applications in both single and dual output configurations are described in a 16-page catalog. NJE, Dayton, N.J.

CIRCLE NO. 291

Laser illuminators

YAG laser illuminators are described in a brochure. International Laser Systems, Orlando, Fla.

CIRCLE NO. 292

Components

Terminals, jacks, plugs, handles, battery holders, IC sockets, IC breadboards, coils and chokes are described in a catalog. Cambion, Cambridge, Mass.

CIRCLE NO. 293

Design Data from Manufacturers

Advertisements of booklets, brochures, catalogs and data sheets. To order use Reader-Service Card

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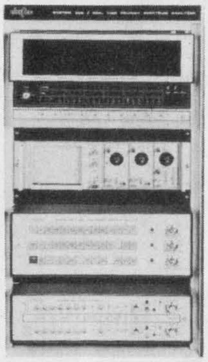
DIGITAL FOURIER ANALYSIS SYSTEM 306



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P.O. Box 671, San Diego, Calif. 92112
(714) 278-2501

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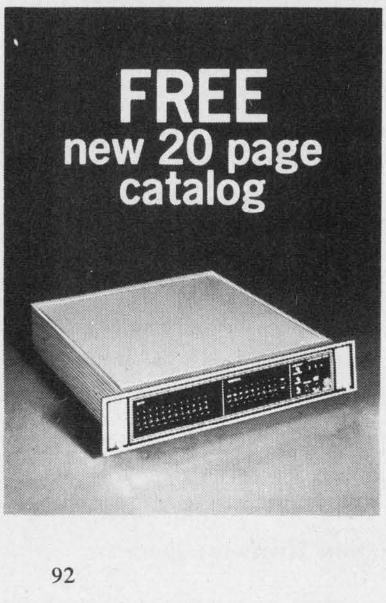

Computer Compatible Data Acquisition System

256 CHANNELS

C/MOS logic reduces power consumption and physical size by 3 times over conventional systems and reduces cost by up to 50% . . .

priced from $1900

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1020 Turnpike Street, Canton, MA. 02021

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ELECTRONIC DESIGN's function is:

- To aid progress in the electronics manufacturing industry by promoting good design.
- To give the electronic design engineer concepts and ideas that make his job easier and more productive.
- To provide a central source of timely electronics information.
- To promote communication among members of the electronics engineering community.

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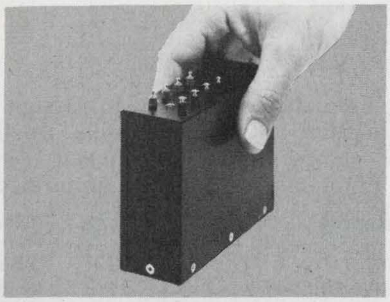
quick ads

New and current products for the electronic designer presented by their manufacturers.



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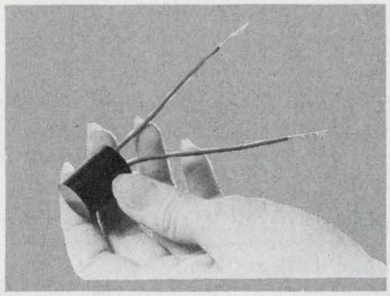

Solid state ac flashers—Low cost from $1.95—and brand new. Why settle for thermal type flashers due to cost? Designed to operate incandescent, inductive, or resistive loads up to 1 amp (120 watts). Virtually infinite life. Request data on Type FS127. SSAC PRECISION PRODUCTS, INC., P.O. Box 395, Liverpool, N.Y. 13088. (315) 699-2551.

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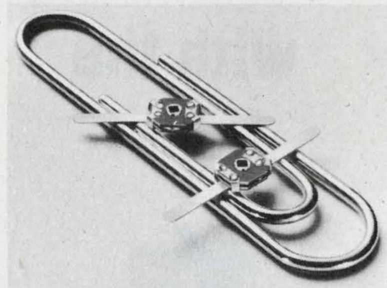

Thin-Trim variable capacitors provide a reliable means of adjusting capacitance without abrasive trimming or interchange of fixed capacitors. Series 9401 has high Q's and a range of capacitance values from 0.2-0.6 pf to 3.0-12.0 pf and 250 WVDC working voltage. Johanson Manufacturing Corporation, Boonton, New Jersey (201) 334-2676.

