VOL. 21 NO. 4

Electronic Design

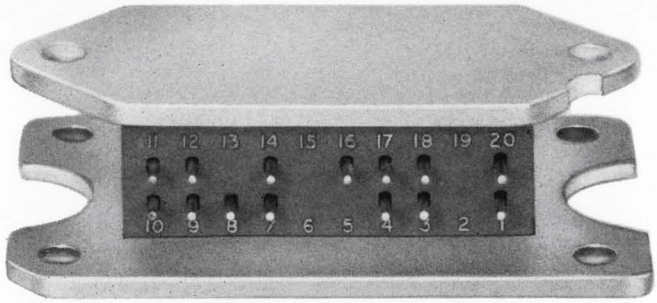
FOR ENGINEERS AND ENGINEERING MANAGERS

FEB. 15, 1973

Industrial telemetry is growing along with factory automation, a money-saving stress on quality surveillance and centralization of control within plants. Needed are more and improved sensors in remote places, higher-capacity data links—both microwave and hardwire—and faster analog and digital displays. See page 28.

Do you face a make or buy decision on power supplies?

Announcing Lambda's new 85W negative power hybrid voltage regulator



85W,-5.2V,5A

$35 ea. (in quantity of 1) $20 ea. (in quantity of 100) $18 ea. (in quantity of 1000)

also available

62W positive power hybrid voltage regulators
62W,5V,3A

$25 ea. (in quantity of 1)
$14 ea. (in quantity of 100)
$11 ea. (in quantity of 1000)

85W positive power hybrid voltage regulators
85W,5V,5A

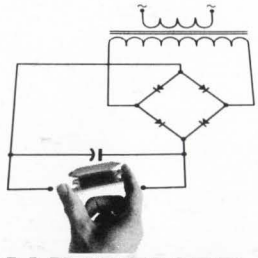
$30 ea. (in quantity of 1)
$18 ea. (in quantity of 100)
$15 ea. (in quantity of 1000)

Regulation: 0.2% line
0.2% load
Ripple: 2mV RMS

100,000 hours MTBF demonstrated

1-DAY DELIVERY

Send for 1973 Power Supply Catalog and Application Handbook



WHETHER YOU MAKE OR BUY...

LAMBDA
ELECTRONICS CORP.
A (Veeco) Company

MELVILLE, NEW YORK 11746 515 Broad Hollow Road Tel. 516-694-4200 **ARLINGTON HEIGHTS, (CHICAGO) ILL. 60005** 2420 East Oakton St., Unit Q Tel. 312-593-2550
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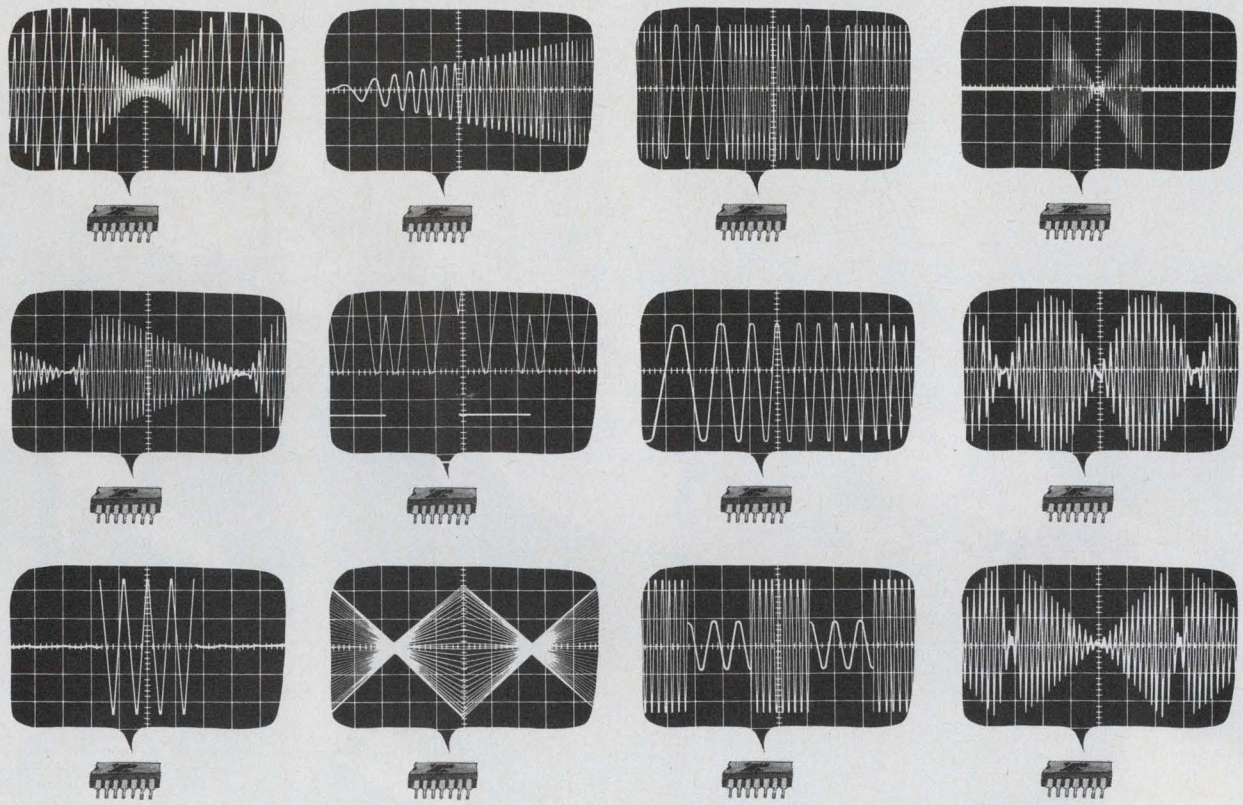
INFORMATION RETRIEVAL NUMBER 202

EXAR'S IC WAVEFORM GENERATOR SPEAKS FOR ITSELF



Yes, the XR-205 monolithic waveform generator speaks for itself in a cost-saving way that systems designers can understand.

Just one Exar XR-205 device provides sine, square, triangle, ramp and sawtooth waveforms without additional active components. By adding a second XR-205, you can create amplitude, frequency or phase modulated varieties of these basic waveforms. So two XR-205 for $16.00 each, in 1-24 quantities, are able to replace comparable large discrete waveform generators selling from $200 to $1300. At the same time they greatly reduce system weight, complexity and power consumption.

Waveshaping is accomplished by a unique monolithic diode-resistor combination with only about 2 percent total harmonic distortion. The harmonic content of the sinusoidal output is relatively independent of the modulation input and frequency of operation.

Here's how the XR-205 works: each chip contains three separate logic sections. A Voltage-Controlled Oscillator section with a frequency range of 0.1 Hz to more than 10 MHz generates the basic waveforms by means of an emitter-coupled multivibrator. A Balanced Modulator provides the wave-shaping and amplitude modulation. A highly linear four quadrant analog multiplier is used for suppressed carrier modulation as well as for conventional double sideband AM generation. A Buffer Amplifier provides a low impedance output with high current drive capability.

To get you started at a modest cost, ask us for the XR-205K Waveform Generator Kit. The kit sells for $28.00 in small quantities and is comprised of two XR-205 devices, a drilled and etched circuit card, and detailed assembly and hookup instructions.

For more information or an order call Jim Shales, Director of Marketing at Exar. He and his people speak your language.

EXAR SPEAKS YOUR LANGUAGE

EXAR INTEGRATED SYSTEMS

750 Palomar Sunnyvale, California 94086 (408) 732-7970 TWX 910-339-9233

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INFORMATION RETRIEVAL NUMBER 2

For the really tough applications, OEM's like Magnavox choose HP.

We all know what collisions at sea can mean to a company's reputation. That's why Magnavox sought reliability above all else in choosing the HP 2100A minicomputer for its all-weather, worldwide Satellite Navigation System. It brings added safety and economy to the operation of large ocean-going vessels. Including the new deep-draft supertankers which must navigate through narrow channels.

In fact, reliability is one of the major reasons why OEM's are using Hewlett-Packard's line of thoroughly modern minis for their systems. But reliability is not enough. Magnavox, like any OEM, also must be competitive in their market place. Hewlett-Packard's 2100A solved their need. Competitive? Just try us!

And modular. So compact and rugged that entire Magnavox systems can be transferred from one vessel to another. Adaptable, too. Commercial transports, oil tankers, passenger ships, exploration vessels for the Navy and Coast Guard. Virtually every large ship plying the waterways of the world can use this system to pinpoint instantly its position anywhere in the world. Night or day.

Peripherals? HP offers OEM's a wide range of competitively priced system components to choose from. No more shopping around for compatible black boxes for your system.

More competitive hardware, firmware, software, spare parts, documentation, training, and service for the OEM from Hewlett-Packard — worldwide.

Are you laying your reputation on the line without an HP mini? Call your local HP sales engineer for details on fitting the right mini into your system. Or write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304; Europe: P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland; Japan: YHP, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

HEWLETT hp PACKARD

22224

INFORMATION RETRIEVAL NUMBER 3

Electronic Design

FOR ENGINEERS AND ENGINEERING MANAGERS

VOL. 21 NO. 4

FEB. 15, 1973

NEWS

TECHNOLOGY

PRODUCTS

Departments

Cover: Command center for a blast furnace at the Indiana Harbor complex of Youngstown Sheet and Tube Co. was built by Cutler-Hammer's Industrial Systems Div. in Milwaukee.

ELECTRONIC DESIGN is published biweekly by Hayden Publishing Company, Inc., 50 Essex St., Rochelle Park, N. J. 07662. James S. Mulholland, Jr., President. Printed at Brown Printing Co., Inc., Waseca, Minn. Controlled circulation postage paid at Waseca, Minn., and New York, N. Y., postage pending Rochelle Park, N. J.

84,392 copies this issue.

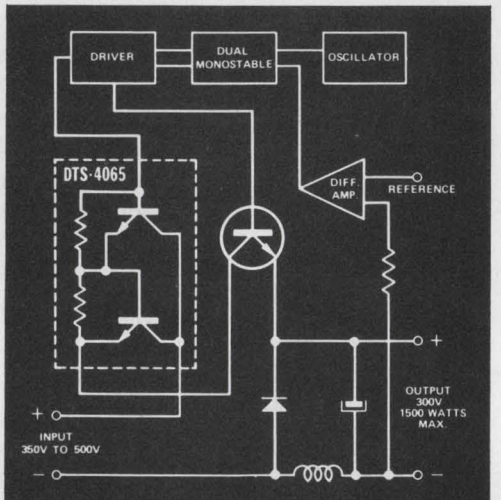
NOW, 400V & 600V DARLINGTONS FROM

Delco Electronics

DIVISION OF GENERAL MOTORS CORPORATION, KOKOMO, INDIANA

Delco's new DTS-4000 series Darlingtons with $V_{CEO's}$ of 400V and 600V are triple diffused mesa units built for rugged duty. They come to you with a practical 15 Ampere rating that you can depend on all the way up to the high voltage requirements of ac motor speed controls, for instance—or the 1.5 kW switching regulator in the illustration.

And they offer new possibilities

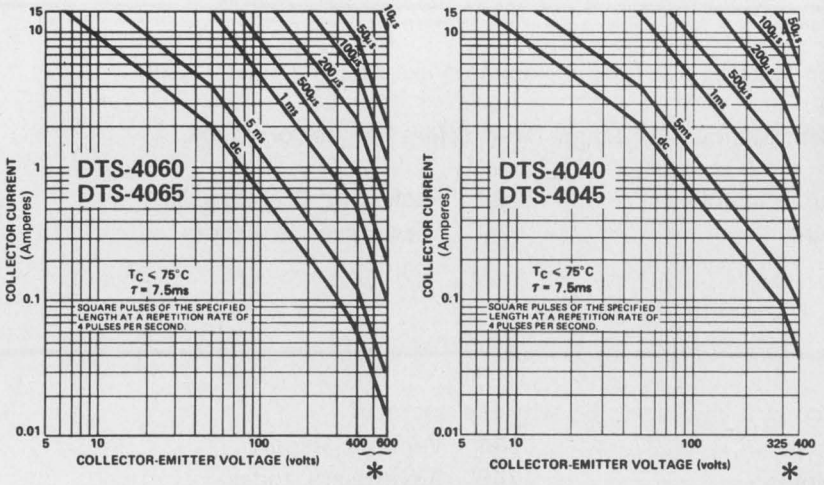


1.5 kW, 300V, 10 $_{K}H_{Z}$ Darlington Switching Regulator

in circuit design where dc drive conditions may have created awkward problems when using SCR's.

Our new Darlingtons can save you space and give you more design flexibility. The high energy capability of the DTS-4000 series is

SAFE OPERATING CURVES

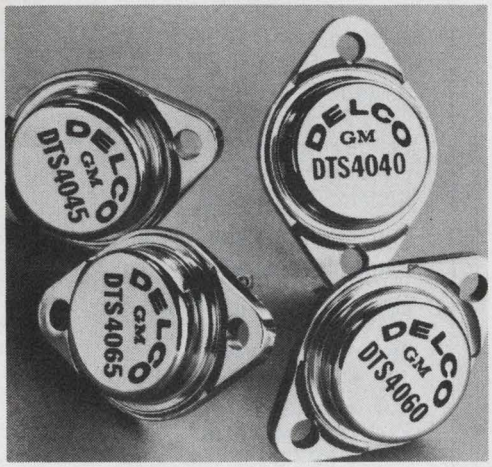


*Reverse Bias Required

TYPE	V_{CEO}	I_C (Cont.)	V_{EBO} (Max.)	$V_{CEO(sus)}$	h_{FE} @ I_C	t_f (com. base)	P_D(max.)
DTS-4040	400V	15A	20V	325V	250/3A	0.25μs	100W
DTS-4045	400V	15A	20V	325V	500/3A	0.25μs	100W
DTS-4060	600V	15A	20V	400V	250/3A	0.25μs	100W
DTS-4065	600V	15A	20V	400V	500/3A	0.25μs	100W

NPN—Triple diffused Darlington transistors packaged in solid copper TO-204MA (TO-3) cases.

HIGH ENERGY THE KOKOMOANS.



backed by safe operating curves up to 600 volts, as shown at left. And to further aid your circuit design h_{FE} is plotted continuously from 15mA to the maximum collector current rating of 15A.

As you expected, the new DTS-4000's are in stock and ready for delivery. Contact us or your nearest Delco distributor for complete details. Ask for Application Note 52 on the switching regulator.

Now available from these distributors in production quantities:

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across the desk

2 tech articles draw kudos from code fans

As much as I enjoyed reading Terry Twigg's article on keeping digital data secure by generating pseudorandom codes ("Need to Keep Digital Data Secure?" ED 23, Nov. 9, 1972, p. 68), I was tickled green to read the next article by C. H. Meyer and W. L. Tuchman on cracking pseudorandom codes ("Pseudorandom Codes Can Be Cracked," same issue, p. 74). I hope Mr. Twigg checks his phone lines regularly, just in case IBM has eyes for the semiconductor market.

Michael S. Benjamin
The Thorson Co.
347 S. Ogden Dr.
Los Angeles, Calif. 90036.

"Need to Keep Digital Data Secure?" and "Pseudorandom Codes Can Be Cracked" are timely and interesting.

I am an amateur cryptologist and a member of the American Cryptogram Association. Nearly any cipher technique can be broken; the idea of cryptology is to make the process too time-consuming or too difficult to be of worth to anyone who desires the data.

I would like to differ with a statement made in the article "Need to Keep Digital Data Secure?" In the second column of page 71, it says: "Any unencoded information or error detection and correction schemes added after the message is encoded provide clues for deciphering the message." It is true that any nonciphered information can provide clues for decryptment; it is not the case that error detection and correction schemes added after encipherment will provide points of attack for the decryptor. Redundancy and error detection and recovery added before the enciphering stage provide cross-checks and points of attack by allowing the decryptor to cross-check and play one part off against another. However, such processing after encipherment, but before transmission, cannot aid decryptment.

Kevin G. Rhoads
Baker 6470
362 Memorial Dr.
Cambridge, Mass. 02139.

The Tri-Flop: Who got there fustest?

In the Nov. 9, 1972, issue there is an article "And Now . . . The Tri-Flop." It is well-written and to the point, but I was first introduced to the Tri-Flop by its inventor, Anatol Turecki, in 1967. Mr. Turecki worked for RCA in Palm Beach Gardens, Fla. Incidentally, his application, which initiated the design, was identical to the comparator shown in the article.

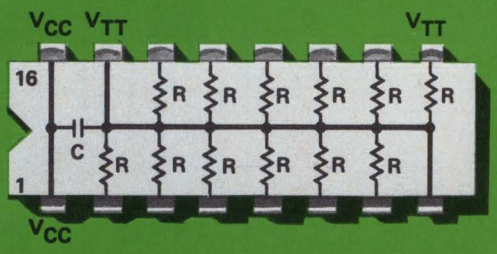
Neil Bronstein
Senior Research Engineer
Airpax Electronics
P.O. Box 8488
Fort Lauderdale, Fla. 33310.

The author replies

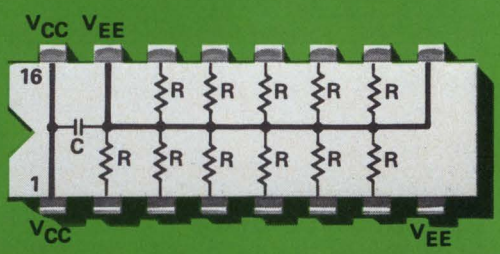
With reference to my article "And Now . . . The Tri-Flop," I would like to state that the presented idea was totally invented by me and that I never in the past had seen or heard about it. Before submitting the idea for publication, I conducted a thorough literature

(continued on page 10)

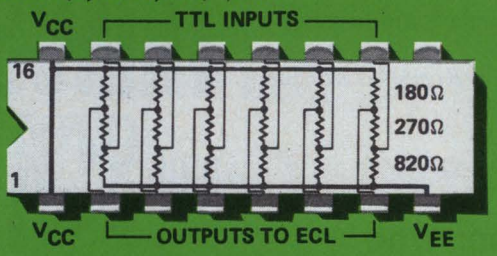
Electronic Design welcomes the opinions of its readers on the issues rasied in the magazine's editorial columns. Address letters to Managing Editor, Electronic Design, 50 Essex St. Rochelle Park, N. J. 07662. Try to keep letters under 200 words. Letters must be signed. Names will be withheld on request.



SERIES 898-41 −2.0 VOLT TERMINATORS contain eleven resistors for ECL line termination to a −2.0 volt bus. Each unit includes a 0.01 μF decoupling capacitor to bypass the −2.0 volt bus. Standard R values of 50, 75, and 100 ohms are available and are designated 898-41-R50, 898-41-R75, and 898-41-R100.
Price (1,000-4,999) $1.25



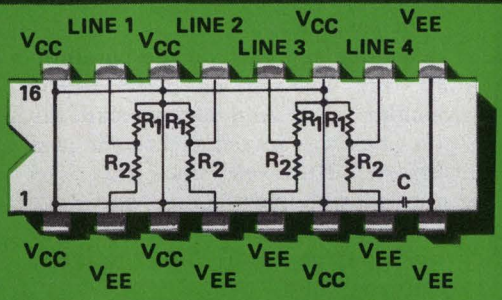
SERIES 898-42 −5.2 VOLT TERMINATORS contain twelve resistors for pull-down to the −5.2 volt bus. Each unit contains a 0.01 μF decoupling capacitor to bypass the −5.2 volt bus.
Price (1,000-4,999) $1.25



SERIES 898-45 TTL TO ECL TRANSLATOR contains six identical three-resistor sections for direct translation from TTL to ECL, both operating between a +5 volt supply and ground.
Price (1,000-4,999) $1.25

Butterfly
Diurnal insect of the order *Lepidoptera*, characterized by clubbed antenna, a slender body, and large, broad, often conspicuously marked wings. Often found fluttering about the design engineer's stomach.

Our Bugs will get rid of your Butterflies

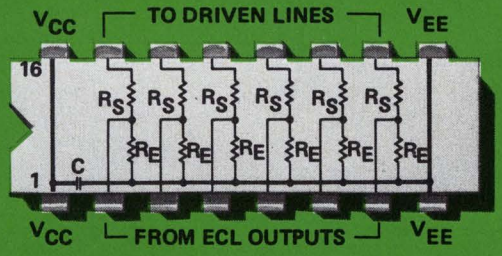


SERIES 898-43 THEVENIN EQUIVALENT TERMINATORS contain four Thevenin equivalent terminator sections. Each terminator section consists of two resistors connected as a divider from the ground bus to the −5.2 volt bus providing a Thevenin equivalent voltage of −2.0 volts. Each unit contains a 0.01 μF decoupling capacitor to bypass the −5.2 volt bus. Series 898-43 units are available with Thevenin equivalent impedances of 50, 75, and 100 ohms.

Series 898-43 R_1 and R_2 Values

Model	R_1	R_2
898-43-Z50	81Ω	130Ω
898-43-Z75	121Ω	195Ω
898-43-Z100	162Ω	260Ω

Price (1,000-4,999) $1.25



SERIES 898-44 SERIES LINE TERMINATORS contain six series terminator sections. Each section is designed for terminating a line at the driven end with a series resistor value equal to the line impedance minus the 7 ohm output impedance for 10,000 series ECL. The second resistor in each section is a pull-down resistor to the −5.2 volt bus. Each unit contains a 0.01 μF decoupling capacitor to bypass the −5.2 volt bus.

Series 898-44 R_S and R_E Values

Model	R_S	R_E
898-44-S43	43Ω	457Ω
898-44-S68	68Ω	682Ω
898-44-S93	93Ω	907Ω

Price (1,000-4,999) $1.25

ECL Terminator Collection

Dependable Beckman ECL terminator networks are specifically designed for, and compatible with, the following Emitter Coupled Logic families:

- Motorola MECL 10,000 Series
- Signetics 10,000 Series ECL
- Fairchild 95K and F10K Series ECL
- Texas Instruments Series SN10000 ECL
- National Semiconductor 10,000 Series ECL

Each Beckman ECL terminator network utilizes thick film resistor materials with layouts specifically designed for low inductance and the high speed requirements of ECL systems. Where possible, the terminator networks include 0.01 μF decoupling capacitors.

Each network is capable of operating in a +85°C still air environment at standard ECL voltage levels and tolerances without heat sinking.

For complete technical data, contact your local Beckman/Helipot representative or write to Beckman Instruments, Inc., Helipot Division, 2500 Harbor Blvd., Fullerton, Calif. 92634.

Beckman®

HELIPOT DIVISION

INFORMATION RETRIEVAL NUMBER 7

(continued from page 7)

search, covering well over 300 relevant periodicals.

No one can exclude the possibility that another engineer had a similar idea. And anyone can say that he "was introduced to the idea before." However, since this idea was not published before, and since I had no exposure to the works of the other engineer, I feel that my claim is valid.

Demetrios K. Kostopoulos
Reliability Engineer
Systems Consultants, Inc.
Ridgefield, Calif. 93555.

Expand your horizon

If you find your engineering specialty too confining and would like to learn more about the rest of the engineering world, you may want to take a crack at being a full-time editor in New Jersey with ELECTRONIC DESIGN. We're looking for an engineer who likes to write and can learn to review and edit technical manuscripts, interview technical authorities and write in a logical sequence with simple and clear English. He must be able to ask penetrating questions and separate important material from the trivial.

The fellow who wins this job will probably work harder than he's ever worked in his life—and love it. If you're interested, shoot a note and resume to Mike Elphick, ELECTRONIC DESIGN, 50 Essex St., Rochelle Park, N.J. 07662.

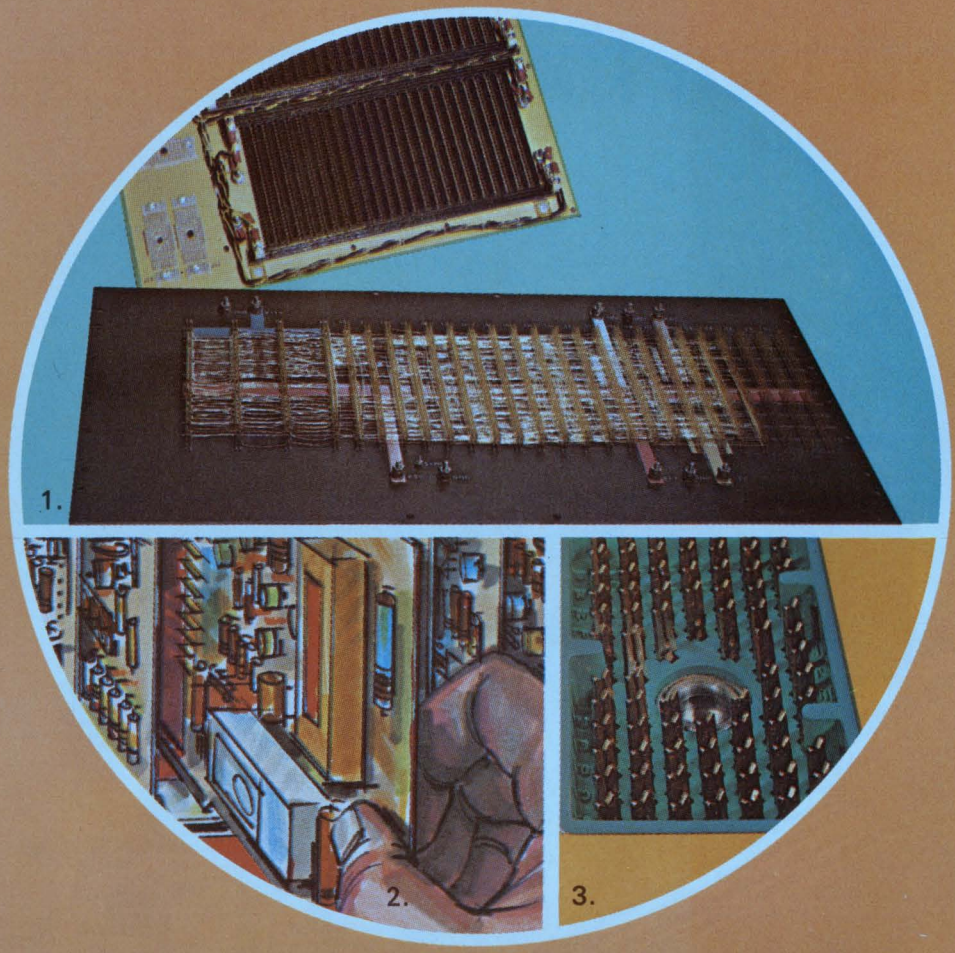
And now a word about 'A Word About Words'

I would like to reply to Newt Crawford ("A Word About Words and How to Use Them," ED 24, Nov. 23, 1972, p. 7). This gentleman must live in a world discouraging to behold. No one, he reasons, makes a sincere, altruistic effort to communicate by writing. It is all done in the interest of some obscure, self-serving motive. Career success depends solely on

(continued on page 15)

ELCO HELPS SOLVE THREE COMMON CONNECTOR PROBLEMS

1. Save money on metal plate backplanes 2. Get cooler, tighter PC cards 3. Double contact density, 1/2 the price



1. **Cost saving backplanes – wire wrapped for you**...to your specs. Elco is the largest manufacturer of metal plate backplanes. Because we offer more variations than anyone – card edge, blade and tuning fork and other two-piece connectors. An example is our Series 5420. With fork and blade connectors: single, doubles, males, females. All with .025" square posts on .100", .125" or .150" centers. And the possibilities of both squared and offset grids. Also ground voltage plane systems to meet just about any electrical requirement. And to top it off, we can wire wrap your backplane system at our own facilities. To save time, cut costs and eliminate split responsibilities.

2. **Keep tightly packed PC cards cooler** . . . with a Varipak® II modular enclosure system. They take up to 41 cards and connectors in a row. Yet even with cards packed this tight, there's ample open space for cooling air to flow between them. The Varipak II system is available in 32 standard models. With an almost infinite variety of configurations. All low in cost. Easily assembled. And on our distributor's shelf for immediate delivery.

3. **Get twice the contact density** . . . at about half the cost. With Elco's new I/O rack and panel and cable-to-cable connectors (Series 8026) that feature contact spacing on .100" and .125" centers. Available with 33, 75 and 117 crimp contacts on a .100" grid. With 55 and 79 contacts on a .125" grid. Automatic wire wrappable contacts for metal plate backplanes also available. All use new Varicon™ low withdrawal force contact (1-6 ozs. per contact pair) which provides MIL-Spec reliability MIL-C-55302 type. Their quality matches or surpasses that of their pin-and-socket counterparts. Yet published prices are much less.

Three ideas from Elco that make good connector sense. In keeping with CONNECTRONICS, Elco's Total Connector Capability. For full details on these better packaging ideas, contact your local Elco representative or distributor, or:

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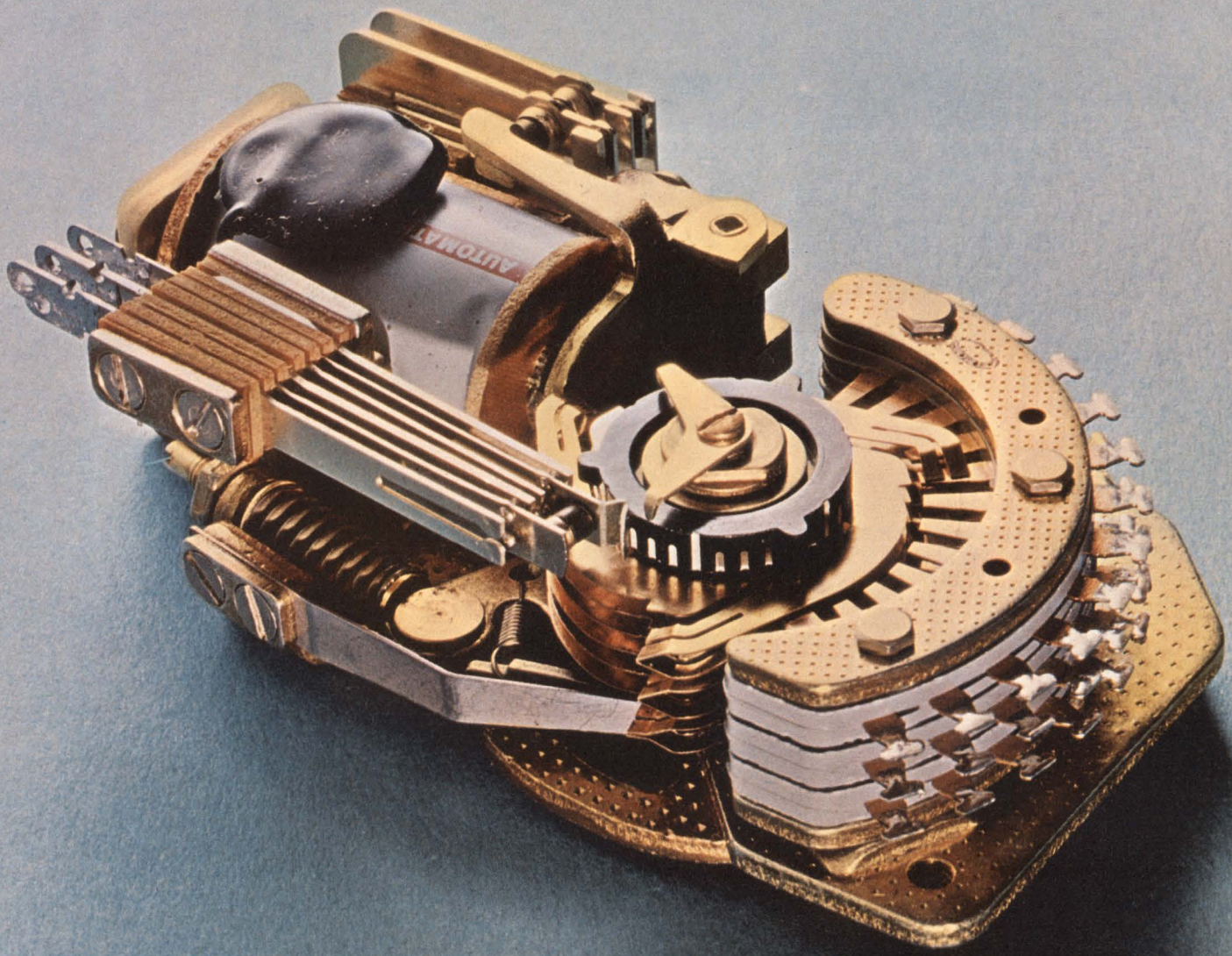
Reliability is a spring, a wheel and two thingamajigs.



Every AE Type 44 stepping switch comes with them.

One-spring power.

The drive spring is a coil. What it does is store up power. When it comes time to switch, the spring lets loose and moves the wiper assembly forward. Each time using precisely the same pressure.

Notice our spring is tapered at one end. It's designed to perfectly match the power input. That's why you always get the best possible transfer of energy.

At one end of the drive spring is an adjusting screw. We turn it a little this way or a little that way and the tension is always perfect.

Try that with a flat spring.

We re-invented the wheel.

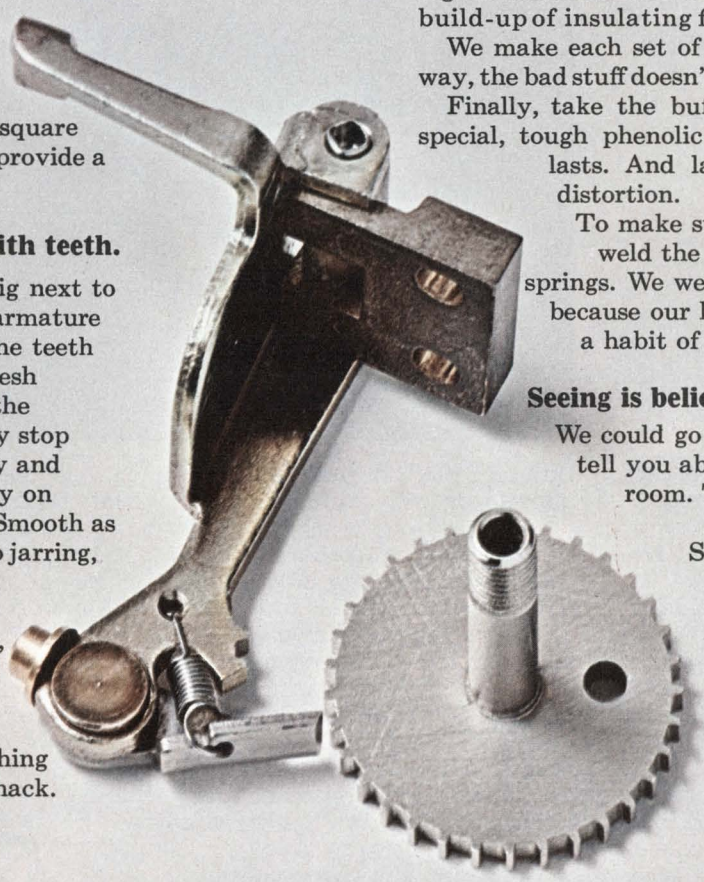
The ratchet wheel is a little different. The way it's made, for one thing. First, we blank it. Next, shave it. And finally, case-harden it. Then it's super strong.