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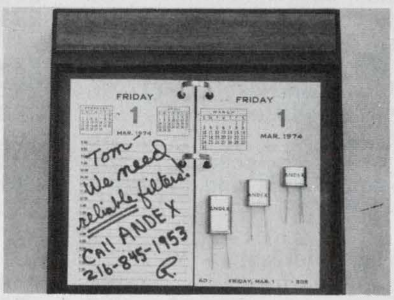

Stable ceramic resonators available in new extended frequency range from 2.8 kHz to 200 kHz. Applications include frequency control in oscillators and clock generators (CM-OS) and narrow bandpass filters for remote control, navigational receivers, and underwater signalling. Andex Corp., 7076 Big Creek Pky, Middleburg Hts., OH. (216) 845-1953

INFORMATION RETRIEVAL NUMBER 184

Pocket Size Tri-Phasic™ Multimeter Model 245 $295. Miniature, Rugged laboratory-quality 4½ digit DMM. 0.005% resolution, 100% overrange. ±0.05% basic accuracy. Measures DCV, ACV, DC and AC current and resistance. Battery and line operation 1¾"H x 3½"D x 5½"W. Data Precision, Audubon Road, Wakefield, Ma. 01880. (617) 246-1600.

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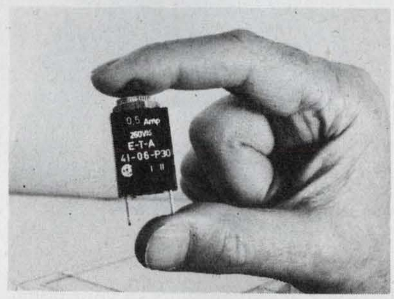

Overcurrent Protector, manual reset eliminates fuse replacement. Convenient panel mounting. 15 fractional ratings from 0.1 to 3 amp. Other models up to 400 amp. Trip-free and fool-proof, UL and CSA approved. High quality, low cost-$1.12 ea. in 1000 lots. E-T-A Products Co. of America, 6284 N. Cicero Ave., Chicago, Ill. 60646. Tel. (312) 545-1553.

INFORMATION RETRIEVAL NUMBER 186

Best buy, 5½ DMM $1295. 5½ Digit Tri-Phasic™ Multimeter 2540A1. Auto ranging; 1 μV to 1000 VDC; 1 milliohm to 12 megohms; AC/DC ratio; 1 μV to 500 VAC; DC/DC ratio; Isolated BCD output; Remote Control; Autozero. Data Precision, Audubon Road, Wakefield, MA. 01880. (617) 246-1600.

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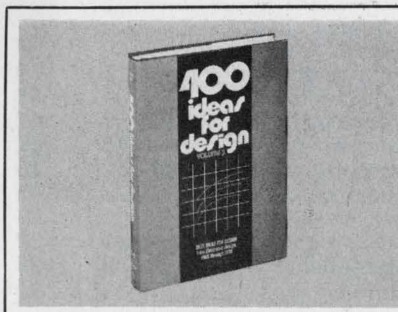

400 Ideas for Design, Vol. 2, Edited by Frank Egan. Ready to borrow, modify, or adapt, the top recent contributions to Electronic Design's popular "Ideas for Design" column range from amplifiers to switching circuits. 288 pp., illus., cloth, $11.95. Circle below for 15-day examination copies. Hayden Book Co., New York, N.Y. 10011.

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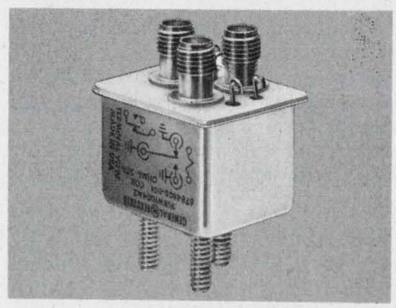


For critical RF switching GE offers space-proven relays with co-axial connections. Welded construction, hermetically sealed, removes dangers of exposed arcing of open relays. Reliability failure rates to .01%/10,000. RF switching up to 150 watts and auxiliary contacts for microvolt signals to 2 amps. Less than 1 cu. in. GE, Waynesboro, Va.