Notice the big, square teeth that always provide a sure bite.

A thingamajig with teeth.

That thingamajig next to the wheel is the armature assembly. When the teeth on the end of it mesh with the teeth on the ratchet wheel, they stop the wiper assembly and position it precisely on the contact bank. Smooth as silk, every time. No jarring, no jamming, no banging.

No adjustments, either. As the teeth wear, they just drop further into the wheel. So nothing ever gets out of whack.



A pawl that floats.

On the end of the armature is the pawl. We made it "free floating" to eliminate the jamming and binding that go with the old style pawl stop block. And while we were at it, we stopped pawl breakage and put an end to double-stepping or overthrow.

Don't bother looking for this special set-up anywhere else. It's patented.

The other thingamajig.

It's called a contact spring. We've got some strong feelings as to what makes a contact spring strong.

In the first place, we believe there's strength in numbers. So we put two sets of contacts on each spring. This means you get a completed circuit every time. Without fail.

But some of the credit for this has to go to our solving the most common cause of contact failure—the build-up of insulating films on the contact points.

We make each set of points self-cleaning. That way, the bad stuff doesn't have a chance to build up.

Finally, take the buffers. We make ours of a special, tough phenolic material that lasts. And lasts. And lasts. All without wear or distortion.

To make sure they stay in place, we weld the buffer cups to the contact springs. We weld, rather than use rivets, because our lab found that rivets have a habit of falling off or wearing out.

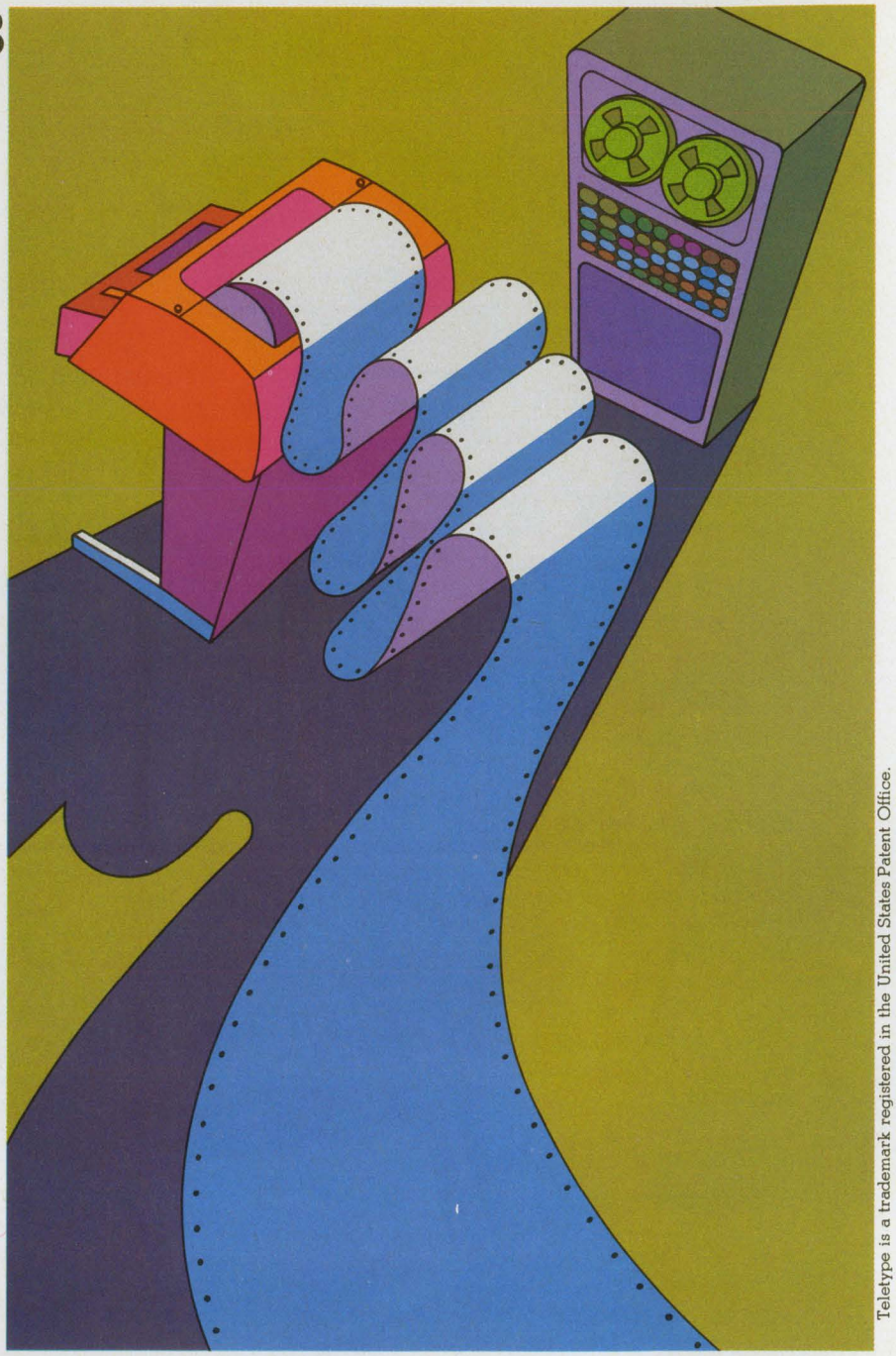
Seeing is believing.

We could go on talking reliability and tell you about our testing and run-in room. There's a lot more to tell. But we'd rather have our Sales Representative show you. And let you see first hand the reliability that's built into every AE stepping switch. Just call or write. GTE Automatic Electric, Industrial Sales Division, Northlake, Ill. 60164.

GTE AUTOMATIC ELECTRIC

INFORMATION RETRIEVAL NUMBER 10

If our model 38 wasn't so new, we'd call it "old reliable."



Teletype is a trademark registered in the United States Patent Office.

Our new wide-platen, eight-level model 38 has some very enviable bloodlines.

Like old reliable model 15. Old reliable model 19. Old reliable model 28. Old reliable model 33. And all our other old reliables. Because of ancestors like these, you can expect the Teletype® 38 terminals to live up to their heritage of outstanding reliability.

If you're in the market for terminals, take a long, hard look at the reliability factor. Because a little investigation before you buy can pay off handsomely afterwards with minimum down-time.

At Teletype Corporation, we think reliability in a data terminal is just as important as low price and flexibility. That's why our very reliable machines are supported by a very reliable national service organization.

So although our model 38 hasn't been on the market long enough to earn a reputation for reliability on its own merits, we're not worried.

Because the way we design and build our machines, we know what to expect.

It takes more than manufacturing facilities to build the machines Teletype Corporation offers. It also takes commitment. From people who think service is as important as sales. In terminals for computers and point-to-point communications.

That's why we invented a new name for who we are and what we make. The computer-cations people.

TELETYPE

For more information about any Teletype product, write or call: TERMINAL CENTRAL: Teletype Corporation, Dept. 89M, 5555 Touhy Avenue, Skokie, Illinois 60076. Phone 312/982-2500

INFORMATION RETRIEVAL NUMBER 11

(continued from page 10)

the ability to pile one polysyllabic word upon another, and our leaders are chosen by their bombast.

To follow his reasoning to its logical conclusion, all the great literature of the world should be reduced to the level of the first reader. Textbooks would bear remarkable resemblance to Erector-set instructions, and all communication must be handled by preschoolers to insure that no word beyond their comprehension gets transmitted.

Mr. Crawford's comments on meaningless words are quite valid, and he demonstrates superbly that the most totally meaningless word when applied to language is "meaningless."

As for some of his "things that seem to work":

1. *Use little words.* If the objective is to reduce confusion, I'm confused. As a general rule, the smaller the word, the more meanings it may have, often totally unrelated. The bigger the word, the more specific it will be.

2. *Write the way you talk.* Please spare me. I would be bored to tears reading "ahh" and/or "y'know" every fifth word. Would Mr. Crawford buy, "If you wouldn't say it, don't write it"?

3. *Try to transfer ideas instead of impressing others.* Excellent. He should also be for motherhood and against sin.

4. *Try to take the reader in little steps.* Right again! In the see-Dick-and-Jane-run level of writing we don't bring in Spot until the middle of the book.

5. *Try to depress the ego.* If he is trying to say eliminate egocentricity, I am in complete agreement. Before Mr. Crawford starts to depress his ego, however, he should consult a dictionary.

I am as opposed to bombast as anyone you'll find, but when you come across someone with a large vocabulary and a firm handle on grammar and syntax, don't automatically shoot him down. Grab a dictionary and try to catch up.

William J. McNeil
Product Manager
Phelps Dodge Communications Co.
P.O. Box 187
North Haven, Conn. 06473

Here's a good reason to buy HP Modular Power Supplies

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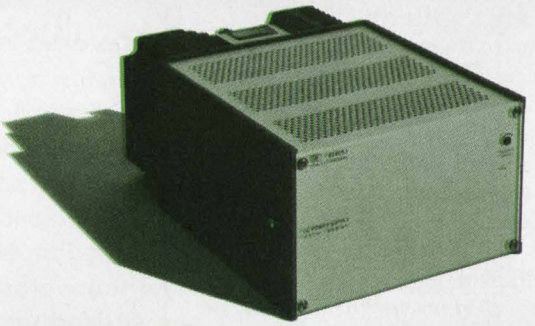
New! Switching Regulated Supplies . . . with advanced transistor switching design and up to 80% efficiency . . . which means a lot more power in a smaller, cooler operating package, with overvoltage, overcurrent, overtemp. reverse voltage and protected remote sensing standard . . . 4V to 28V; with up to 300 Watts output.



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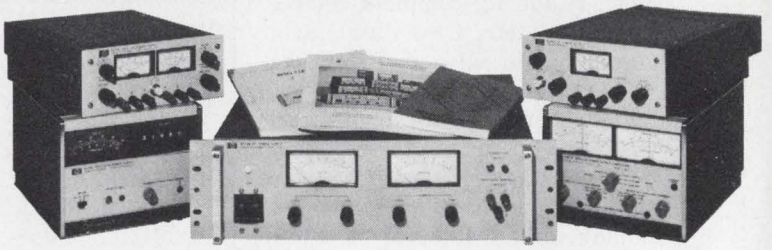

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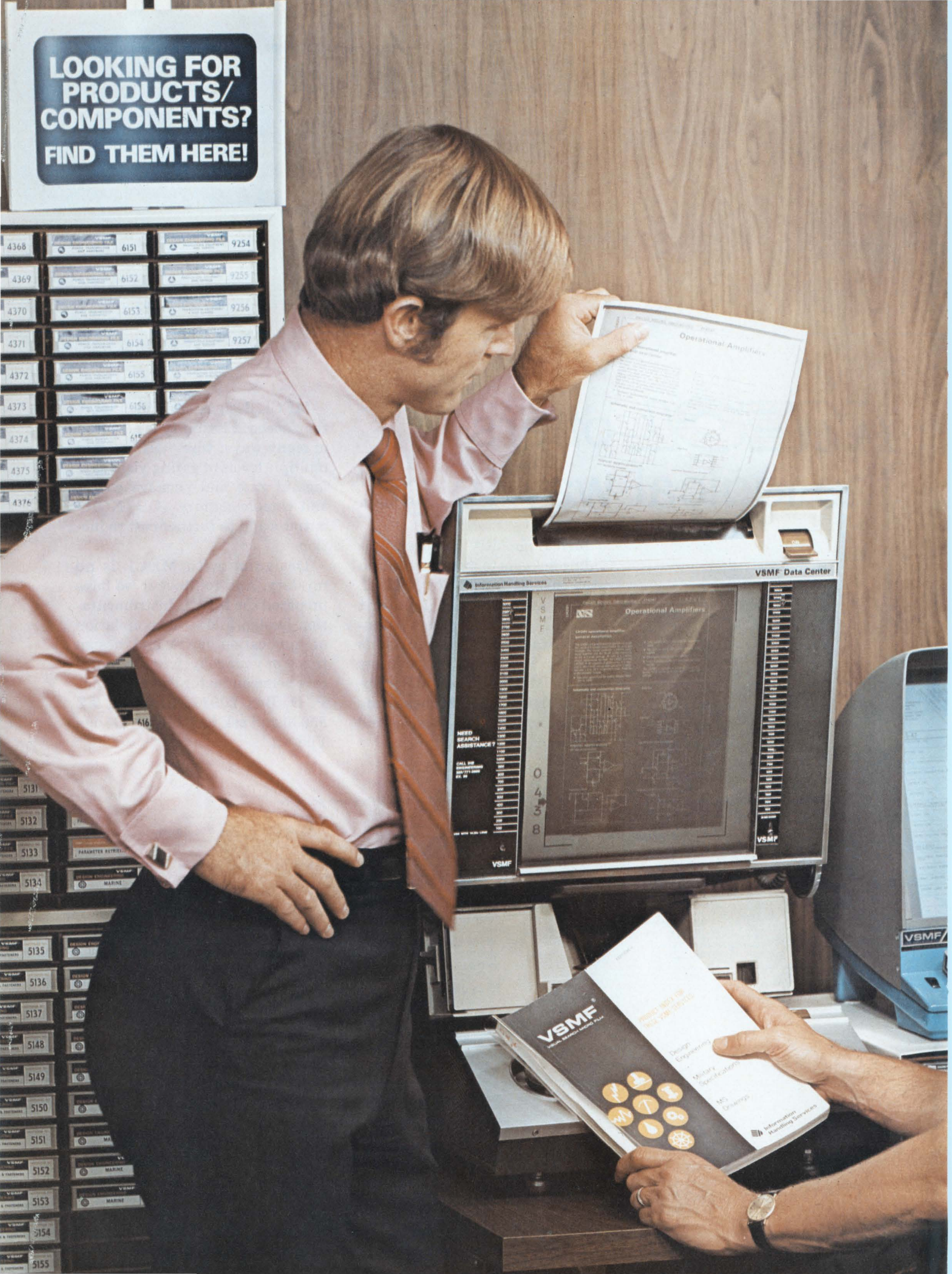
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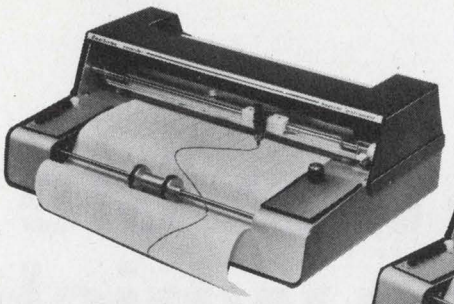
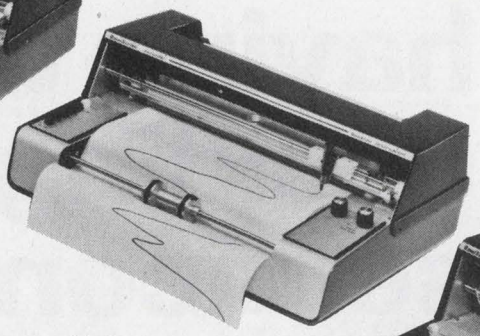


$395

Model 5112-1 single pen recorder with 1, 2, 5, 10 in/min. chart speeds and 10 mv fixed input spans.



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Model 5110-2 single pen recorder with 2.2, 5, 10, 20 cm/min. chart speeds and 5 input spans of 10 mv up.

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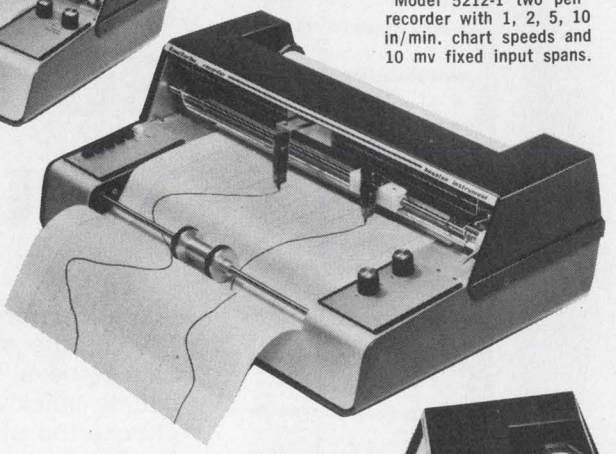
Model 5212-1 two pen recorder with 1, 2, 5, 10 in/min. chart speeds and 10 mv fixed input spans.



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Model 5212-2 two pen recorder with 1, 2, 5, 10 in/min. chart speeds and 5 input spans of 10 mv up.

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And features? Just the lowest cost on the market. About half price. And a perfected positive feed sprocketless paper drive. Plus a unique operating feature in the non-contact re-balance element. And the multi-speed chart drive with English/Metric option. More for your money with ***OmniScribe***™

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Model 5220-5 two pen recorder with electric pen lift, 2.5, 5, 10, 20 cm/min. chart speeds and 5 input spans of 1 mv up.

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THE NEW AMPEX 2065.

The fastest, most compact 20-bit memory available. Access time—260 ns, cycle time—650 ns. 8K words of up to 20 bits per module. Modules can be combined to give you up to 65,536 words. Size: only 8″ x 10″ x 2″.

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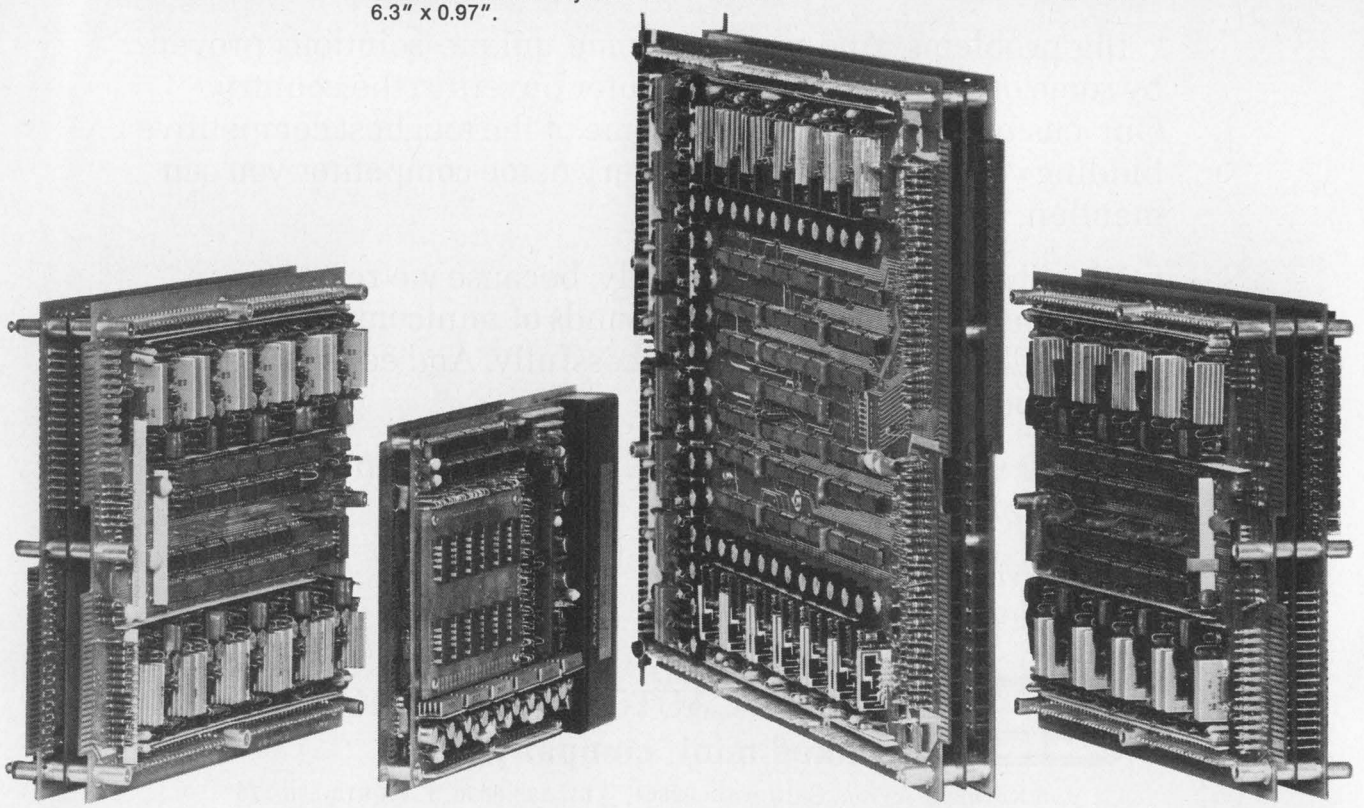
A perfect selection for buffer memories. Access time—350 ns, cycle time—900 ns. 1K or 2K words of up to 18 bits, or 4K words by 9 bits per circuit board. No forced-air cooling is required because TIN cores are used. Modules can be combined. Size: only 9.2″ x 6.3″ x 0.97″.

THE NEW AMPEX 4090.

Everything you need in a large-capacity memory. Unmatched size and speed. Access time—350 ns, cycle time—900 ns. 16K words of up to 40 bits per module. Modules can be combined to give you up to 131,072 words. Size: only 11.6″ x 15″ x 2″.

THE AMPEX 1800.

The working man's memory for use out where the action is. Access times—230, 250 or 340 ns, cycle time—600, 650 or 850 ns. 8K words of up to 18 bits per module. Modules can be combined to give you up to 64K words. Size: only 8″ x 10″ x 2″.



INFORMATION RETRIEVAL NUMBER 19

sion problems, according to Nuckells. The first is developing the system for producing the laser implosion and fuel-pellet burn. The second is the need for a laser with high enough output.

"The limits of present lasers vary between 300 and 800 J," says Dr. Lubin. "What we need is a minimum of between 5 and 10 kJ."

A new laser will have to be developed for this, he says.

IEEE moves closer to an expanded role

The Institute of Electrical and Electronics Engineers has moved a step closer to becoming an organization with more political muscle. It has voted to amend its certificate of consolidation, with almost 87% of the ballots cast favoring the expanded role.

Last November institute members voted to amend the IEEE constitution to incorporate the additional goals.

The next and final step—expected next month—will be the signing of the amended certificate by a New York State Supreme Court justice. When this is done, the IEEE will be able, as it puts it, "to provide information, without solicitation, to Congress and to the public.

The legal move was necessary to change the tax status of the institute from a so-called C-3 organization, which is not allowed to influence the legislative process, to a C-6, which is.

In addition the IEEE will be able to develop a pension plan for engineers, collaborate with public bodies and other societies and establish standards of qualification and ethical conduct. (See "IEEE Announces Major Changes for Next Year," ED 8, April 13, 1972, p. 23, and "IEEE Poll Backs Changes: Pensions and Lobbying Due," ED 24, Nov. 23, 1972, p. 39.)

2-way CATV system to be tested in homes

A modified two-way select-and-pay system for cable-television users will soon be tested over existing systems, now installed as one-way setups in many homes.

The new system, developed by Magnavox and being sold by TelePrompter, requires no prior purcase of tickets, to receive CATV programs, no plastic identification cards and no telephone calls. It provides automatic billing.

"All you do," a TelePrompter spokesman says, "is turn a key and push a button for a preview of the program you want. This immediately activates a control terminal outside the home, which unscrambles the signal, giving you picture and sound. If you like the program, you push an acceptance button, which giyes you the program to its conclusion and records your bill."

Periodically the billing data are collected at the outside substation on a tape recorder, which is then fed into a central computer that prepares monthly bills. Each substation can handle 32 home units.

Designed and developed by the Magnavox Research Laboratory in Torrance, Calif., the system will be delivered to TelePrompter by spring for testing in the field.

Microwave transistor employs Gunn effect

By combining a gallium arsenide field-effect transistor with the Gunn effect mechanism, researchers at RCA's David Sarnoff Research Center, Princeton, N.J., have been able to fabricate a new kind of microwave transistor.

Known as a traveling-wave transistor, the new device has an epitaxial construction, an average gain of 12 dB, an output power of about 0.2 mW and operates in the frequency range of 8 to 18 GHz.

According to Raymond Dean, developer of the new transistor, its structure is similar to that of a dual gate FET. In operation, he continues, the transistor-like input of the device launches a traveling space charge wave that propagates along the surface of the gallium arsenide. As the wave traverses the 50 microns between the input and the output, the Gunn effect makes the space charge grow exponentially, resulting in amplification.

The transistor is being developed for the Air Force, he continues, and plans call for a device that operates in the 8 to 16 GHz range with 35 dB of gain and 50 mW of output power by next year.

Used computers offer big savings to buyers

Computer buyers who want to hold the line on costs can now get help from the newly formed Computer Dealers Association of Boston.

The organization, a group of 34 used-computer dealers, offers designers the opportunity of purchasing computers at savings of up to 80%, says Adolf F. Monosson, president. More and more companies, he continues, are turning to used computers as a means of cutting costs on projects.

Monosson says the association can assemble a used-computer system for a designer either completely of a single vendor's hardware or of a mix of equipment made by several computer and peripheral manufacturers. The maintenance of such systems, he points out, can be obtained either from the equipment manufacturers or from independent maintenance companies.

As an example of the savings in purchasing used computers, the association president notes that second-generation machines can be picked up at 80% off the original cost and third-generation machines, such as the IBM 360/65, at 50% off.

The new trade group has projected the size of the used-computer market at about a billion dollars.

Signetics penetrating automotive market

Signetics says it is ready to make a substantial move into the automotive electronics market this year. Working with a proprietary process, the Sunnyvale, Calif., company says it can supply ICs that are one-eighth the standard IC package size and in volumes high enough to satisfy the formidable appetite of the car manufacturers. ers.

The result, a Signetics spokesman says, will be components that will permit automobile and accessory makers to cram more performance into smaller space.

news

Telemetry is making it big in industry as the costs tumble

John F. Mason
Associate Editor

Not too long ago telemetry meant collecting data and measurements by wire or radio from a remote site. Now, with low-cost LSI technology, sophisticated telemetry systems—a development resulting from military and space programs—are moving into industry and changing manufacturing techniques.

Not only are minicomputers collecting data from remote stations, but they also are acting on the information and sending back instructions to either a work force at the site or to another computer.

The cost of commercial telemetry systems is dropping at 10 to 15% a year, according to General Electric's Billy J. Brown, manager of the company's supervisory control system sales in West Lynn, Mass.

With lower costs and a greater need for automation, industrial telemetry is spreading within industries where it is already established and is also moving into new ones.

Its old standbys include gas distribution, pipe lines, oil and gas production, power plants, blast furnaces (see cover photo) and computer-controlled machines. New applications include hospital patient monitoring, pollution-abatement programs, traffic control, housing technology, urban transportation services, retail electronic charge authorization systems, vehicular testing and even underwater positioning for fishing nets or drilling rigs on the ocean floor.

The dramatically lower costs of minicomputers and programmable controllers have also boosted telemetry's importance. As more of these little logic machines are placed in factories or by oil wells, more telemetry is needed.

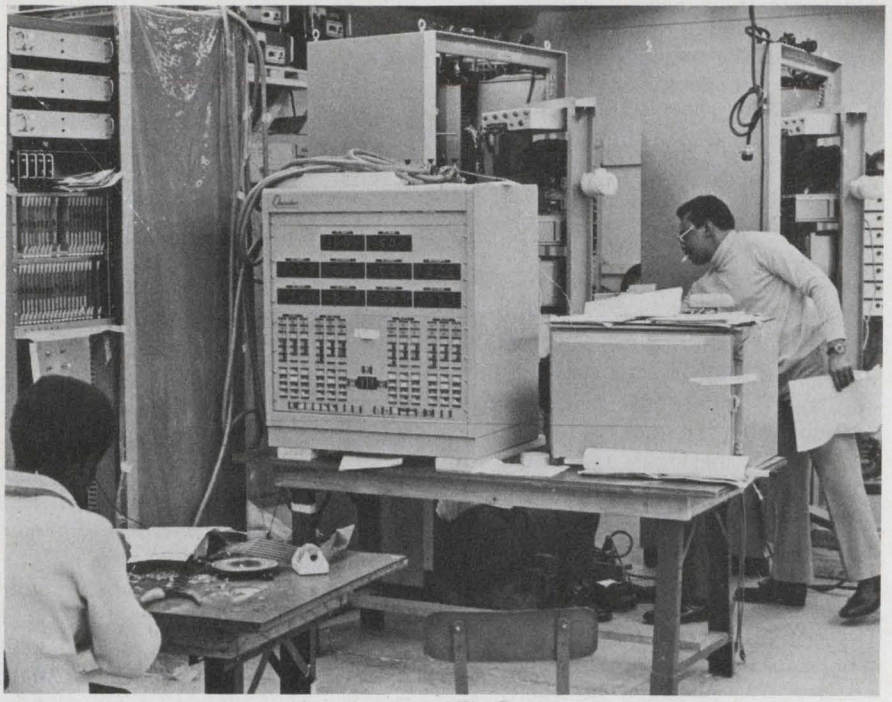
A typical telemetry system consists, first, of transducers to measure whatever quantities are involved. The measurement is then reduced to a form that can be transmitted by the least expensive channel possible. One fairly common method is to use an analog-to-frequency converter. The analog signal, for example, is converted to a frequency rate of 5 to 25 cycles. Then, by use of a frequency-shift-key (FSK) tone channel, the signal can be transmitted over any frequency in the audio spectrum—from 300 to 3000 cycles. The use of a very narrow band like this permits multiplexing and the transmission of a number of signals over one communication link. At the end of the line the signals are received on an FSK receiver, which feeds them into a frequency/analog converter and to a display.

The actual communications link may be a hard-wire or wire-pair. Often it is a dedicated voice-grade telephone channel or a dial telephone line. Uhf, vhf, microwave radio and even acoustic systems, for underwater work, are also used. The choice depends on location, distance and cost.

Single dedicated wire-pairs become expensive when a large number are needed, making multiplexing under some circumstances the cheaper of the two techniques. But multiplexing equipment itself isn't cheap, so radio is preferred when very long distances are involved, says Sam Harbaugh, manager of product development at the Harris Intertype Control Div., Melbourne, Fla.

Microwave installations are also expensive, cautions Frank Miles, regional sales manager for TRW Controls in Houston, Tex. "Most people prefer existing telephone wire if it is dependable," he notes. "Unfortunately some telephone companies don't have the technology or personnel to install and maintain proper telephone facilities, so every situation is different."

Probably the newest commercial link is the underwater acoustic. The AMF Electrical Products Development Div. in Alexandria, Va., has had considerable success with its Sea-Link for oceanographic communications, and it now hopes to sell the unit commercially for offshore drilling operations and commercial fishing. With coded acoustic



This supervisory-control system is being built for the Public Service Co. of New Jersey by Quindar Electronics in Springfield, N. J. The tall cabinet (left) is the master station. The smaller cabinet (center) is the operator's console. The cabinets in the rear are remote stations.

can't handle and certain data for storage."

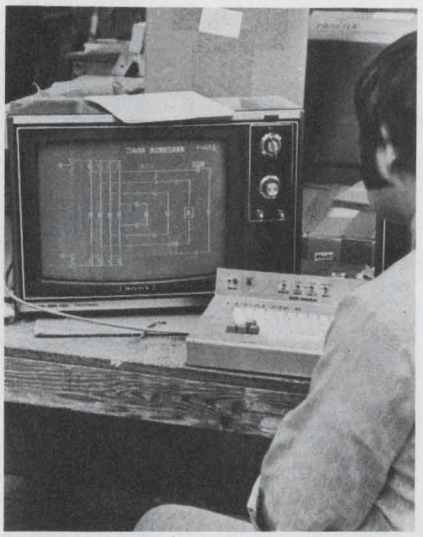
TRW Controls builds such programmable remote stations for some of its supervisory control systems. "We've put a minicomputer into a remote station with closed-loop capability," notes sales manager Miles. "It monitors and controls a number of operations."

The Humble Oil Co. uses a combination of systems, Miles says. Data from some of Humble's wells are fed into a central control room by hard-wire—which means all measurements come in without screening. Other Humble wells have programmable controllers, which send in selected data.

Displaying the information

The manner of presentation of the data at the control center is also evolving, if unevenly, from industry to industry. Almost gone in big industrial facilities are the manually operated ballroom-sized data boards. The big boards that remain—and there are many—are now activated by signals received directly from remote sites by hard-wire or through a computer that digests the information and offers only a selective presentation.

The trend—which incidentally many old timers are fighting, according to one producer—is to throw out the gigantic map board and replace it with CRTs the size of a 19-inch television set. Instead of displaying the entire system, the computer presents only portions of the network that need attention—those that the operator calls up. "Pipeline people are getting away from the big boards and doing more and more with computers and CRTs," TRW's Miles says.



TV set serves as a CRT for Quindar's supervisory-control system. It can display all or portions of an electric utility network.

Leeds & Northrup's Conitel 2050 supervisory-control system displays its data on a 19-inch screen. "You push a button, and you've got a system alarm review," says Ed Frick, the company's manager of industrial systems in North Wales, Pa. "When trouble occurs, you push another button, and you've got a telescopic view of data which shows what's happening at the substation. You can demand a display of any substation or all subs on a critical transmission line—all in color. The system has the potential for one-line diagrams—a feature that we plan to provide."

Besides the inflow of data, Frick says, the Conitel system "gives you control over remote substations; with it you control breakers, tap-changers, motor-operating disconnects, with message integrity afforded by an error-detection code."