INFORMATION RETRIEVAL NUMBER 189

product index

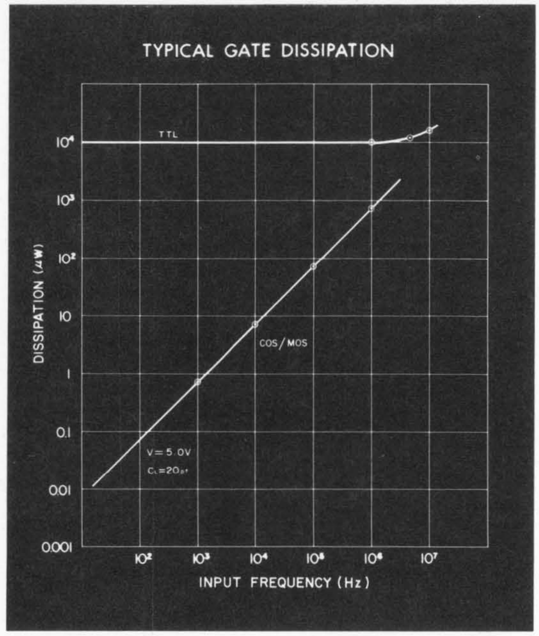
Information Retrieval Service. New Products, Evaluation Samples (ES), Design Aids (DA), Application Notes (AN), and New Literature (NL) in this issue are listed here with page and Information Retrieval numbers. Reader requests will be promptly processed by computer and mailed to the manufacturer within three days.

new literature

design aids

INFORMATION RETRIEVAL NUMBER 246

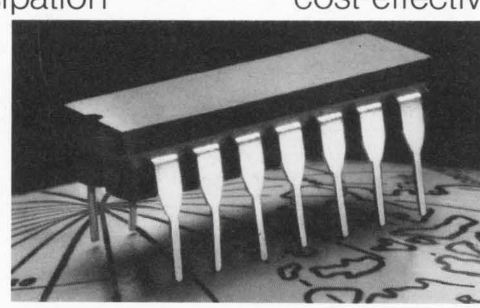
COS/MOS is Power Conscious



Plagued by expensive power supplies and cooling systems? Having a rough time trying to cram too many system functions into a mini-package? Heat causing a reliability problem?

"Yes" to any of these problems means you have a need for RCA COS/MOS IC's.

COS/MOS power dissipation is negligible at dc and increases linearly with frequency. Since many logic elements in a digital system are idle much of the time, or switch at lower rates than the maximum clock frequency, a substantial net power saving can be achieved with COS/MOS in comparison with other logic families whose dissipation remains constant with frequency.



For example, a Digital Clock with 21 COS/MOS IC's takes only 6.3 milliwatts for the countdown from a 262 KHz crystal and the logic to drive an hours, minutes and seconds display. A comparable TTL system will consume 600 milliwatts—a difference of almost 100 to 1 in power cost savings with COS/MOS.

Power conscious? You bet it is. But ultra-low power consumption is not the only great feature you get.

☐ COS/MOS circuits work from 3 to 15 volts, eliminating expensive regulators.

☐ COS/MOS noise immunity is among the highest of any technology (typically 45% of supply voltage).

☐ COS/MOS features stable transfer characteristics—less than 3.0% change over the full temperature range of −55°C. to +125°C.

It all adds up to ease of use and cost-effective designs. Try it. You'll be convinced that the digital world is a COS/MOS world.

Send for your guide to the ever-growing COS/MOS Product Family. Write: RCA Solid State, Section 57C-1, Box 3200, Somerville, N.J. 08876. Or phone: (201) 722-3200, Ext. 2565.

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products that make products pay off

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