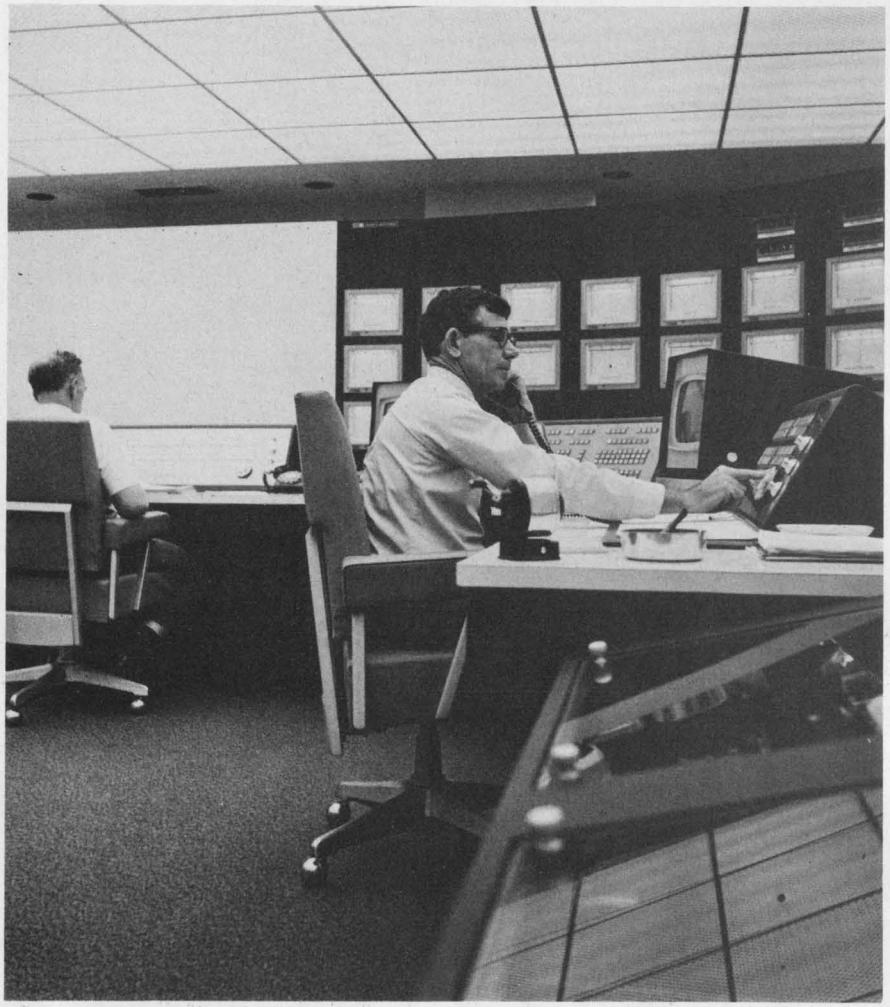
Making it easy to use

The "big, costly problem of software has been substantially overcome" at Quindar Electronics in Springfield, N.J., according to the company's senior project engineer, Steve Dobisz.

For reprogramming, Quindar now offers what it calls "the uncomputer"—or Super Compiler—a programming system that utilizes a conversational mode. "For example," Dobisz says, "the user tells the computer in English that he wants to add more remote stations to the system and more inputs. The computer says, 'OK here's what I need to know'."

Available with the Super Compiler is a general library of supervisory-control and data-gathering programs that take care of most applications, Dobisz says. These include programs to control various peripherals, such as modems, teletypewriters, keyboards and CRTs. The user can buy the particular programs he needs at any time.

To communicate with the computer, the operator types instructions on the Super Compiler's keyboard. The computer's answers appear on a CRT display or teletypewriter printout. None of this exchange requires knowledge of a special computer language, Dobisz



Electric utility control system built by Leeds & Northrup uses the company's Speedomax recorders on the wall to keep dispatchers posted on frequency and load conditions telemetered from key points.

stresses—just plain English.

The central processing unit that Quindar is using with the Super Compiler is expandable in 4-k word sections to 64-k. The memory discs for the machine are expandable to 2.2-million words.

Analog is giving way to digital

Although the measurements transmitted over telemetry systems are analog—pressures, volumes and rates—analog transmission is giving way to digital. Analog pulse-duration and variable-frequency-modulation techniques are used particularly for electric utilities and pipelines, but digital transmission is attractive for several reasons: It lends itself to greater speed, accuracy and data quantities. It affords a capability to control, and it enables data from remote sites to be fed directly into computers.

One effort under way to improve accuracy is to improve the very source of the measurements—the transducers. "Normally transducers to measure volts, amps, watts, vars and frequency phase angle are accurate to within 0.5%, but users are now looking for 0.1% accuracy," says Quindar's manager of applications, Paul Schirmer. "We hope to be able to provide this higher accuracy soon. Some transducer makers say they have already achieved it."

Master stations handling more

The trend in master stations is away from quiescent systems and toward high-speed, continuous-scanning systems. With quiescent systems, remote stations automatically transmit messages to the master station when a measurement changes significantly. But when two remote stations transmit at the same time, the master isn't able to handle them.

Newer systems, such as Leed & Northrup's Conitel and General Electric's TAC-7020, continuously scan all the remotes. If there is no change in status, the remote stations in GE's system respond to the master station's alarm scan merely by acknowledging receipt of the scan. In this way there is a continuing check of communication and remote station equipment.

When a status change does occur at a remote station, receipt of the alarm scan causes all status and alarm information at the station to be transmitted, updating the corresponding indications at the master, including those points that are in the alarm condition.

In the event of difficulty in communicating with remote stations, the TAC-7020 master automatically makes additional scan attempts in an effort to secure a correct remote-station response. If this doesn't work, the master station sounds a failure alarm.

The major weapons for fighting the growing competition in the supervisory-control field are systems with superior message security, efficiency and flexibility. L&N claims 99.5% information security in its Conitel system by using the Bose-Chaudhuri coding technique for detecting errors. The system is based on the use of five check bits to perform error detection upon 26 information bits. For example, the block length is 31 bits, of which 26 bits are useful information and five bits are for error checking.

Other error-detection codes include the two-out-of-five technique, select-before-operate with check-back, and dual transmission redundancy.

An example of a new remote terminal unit is TRW Controls' S-703, The unit uses pluggable printed-circuit cards for easy removal and replacement. The field wiring to each module is terminated on a pluggable printed-circuit card, which enables all wiring to be completed and tested before the S-703 module is connected to the system. It also allows isolated off-line testing of the module during trouble-shooting. In addition the logic is partitioned, which allows expansion to a large unit by the simple addition of modules. ■■

achieved by use of an optical mask that has openings at only those points at which it is desired to activate the photosensors.

Several optical PMOS arrays have been produced by RCA for the Air Force project, which is aimed at developing systems for self-repairable computers and alterable-function logic. The largest array contained 3600 photodiodes.

While self-repairable or alterable-function logic has been achieved in limited cases solely with electrical connections to the logic arrays, the extra peripheral circuitry needed to access and control the logic becomes a formidable design and space problem.

The availability of hundreds of parallel inputs through the optically accessed PMOS simplifies these problems, according to Marvin E. Brookings, computer analyst and Air Force contract monitor on the new project.

"The PMOS approach gives us the simplest, direct access to each logic cell or flip-flop on the chip," Brookings says.

"Although we are still far from the self-repairing-computer hardware stage, the concept of optically accessed PMOS has definitely proved to be feasible.

"Problems remaining before the optical PMOS can be applied in practice include improving the device yield over that of the experimental arrays, as well as developing an optical system to project, as well as change, optical masks."

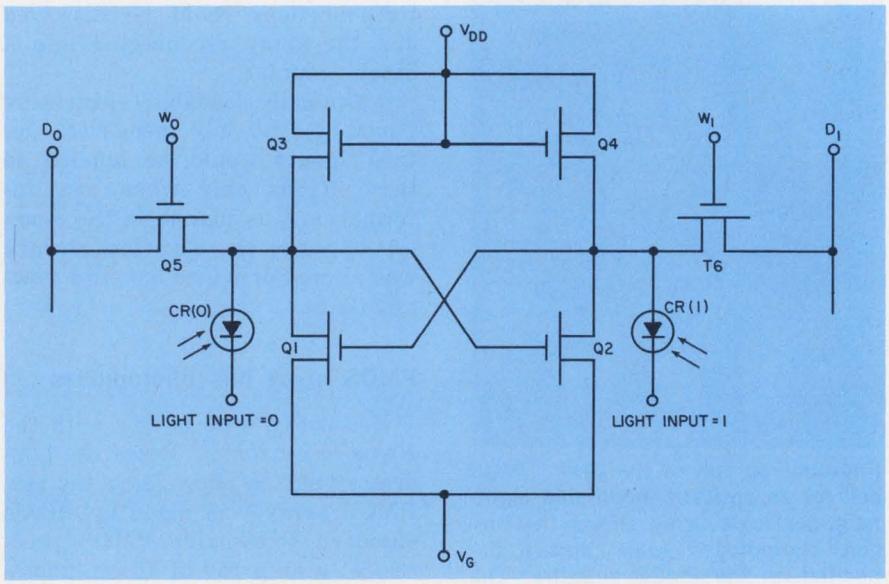
Solutions to these problems, Brookings says, will be sought at the Rome (N.Y.) Air Development Center.

Eight-neighbor array is alterable

The circuit configuration for the RCA PMOS arrays is one deemed best for optically modifiable capabilities—the eight-neighbor array. This is an array of identical devices that can be organized, through changing of interconnections, into counters, shift registers and other computer subsystems (see "Can Logic Arrays Be Kept Flexible?" ELECTRONIC DESIGN, May 24, 1965).

The basis logic element in these arrays, Brookings explains, is a NOR gate with eight controlled-output connections. With the NOR gate, any Boolean function can be realized by the interconnection of two or more NOR elements. The photodiodes on the PMOS control these interconnections, Brookings points out.

The basic PMOS cell for the eight-neighbor array (see photo) consists of a two-input NOR gate that has its inputs controlled by an AND gate and a flip-flop. The flip-flop is set or reset by optical signals that coincide with a control pulse. This cell represents a quarter node of the eight-neighbor array. A full node is made up of a parallel connection of four basic PMOS cells.



2. **Reading data electrically into and writing it** out of the optically loadable memory cell is the same as doing it for a conventional PMOS static cell.

As Kosonocky describes the function of the basic PMOS cell, a control-pulse signal (Fig. 1) cuts off transistors Q11A and Q12A, thus open-circuiting photodiodes CR1A and CR2A. If an ON optical signal is applied to CR1A, transistor Q14A is turned off and Input 1 is connected to the eight-neighbor node at V_{OUT}. An OFF signal applied to CR2A disconnects Input 1 from the node.

Kosonocky points out that although a single control pulse is applied to the complete eight-neighbor array, each flip-flop in the array can be set or reset separately by the optical signals. However, the flip-flops will not change state if the light is applied in the absence of the control pulse, or if the control pulse is applied in the absence of the optical signals.

Optical signals load memory

Another configuration of PMOS arrays produced by RCA is a static, optically loadable read-only memory. Whereas the photosensors of the eight-neighbor PMOS arrays drive flip-flops that control the array interconnections, the photodiodes of the optically loadable memory control the state of each logic cell in the memory.

Electrical reading and writing is the same for this memory (Fig. 2) as for a conventional PMOS static memory, Kosonocky explains. The symmetrical resetting of both photodiodes to the same reference potential is accomplished by the application of a negative voltage pulse, V_G, to turn on switching transistors Q_5 and Q_6, while a reference potential is applied simultaneously to digit lines D_0 and D_1. During this sequence of events the voltage, V_{DD}, is switched to ground to leave transistors Q_3 and Q_4 open.

Application of an optical signal to either of the photodiodes opens transistors Q_5 and Q_6 when the negative reset voltage is removed from the word lines.

The optical reading cycle is terminated when V_G is returned to ground and V_{DD} is restored to a negative level. At this point the cell is ready for an electrical readout operation. Refreshing of this memory is not required because of inherent holding currents. ■■

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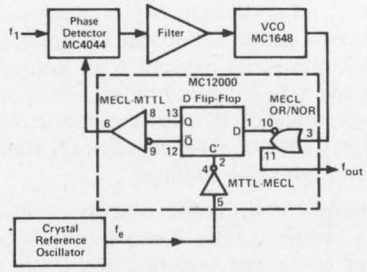
Literally speaking, Motorola's new MC12000 Digital Mixer/Translator makes the difference in phase-locked loop systems. For the MC12000 is a digital mixer whose output frequency is the *difference* between two input frequencies.

In operation, the MC12000 is a MECL type "D" flip-flop with MTTL to MECL and MECL to MTTL translators to accommodate system interfacing. Toggle frequency is typically 250 MHz.

Prime application for the MC-12000 is as a prescaler in phase-locked loop systems where the VCO > 10 MHz and the tuning range is narrow. Also, the MC12000 provides an excellent (and economical) means to generate frequencies up to *250 MHz without the use of tuned circuits.* The output frequency can be either a single fixed frequency or a series of programmable frequencies.



Typical Digital Mixer

One particular advantage of mixing is that lower frequencies may be generated for use in portions of the circuit where digital processing is done. Lower frequency operation often reduces overall system cost since a less expensive logic form may be utilized.

For further details and design examples write to Motorola Semiconductor Products Inc., Box 20912, Phoenix, Arizona 85036. The MC12000L is now available for evalution at your nearby Motorola distributor. Prices range from $7.50 (1-24 units) to $5.00 (100-up). Evaluate the MC12000 now . . . it will make the difference in your system.

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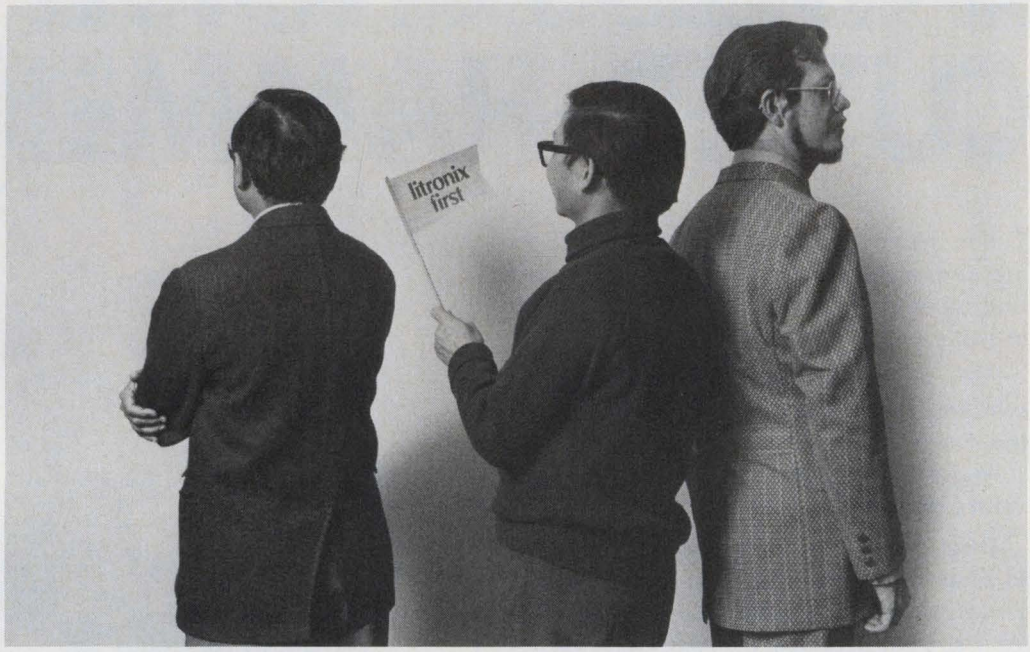
THE GRAND ISOLATIONISTS: MOIZ, SHEUNG-MING AND DAVE



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2,500	20%	IL-1	1.55
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1,000	2%	IL-12	1.19
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2,500	100%	ILCA2-55	1.95

Here's what you can do with our line: Opto-isolators can replace relays and reed relays, giving faster switching speeds, no contact bounce, better reliability and, of course, better isolation. And because opto-isolators can transmit DC signals and low frequency AC, they are more efficient than transformers. They can also replace line receivers and eliminate ground loop problems, and common mode noise when driving long lines. Our new IL-74 is optimized for going in and out of TTL—so you can see how useful opto-isolation can be in a digital system.

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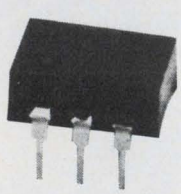
So write to Moiz, Sheung-Ming or Dave, they'll send you a fist full of application notes and a free part—if you ask nice, and tell them how you plan to use it. Company letterhead only. And remember, **Litronix First!**



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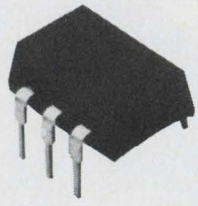

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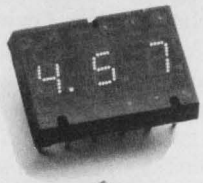

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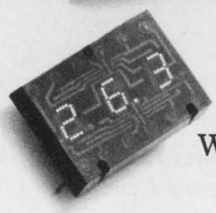

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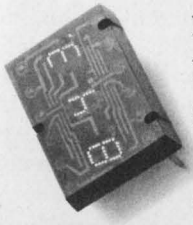
Our numbers racket is otherwise known as the LEDs business.

Otherwise known as light emitting diodes.

So now you electronic calculator people have another source. Which is kind of nice to know for something in as short supply as LEDs are today.



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National

In the missile category, the Army is seeking $70.6-million for the Dragon antitank weapon, $139.3-million for Hawk surface-to-air missiles and $194.2-million for SAM-D surface-to-air missiles. The Navy is asking $100.3-million for the Phoenix air-to-air missile, $98.7-million for the Sparrow air-to-missile and $85.6 million for the Harpoon anti ship missile. The Air Force missile requests include $112.2-million for the Maverick air-to-ground missile.

The Navy, which faces some tough questioning on its claims-ridden shipbuilding program, is asking $1-billion more than last year—a request of $3.9-billion. Major items include $657-million for the CVN-70 nuclear aircraft carrier, $921.6-million for four nuclear-attack submarines and $590.9-million for the DD-963-destroyer program.

A big rise in R&D funds requested

The research-and-develepoment funds request got a big boost, going from $6.5-billion in fiscal 1973 to $7.4-billion in 1974. Major R&D accounts include $473.5-million for the B-1 bomber, $170.1 million for the Site Defense ABM, $72.2-million for the Subsonic Cruise Armed Decoy Missile and $49.3-million for the Advanced Attack Helicopter to replace the canceled Cheyenne Attack Helicopter Program.

The National Aeronautics and Space Administration put in for a slight increase in its expenditures' budget—$3,136,000,000 compared with $3,062,000,000 for fiscal 1973. According to NASA Administrator James G. Fletcher, the agency will launch an unmanned Skylab in May, 1973, and three more thereafter. The Skylab budget request is $233.8-million. Some $475-million is earmarked for the Space Shuttle.

Scientific space studies pushed

For space sciences, NASA is requesting $584-million for such projects as the OSO-1 orbiting solar observatory, the German-American Helios probes toward the sun, and the various Explorer scientific satellites.

NASA is phasing itself out of the communications satellite business and is asking $22-million to finish out the ATS-F satellite and its cooperative Canadian satellite.

In the aeronautics field, NASA has upped its supersonic research activity from $11-million to $28-million "to provide technological options to make a later decision—late this decade or early next decade—to take up the SST.," Administrator Fletcher says.

Transportation projects lean on electronics

The Department of Transportation is asking for $29.67-million for research and development. The Coast Guard wants $108-million for aids to navigation and $17-million for R&D including a helicopter sensor system for search and rescue and initial field-testing of an experimental precision navigation system for rivers and harbors.

The Federal Aviation Administration is asking $80-million for R&D, a substantial increase over fiscal 1973. In addition the FAA's facilities and equipment request of $250-million includes funds for new airport surveillance radars, long-range route radars, the computerization of traffic-control centers and navigation aids.

Hard-boiled hermetics...
TI's rugged 1-amp glass rectifiers.

TI's 1-amp glass rectifiers are tough, high-performance units you can depend on.

They're proven through extensive high-reliability testing—like 168 hours in a pressure cooker at 15psi, 120°C (no failures). This high reliability is achieved by combining the best processing, construction and packaging technologies.

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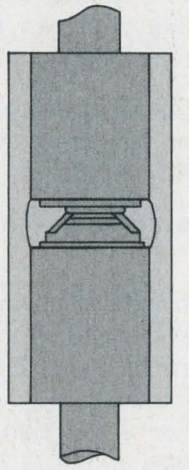

Glass hermetic package, double-plug construction.

Designated 1N4001 through 1N4006, the 1-amp devices offer a reverse voltage range of 50 to 800V. Repetitive peak forward current (10 cycles, 75°C or below) is 10 amps. Peak surge current is 30 amps. Static reverse current is 10 microamps at 25°C and 50 microamps at 100°C.

For more information

For price and delivery, call your local TI sales office or authorized TI distributor. For complete data sheet covering the 1N4001-1N4006 1-amp glass series, circle 246 on the reader service card. Or write Texas Instruments Incorporated, P.O. Box 5012, MS 308, Dallas, Texas 75222.

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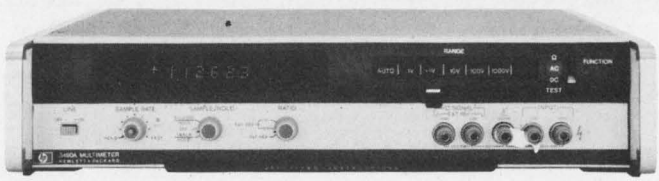

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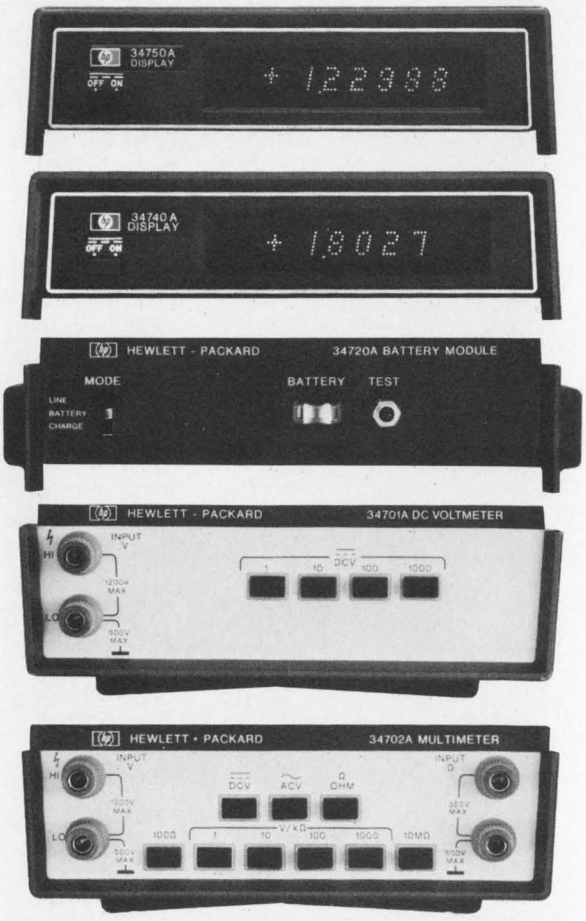


Boost a/d rates with staggered operation.

But analyze the system carefully. You may find that external timing constraints limit the attainable speeds.

It's no design secret that you can increase the rate of analog-to-digital conversions by linking two or more a/d circuits in a staggered time sequence. But don't forget to look before you leap along this path, or you may end up in a diminishing-returns situation. In extreme cases, you could get so little increase in conversion rate that the scheme is hardly cost-effective or even beneficial. Here's why:

While one of the added converters performs its conversion cycle, a second will have completed a conversion and will be ready to supply output data. But the converted digital data must be duly stored, transmitted or processed. Each of these steps requires some period of time. And the next set of results cannot be accepted until that time has elapsed. As more and more converters are interleaved, the cost of interface circuitry rises almost as rapidly as the speed improvement. More converters also mean more load on the signal input circuitry so that the upper speed limit may be imposed by the use of analog buffers.

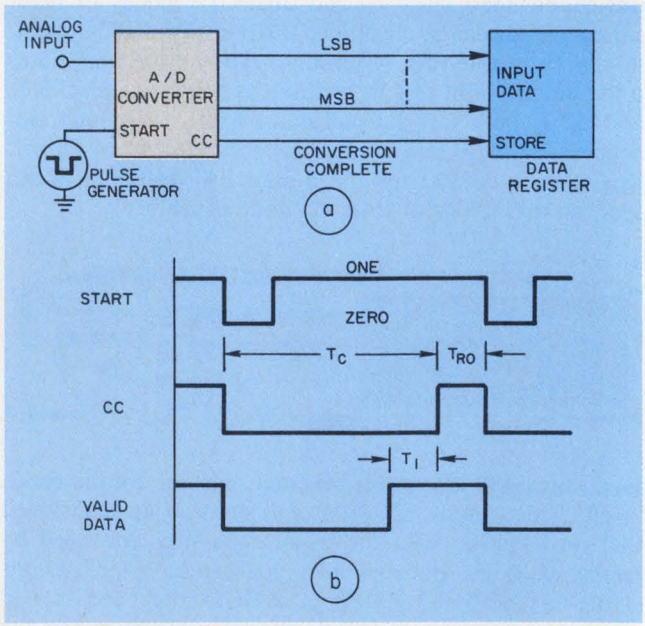
The details of interface circuit requirements versus the number of converters used will become clear as we examine what happens when the operation of two a/d converters is interleaved.

The basic operating sequence

Most a/d converters require a Start signal to initiate the conversion and produce a Conversion Complete (CC) signal when the digital data have stabilized and are available for use. The sequence of operating events for a typical converter, Data Device's HADC-11 is shown in Fig. 1. A ONE-ZERO transition of the Start signal initiates the conversion cycle. A short time (T_c) later, the CC signal changes to a ONE and remains in that state until the next ONE-ZERO transition of the Start signal. The minimum time between conversions (T_T) is the sum of T_c and the readout time (T_{RO}) for performing a parallel transfer of output digital data to the data register.

The conversion speed is doubled by the interconnection of two converters (Fig. 2). Converter ADC_2 receives the start signal delayed by $T_T/2$. Since the conversion (T_c) and readout (T_{RO}) periods for ADC_1 and ADC_2 are both equal, the digital output from each will be available during alternate $T_T/2$ intervals. Both sets of parallel data outputs are fed into a bank of OR gates so updated digital information is available at $T_T/2$ intervals—or at about twice the conversion rate of a single converter.

Random data may appear on the digital output lines of a converter during the conversion cycle. Data from that a/d are prevented from altering the system output by ANDing them with the converter's CC signal prior to combining them. The CC signals of both a/d's are combined through the OR gate and made available as a single output



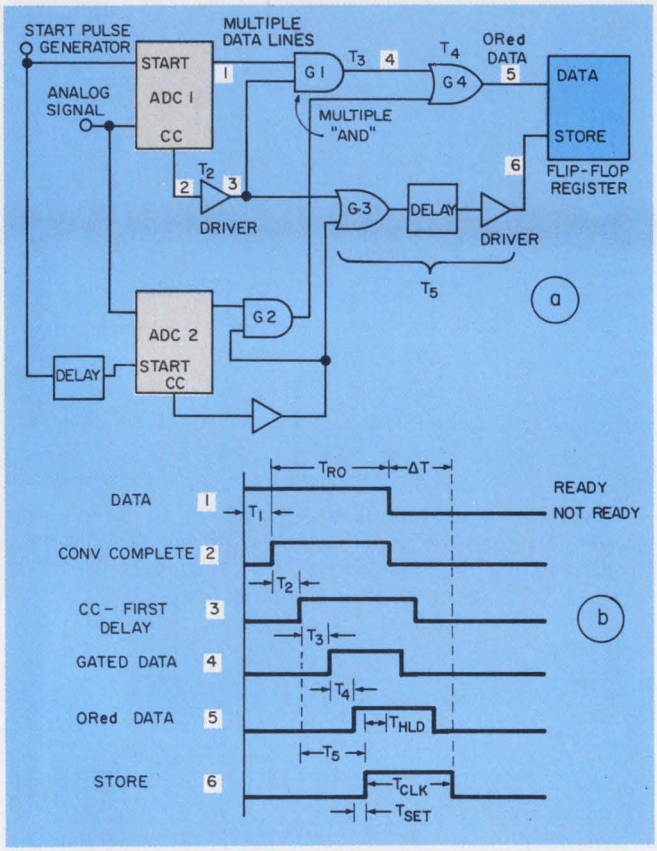
1. **A ONE-ZERO transition of the Start signal** initiates each a/d conversion (a). Completion is signaled when the converter's CC line goes high. Data are fully stored in the receiving register after interval T_{RO} elapses. The sum of the conversion time (T_c) and T_{RO} is equal to the minimum conversion period. Time T_1 (b) indicates that the data lines are valid just before the CC line turns ON.

Henry Baluta, Product Support Engineer, Grumman Aerospace, Box 513, Moriches, N.Y. 11955.

registers involve the clock and data signals:

- T_{CLM}: Minimum duration of a clock pulse to store the data.
- T_{SET}: Period during which the data must remain stable before arrival of the leading edge of the clock pulse.
- T_{HLD}: Minimum time for which the data must remain valid and stable after the leading edge of the clock pulse.

Stable data (Fig. 4b) appear on the converter output lines during interval T_1 before the CC signal becomes a ONE. The data are ANDed with the CC signal and undergo gate propagation delays T_2, T_3 and T_4 before arriving at the register inputs. Meanwhile the clock pulse arrival is delayed by an interval T_5 to allow a period T_{SET} for the settling of the input data to the register flip-flops. Readout time T_{RO} is measured from the time when the CC signal goes high until another ONE-ZERO transition of the Start signal can be given.



4. **System delays rather than actual hardware** are emphasized (a). The CC signal (b) gates the a/d output data and generates the Store signal. Data to the register are delayed by arrival of the CC signal at gates G_1, while the generation of the Store signal is delayed by the driver and composite delays T_5. Other circuit requirements include the register setup time (T_{SET}), data hold time during clocking (T_{HLD}) and a minimum clock signal duration at the store input.

Table. Waveform timetable for receiving register

	ORed DATA	CLOCK PULSE
TRAILING EDGE	$T_1 + T_{RO} + T_3 + T_4$	$T_1 + T_{RO} + T_2 + T_5$
LEADING EDGE	$T_1 + T_2 + T_3 + T_4$	$T_1 + T_2 + T_5$
DURATION	$T_{RO} - T_2$	T_{RO}

The timing constraints of the register govern the latter event. And these constraints must be reflected back through the circuit delays to find the transition time. One very convenient way to accomplish the task is, first, to express the register timing constraints in terms of the following three leading and trailing-edge conditions on the data and clock inputs:

1. The leading edge of the clock pulse follows the leading edge of the ORed data by at least the interval T_{SET}.
2. The minimum duration of the clock pulse is T_{CLM}.
3. The trailing edge of the ORed data follows the leading edge of the clock pulse by at least T_{HLD} seconds.

Then a timetable is drawn up (see table) to express leading and trailing edge arrivals at the register in terms of system delays. The time origin coincides with the presence of valid data on the converter output.

Condition 1 provides a relation between delay T_5 and the other system delays:

$$T_1 + T_2 + T_5 \geqq T_1 + T_2 + T_3 + T_4 + T_{SET}.$$

The remaining two storage conditions each impose a minimum value on readout time T_{RO}:

$$T_{RO} \geqq T_{CLM}$$

and

$$T_1 + T_{RO} + T_3 + T_4 \geqq T_1 + T_2 + T_5 + T_{HLD}.$$

For greater convenience, these can be summarized as:

$$T_E \geqq T_{SET} \quad (1)$$

$$T_{RO} \geqq T_{CLM} \quad (2)$$

$$T_{RO} \geqq T_{HLD} + T_2 + T_E, \quad (3)$$

where T_E is defined to be

$$T_E = [T_5 - (T_3 + T_4)]. \quad (4)$$

Duration T_{RO} is determined to be the larger value computed in Eqs. 2 and 3. And the Start signal can be initiated T_{RO} seconds after the Conversion Complete line goes high. In terms of relative magnitude, T_{SET} is about a tenth the value of T_2, so that T_{RO} is usually determined by T_{CLM} or T_2. Also, more often than not T_2 will exceed T_{CLM}. The minimum obtainable readout time is set by the required duration of the clock pulse, as shown in Eq. 2.

In contrast, the same register timing conditions, but with only a single a/d converter (Fig. 5), result in the following:

$$T_{RO} \geqq T_{CLM}$$

$$T_{RO} \geqq T_{HLD} + T_2.$$

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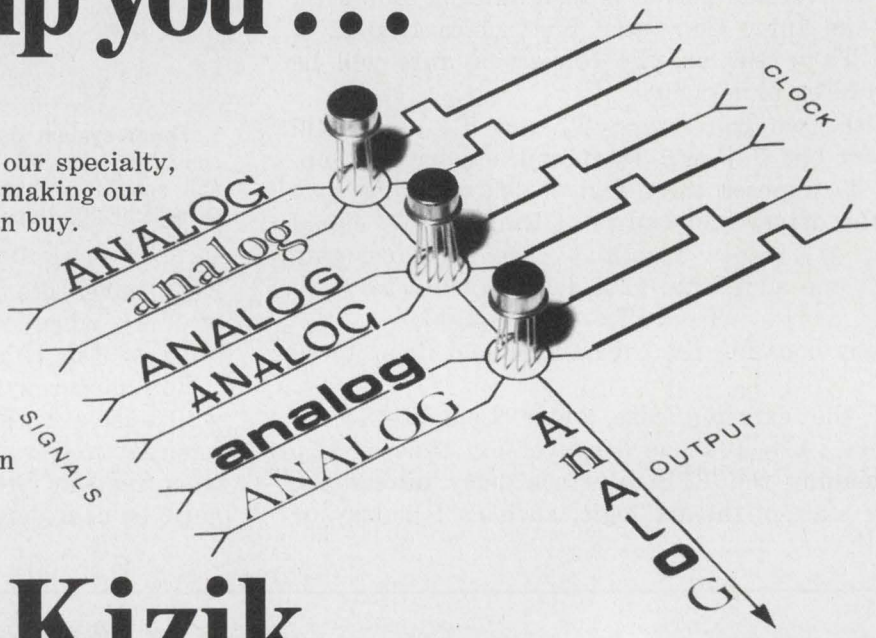

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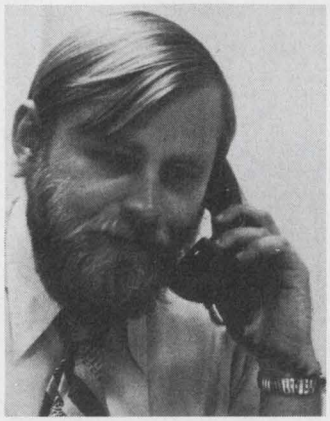

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INFORMATION RETRIEVAL NUMBER 36

Get wider dynamic range in a log amp.

Build the device with only a couple of monolithic operational amplifiers and a few discrete components.

Many nonlinear circuit applications require logarithmic amplifiers with characteristics that can't be found in off-the-shelf components or modules. The designer must build his own to get wide dynamic range with a specific scale factor and input set point. For such occasions, try a log amp with a seven-decade dynamic range. It can be built with only a couple of ICs (op amps) and a few discrete components. In addition to having wide dynamic range, the circuit is very compact and temperature-stable, and it can be adjusted quickly and easily.

Here is how it works

The basic theory of using a silicon transistor to achieve a wide range of logarithmic performance is well known[1,2]. Thus the design of our seven-decade log amp is based on the theory that the short-circuit collector current, I_C, and the emitter-base junction voltage, V_{BE}, have an accurate logarithmic transfer characteristic over a wide range.

Referring to Fig. 1, we see that a bipolar npn silicon transistor in the feedback network of an op amp achieves the desired logarithmic transfer characteristic. The op amp supplies at its output a voltage, V_{BE}, that forward-biases the emitter-base junction of the transistor by exactly the amount required to produce the desired I_C. Since the inverting input of the op amp is effectively at ground potential, the collector-base junction is essentially at zero bias. Thus the relationship between the short-circuit collector current and the emitter-base voltage is

$$I_C = I_S(e^{(qV_{BE}/kT)} - 1), \quad (1)$$

where q is the charge of an electron, k is Boltzmann's constant and T is the absolute temperature in degrees Kelvin. The value I_S is nearly constant for a given transistor type.

If the emitter-base junction voltage is sufficient—that is, larger than 0.1 V—Eq. 1 becomes

$$I_C = I_S e^{(qV_{BE}/kT)},$$

or

$$\ln I_C = (\ln I_S) + (qV_{BE}/kT). \quad (2)$$

A plot of ($\ln I_C$) vs V_{BE} should be a straight line with a slope kT/q (59 mV/decade). Collector leakage current can cause problems at very small currents, because V_{BE} becomes small and $e^{qV_{BE}/kT}$ becomes less than unity. At high currents voltage drop in the emitter and base ohmic resistances becomes important and causes the characteristic to deviate from the logarithmic.

From Eq. 2, we note that the difference of the emitter-base junction voltages between two matched transistors (V_{BE1} and V_{BE2}) can be written as

$$\Delta V_{BE} = V_{BE1} - V_{B2E} = (kT/q)\ln(I_{C1}/I_{C2}). \quad (3)$$

Thus a logarithmic amplifier is designed on the basis of Eq. 3. As is shown in Fig. 2, it uses two well-matched transistors and two high-performance op amps. Its operation is as follows:

The negative feedback of op amp AD503K forces the collector current of Q_{1A} to be equal to the input current into the summing point S1, so that we have

$$I_{C1} = E_{in}/R_1. \quad (4)$$

The collector current of Q_{1B} is determined by the voltage at point C and the value of R_3:

$$I_{C2} = V_C/R_3. \quad (5)$$

V_C is fixed by the "zener-function" diode, Q_{2B}, and the value of the variable resistor, R_9.

Since Q_{1A} and Q_{1B} are well matched, Eqs. 4 and 5 can be substituted into Eq. 3 to get

$$\Delta V_{BE} = (kT/q)\ln[(R_3E_{in})/(R_1V_C)]. \quad (6)$$

Because the base of Q_{1A} is grounded, the negative of ΔV_{BE} is presented to the summing point S2. This voltage is amplified by noninverting voltage amplifier μA741 with a closed-loop gain,

$$A_{V2} = E_{out}/\Delta V_{BE} = (R_4+R_5+R_6)/(R_4+R_5). \quad (7)$$

Substituting Eq. 7 into Eq. 6, we get

$$E_{out} = A\log(E_{in}/B), \quad (8)$$

where

$$A = [2.3kT(R_4 + R_5 + R_6)]/[q(R_4 + R_5)],$$
$$B = R_1V_C/R_3.$$

From Eq. 8 we can see that the output voltage is proportional to the logarithm of the input volt-

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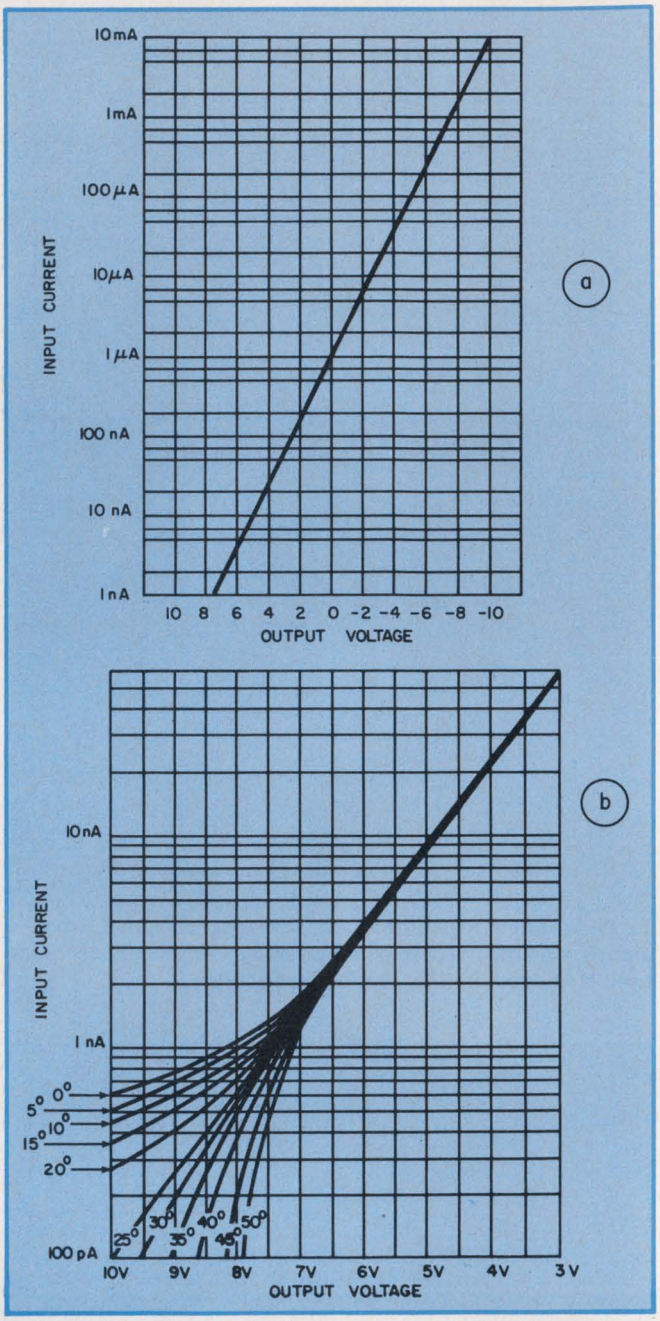

3. **Wide-range linear response** of the log amp (a) is very temperature-stable (b) except at extremely low currents.

logarithmic amplifier is determined by the value of R_6, and the zero-crossing point is determined by the value of R_9.

The excellent performance of the log amp shown in Fig. 2 can be appreciated from its transfer-characteristic curves (Figs. 3a and 3b). It should be noted, however, that the temperature drifts of all resistors will affect the accuracy of the log amp. Therefore the resistors are 1% metal-film units. ■■

References

1. Gibbons, J. F. and Horn, H. S., "A Circuit with Logarithmic Transfer Response over Nine Decades," *IEEE Transactions of Circuit Theory*, Group Vol. CT-11, 1964.
2. *Linear Integrated Circuits Applications Handbook*, Fairchild Semiconductor.

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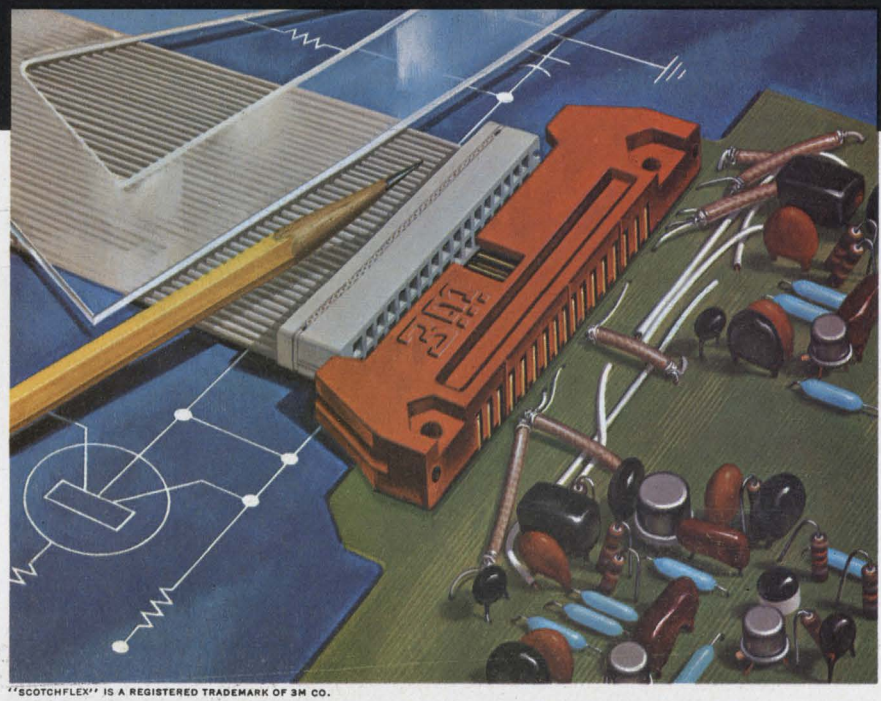

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INFORMATION RETRIEVAL NUMBER 40

Lift IC op-amp performance at high frequencies by adding a 'fast' amplifier. You'll get a slew rate to 1000 V/sec., without impairing open-loop gain or dc temperature stability.

In today's popular IC operational amplifiers, the input node consists of a differential bipolar transistor or FET amplifier. This permits satisfactory operation for signal frequencies to 20 MHz. But response at higher frequencies is limited by the configurations' summing-point capacitance and high input impedances.

A composite circuit can boost the high-frequency response. Using a fast amplifier to provide the response—but controlled by an IC op amp to preserve dc characteristics—the circuit will yield slew rates of 10^3 V/μs together with dc stability of 1 μV/°C and open-loop gain of 100,000.

Two amplifiers: Fast and slow

In the composite circuit (Fig. 1), the fast amplifier A_2 provides an extremely low impedance (8 Ω) at point E_{FS} for frequencies up to and above 100 MHz. Op amp A_1 controls the dc performance of the fast amplifier by sensing and correcting error voltages at point E_N.

Under dynamic conditions, A_2 drives the "fast" null point, E_{FS}, to within 1% of its final value in about 30 ns. Then the op amp begins to slew, thereby driving the "slow" null point E_N to zero, since the voltage at its inverting terminal is zero.

The ratio of R_{1P} to R_{FP} is chosen to be the same as for R_1 to R_F, so that the final value of the output, E_o, is given by:

$$E_o = -\frac{R_{FP}}{R_{1P}} \cdot E_{in} = -\frac{R_F}{R_1} \cdot E_{in}.$$

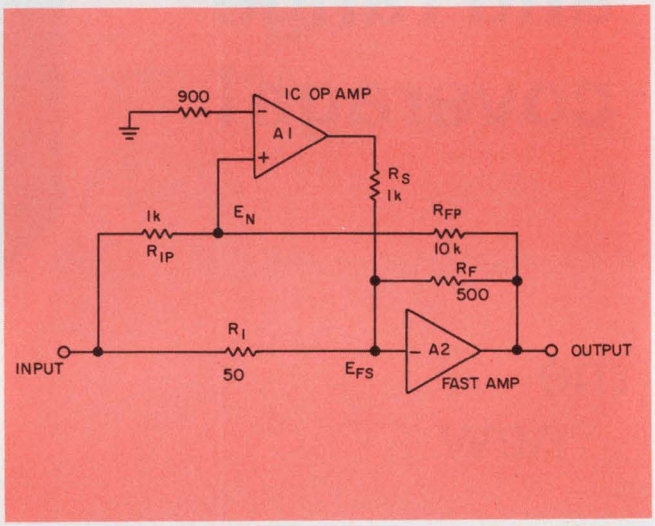
When the two ratios are not equal, R_{FP} and R_{1P} adjust the low-frequency gain, while R_F and R_1 adjust the high-frequency gain. The dc equilibrium is determined by R_{FP} and R_{1P}.

Design of the fast amplifier

The fast amplifier, A_2, in Fig. 1 can be little more than a simple two-transistor inverting amplifier or it can be a high-performance unit, as shown in the detailed schematic of Fig. 2.

In Fig. 2, the emitter of differential pair Q_1 and Q_2 provides a very low impedance at point E_{FS}. Noninverting stage Q_2 and its load, Q_3, drive the single inverting stage, which is comprised of

Robert L. Young, Engineering Supervisor, Dept. of Physics, Ohio University, Athens, Ohio 45701.



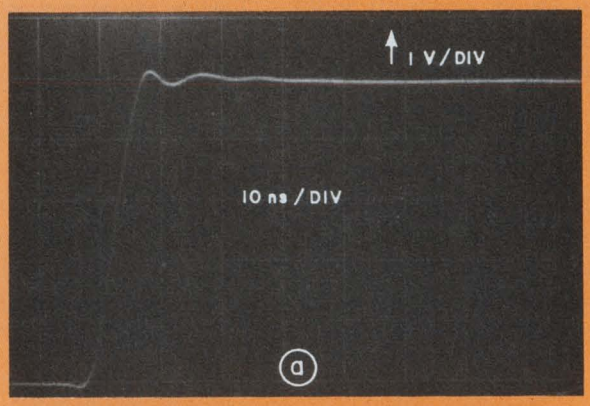
1. **Junction E_{FS} is held at zero** by the "fast" amplifier for the first 100 to 200 ns. Then the IC op amp begins to make the final corrections with its high open loop gain.

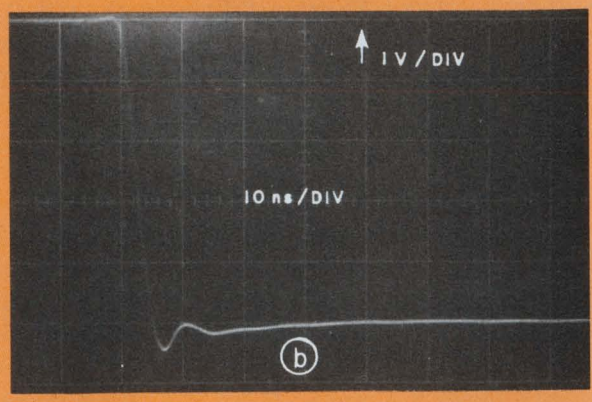
Table. Maximum Sinusoidal Output vs Frequency

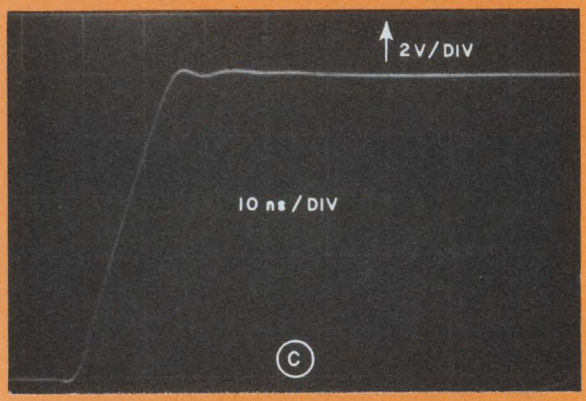
Amplifier Output (V_{p-p})	Maximum Frequency (MHz)	Resistors R_1/R_F (ohms)
20	12	50/500
16	14	100/1 k
12	19	100/1 k
10	25	100/1 k
6	36	100/1 k
1	42	100/1 k
1.2	65*	100/1 k
6	80*	50/500

Note: These results are for the circuit of Fig. 2 using a μA777 for A_1 and with a 1-kΩ load. The input signal level is set so that no visible distortion is seen on the scope.

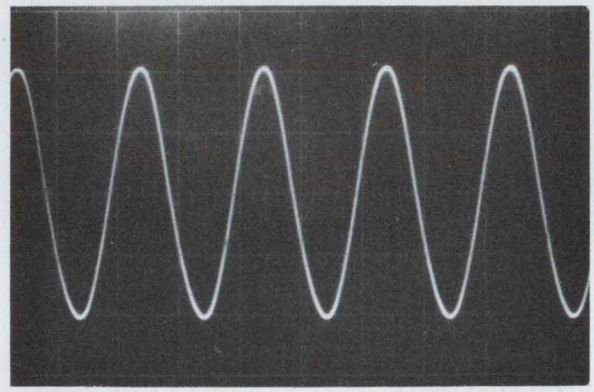
* 3 dB signal frequencies for the given values of R_1 and R_F.



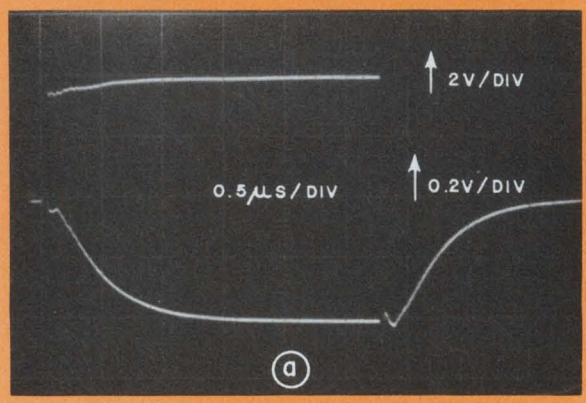


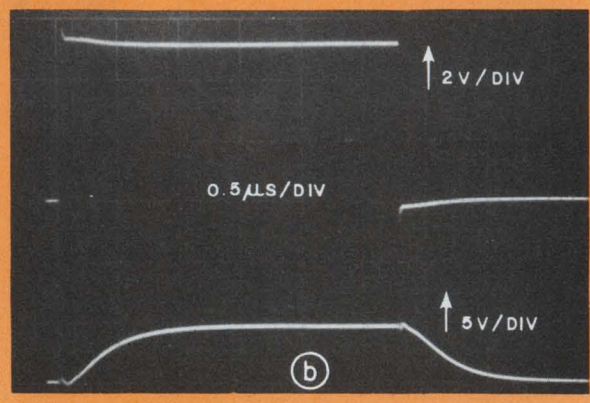


3. **Composite amplifier output measurements** show clean leading edges with little overshoot or ringing. Lower level positive (a) and negative (b) transitions, as well as the 10-V full-power transition (c), settle to within 3% of final value in 20 ns. The amplifier was operated at a gain of −10 with a 1-kΩ load. The photos were obtained with an HP 222A pulse generator (T_r = 2.8 ns) and Tektronix 647 scope (T_R = 3.5 ns).



4. **Full power is available** (20 V_{p-p} into 1 kΩ) with a gain of −10 for frequencies up to and above 10 MHz. The output shape is sinusoidal, not triangular, because of the high slewing rate of the composite amplifier. The vertical scale is 0.5 V/div and the horizontal scale is 10 ns/div.





5. **With improper adjustment** of R_N, the amplifier output (top trace) shows a slight droop (a) or overshoot (b). The corrective action of the op amp (lower trace) was taken at the output of the μA777.

Compute the noise figure of a system with this simple nomogram. All entries to the chart, and the answers, are in convenient dB power ratios.

Because the noise figure of merit is important in many electronic systems, engineers are forced to spend a lot of time calculating it with tables or a slide rule. A nomogram solves this type of problem in seconds and without the need to convert from dB to ratios and back again. Let's see why this is so.

Noise figure defines the degradation in signal-to-noise ratio from a system's input terminals to the final output. The noise figure, F, is

$$F = \frac{S_o/N_o}{S_i/N_i},$$

where S_i is the available signal power and N_i is noise, usually thermal in origin, at the system input. S_o and N_o, respectively, are the signal power and noise power at the output.

The noise figure of a system, such as a receiver, can be expressed in terms of the individual noise figures and amplification factors of the individual stages that make up the system. If there are N tandem stages and the N^{th} stage has a noise figure, F_N, and an amplification, G_N, the over-all system noise figure, F, is

$$F = F_1 + \frac{F_2-1}{G_1} + \frac{F_3-1}{G_1G_2} + \cdots + \frac{F_N-1}{G_1G_2\cdots G_{N-1}}.$$

In this expression, the individual noise figures and amplification factors must be expressed as ordinary power ratios. The resulting over-all noise figure, F, is therefore also an ordinary power ratio.

Although this expression is mathematically simple, using it is difficult, because noise figures and gains of amplifier stages are generally supplied in dB form that is not directly usable in the expression. Thus the selection of individual stages, such as amplifiers, filters and attenuators, to meet a system noise figure requires constant conversion between dB and ordinary power ratios. This is both time-consuming and subject to errors.

The accompanying nomogram simplifies this process by allowing the system designer to work exclusively in dB. The designer computes incremental changes in the noise figure by working with two stages at a time. The over-all noise figure is determined by finding the noise figure and gain of the first two stages and then using this result to combine with the third stage. By this iterative process, the noise figure of a system's entire chain of stages can be calculated.

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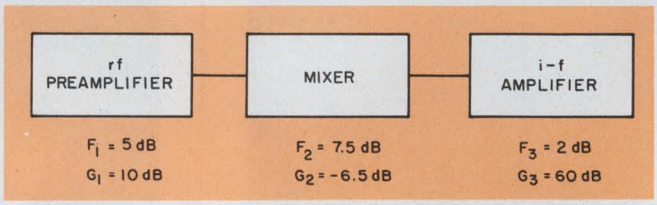
Using the nomogram, step by step

As an example, consider a receiver consisting of an rf preamplifier, a down-conversion mixer and an i-f amplifier. The noise figure and gain of each of the stages is expressed in dB, as shown in the figure.



Let's start with the rf preamplifier and mixer. Place a straight edge on the nomogram to intercept the F_b line at 7.5 dB, for the mixer, and the F_a and G_a line at 15 dB, for the rf preamplifier. The intercept with the Δ scale is 0.6 dB. This value is the incremental increase in noise figure for the mixer and preamplifier stages. The combined noise figure of these two stages is then

$$F' = F_1 + \Delta = 5 + 0.6 = 5.6 \text{ dB}.$$

The net gain of the first two stages is

$$G' = G_1 + G_2 = 3.5 \text{ dB}.$$

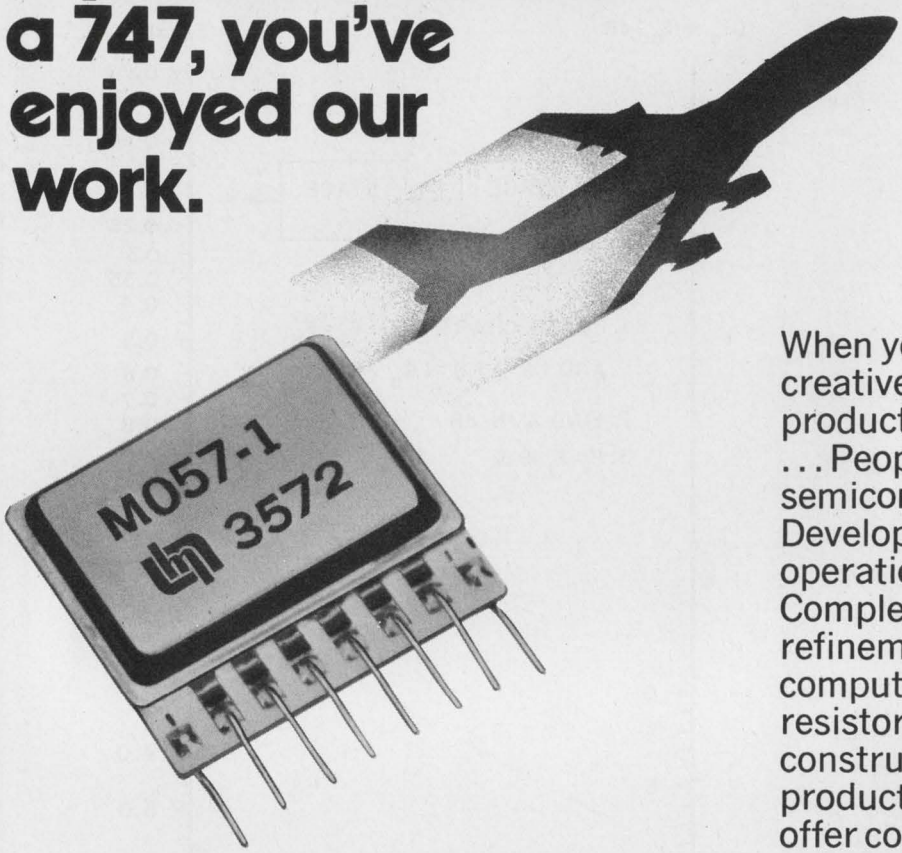
The values for F′ and G′ are now combined with the values for the i-f amplifier to find the noise figure of the entire three-stage chain. Again, enter the chart. However this time, F_3 in the figure becomes F_b on the chart. Therefore the chart is entered at $F_b = 2$ dB. The second intercept is

$$G_a + F_a = G' + F' = 9.1 \text{ dB},$$

and the Δ intercept is 0.3 dB. The over-all noise figure is thus

$$F = F' + \Delta = 5.6 + 0.3 = 5.9 \text{ dB}. \blacksquare\blacksquare$$

If you've flown on a 747, you've enjoyed our work.



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THE HYBRID PROFESSIONALS

INFORMATION RETRIEVAL NUMBER 45

Creativity—every engineer has some,

says this manager. The trick is to use two types of thinking in series, and never look for the 'best' way.

Although engineers don't have to be Tom Edisons to be creative, many must change their thinking. I often ask engineers to define creativity, and their response generally includes these points:

- The ability to come up with something useful.
- The ability to recombine old elements in a new way.
- The ability to come up with something that's totally unique.

While these answers aren't completely wrong, they're not completely right either. One reason the definition for creativity is elusive is because historically we've asked anybody who had a good idea what it means to be creative. That's like asking the guy who's 114 years old how he's so good at getting old, or like asking the golfer who gets a hole-in-one how he did it; neither really knows.

Creativity is the ability to come up with lots of ideas that are new to the guy who's coming up with them. This says that the word "new" is very important to the creator, because for him inventing the wheel is just as creative an act as it was for the guy who invented it the first time. In other words, "new to the world" is not a necessary ingredient in a creative person's makeup. It also says that the word "value" is not part of the definition of creativity, because an invention doesn't have to be useful or valuable or practical to be creative.

The thinking man's approach to thinking

Some engineers may wonder what good it does to define creativity if they don't feel creative. I say that attitude is nonsensical. Everyone has some creativity, and for those who think they don't, there are a couple of tricks they can use to help them along.

Back in the 1930s, Alex Osborn of Batten Barton Durstine & Osborn, the advertising agency, came up with a technique now commonly known as "brainstorming." At the time it was an extremely innovative approach to thinking up new ideas. Before the 1930s the world viewed creativity as some kind of magical gift, like being a great singer or dancer. The word was being used synonymously with "talent." Edison, for example, was portrayed by the press of his day as "The Wizard of Menlo Park;" the world didn't want to believe that this great inventor had a bunch of PhDs working for him. Then Osborn came along and said in essence that he had these particular tricks that he used to get groups of

R. Donald Gamache, President, Innotech, Norwalk, Conn. 06851.

R. Donald Gamache

Education: B.S., Saint Peters College, 1958.

Experience: Has conducted new product invention programs for dozens of companies, including U.S. Steel, Tupperware, Union-Carbide, 3M Company, and J. C. Penney; has taught creativity and the use of creative techniques to many R&D and executive groups; was Vice President of a leading new product design and development firm and has held marketing, creative and communications posts in advertising and in the aerospace industry.

Professional Affiliation: American Management Association; Creative Education Foundation; World Future Society.

Employer: Innotech is a company that says it can invent anything for anybody on demand. Don Gamache, the president, is a specialist in the application of creativity, via group techniques, to the generation of sound commercial concepts for new products and processes. The techniques embodied in his planned invention approach have been applied in both the consumer and industrial product areas to generating new products, solving specific technical problems, and identifying new uses for materials.

sets, I have a staff that knows a lot about TVs. And in every 100 of these assorted EEs I'm going to find essentially a 99% overlap in A's and B's. If they've been working at a problem for some time without success, the reason for their failure probably lies somewhere outside the realm of their primary expertise. Yet companies obviously can't staff everyone from astronomers to zoologists. What's the answer?

Putting the heat on creativity

One solution is the ad hoc committee—an outside group called in to solve a special problem. The idea is to bring together a bunch of specialists who can relate to a particular problem, solve the problem and when they're finished, break up the committee. That appears to be one of the better ways for a company to marshall creative forces.

Another way is *planned invention* © within the company—a methodology developed on the firing line. It's selecting company specialists and other outside experts with the necessary A's and B's and putting them together in creative task forces. That way a company can fabricate a collective superintellect. None of the people in the task force may have a history of creativity. However, their thinking processes can be massaged. Based on research at the Creative Foundation, State University of New York at Buffalo, there are a number of proven creative principals and techniques—such as "giantism," in which models of whatever the task force is working on are made very large or very small. In ways like this, the group can be made to think creatively.

Laughing, scratching and creating

Finally, remember this: The best climate in which to generate ideas is one of relaxed laughter. Everyone should be laughing a lot and having a good time, because as long as there's humor present, someone can slip in a "crazy" idea. If it's really wild—well, it's a good joke. Right? But if it's apparent that it has potential, you may be in business. People air their ideas quicker that way than if everyone is sitting around with a long face.

And the creative group should be a peer group. There shouldn't be a company president sitting here, looking down his nose at everybody.

I contend that the single most important characteristic of a creative person is courage. If you keep coming up with a lot of ideas, you're bound to come up with a few bummers and people are going to laugh at you and try to show how stupid you were. If you keep doing that for a long enough time, you're either crazy or courageous. ■■

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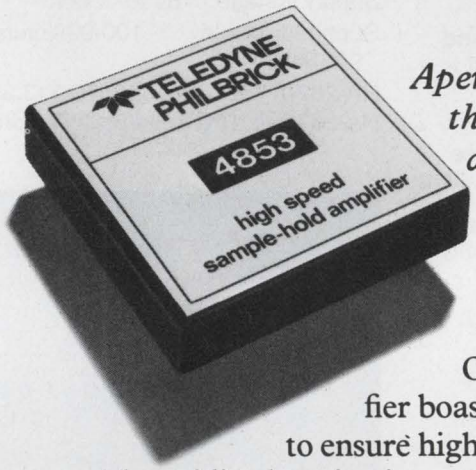

Aperture-Time Uncertainty—the tolerance of the delay between a hold command and the actual opening of the hold switch, i.e., the repeatability of the aperture time.

Feed-thru—the effect of input on output when in the hold mode, usually a function of input signal level and frequency.

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INFORMATION RETRIEVAL NUMBER 49

Adjustable sinewave audio oscillator employs improved age for wide frequency range

The problem with ordinary Wien bridge op-amp oscillators is maintaining operation in the linear region of the amplifier. Otherwise excessive loop gain causes sinewave clipping to occur at the lower frequencies. And at the higher frequencies the circuit fails to oscillate because of inadequate loop gain.

Most single-amplifier designs control loop gain via the nonlinear resistance of an incandescent lamp. The circuit shown follows this approach but it includes additional agc circuitry.

Ignore for the moment the presence of CR_1, CR_2 and R_2. Then, the nonlinear resistance of lamp L_1 provides agc action. As the frequency is increased by adjustment of the potentiometer R, the voltage at the noninverting (+) terminal decreases. This in turn causes the output amplitude to decrease. The resulting decrease of power dissipation in the lamp means its resistance will decrease thereby increasing the amplifier gain and restoring the output level to its previous value.

The opposite action occurs as the operating frequency is decreased by the potentiometer. The voltage at the plus terminal increases. But as the output voltage increases, the voltage across the lamp also increases and causes the lamp resistance to increase. The amplifier gain is decreased, thereby preventing clipping at the output.

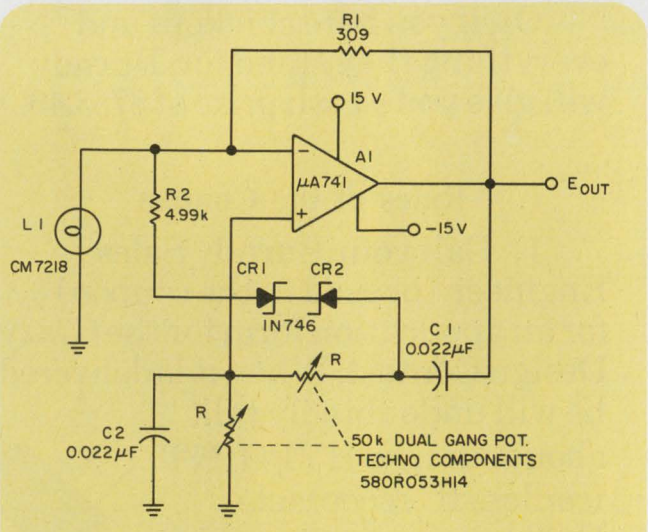
The back-to-back zener diodes in the bridge circuit limit the sinewave amplitude as the frequency decreases. This overcomes two limitations of the lamp agc system: (1) lack of constant-amplitude gain adjustment because of nonlinearities in the lamp resistance, and (2) poor low-frequency amplitude stability because of the low thermal time constant. As the amplitude grows, the diodes begin to conduct and shunt the current away from the potentiometer resistance in series with C_1. Consequently the voltage at the plus-amplifier terminal will decrease: Since $V_1 \simeq V_2$ the output voltage V_o will also decrease, thereby preventing saturation and subsequent clipping of the output signal. The value of resistance R_2 is chosen to soften this zener limiting action and thus prevent undue distortion.

The addition of the three components R_2, CR_1, and CR_2 increases the frequency adjustment range from about 3:1 to greater than 10:1.

With the component values shown, the circuit operates from 200 Hz to 2 kHz. The frequency variation can be made less than ±1% over the temperature range of −55 to 125 C by choosing components with sufficiently low temperature coefficients for R, C_1 and C_2. Total harmonic distortion is more than 35 dB below the signal level. And only eight discrete parts are used.

Christopher B. Schwerdt, Design Engineer, Westinghouse Electric Corp., Defense Development Div., Station 482, Box 746, Baltimore, Md. 21203.

CIRCLE NO. 311



Waveform purity at low frequencies for a Wien bridge oscillator is enhanced by diode limiting. Lamp L_1 stabilizes the loop gain at higher frequencies while the limiting action of R_2, CR_1 and CR_2 prevents clipping at low frequencies.

Dual comparator and R-C filter estimate probability density functions

A surprisingly simple circuit measures probability density functions for random inputs. It produces a dc output voltage proportional to the percentage of time that an ac input voltage lies within an adjustable amplitude window $V_r \pm \Delta V$. By definition, the output voltage V_o is an analog of the probability density function of the input V_i evaluated at the point V_r.

The circuit (Fig. 1) uses a dual differential comparator. Each section of the comparator delivers a high, or logic ONE, output only when its noninverting (+) input is more positive than its inverting (−) input.

An external dc reference voltage, V_r, is applied to both the inverting input of section 1 and the noninverting input of section 2. Potentiometers R_1 and R_2 can add and subtract, respectively, a small voltage ΔV from the reference.

From the previous description of the comparator operation, we can see that the output will be a logic ONE when

$$V_i > V_r + \Delta V$$

or when

$$V_i < V_r - \Delta V$$

In other words, a logic ZERO occurs when the input signal V_i lies inside the window.

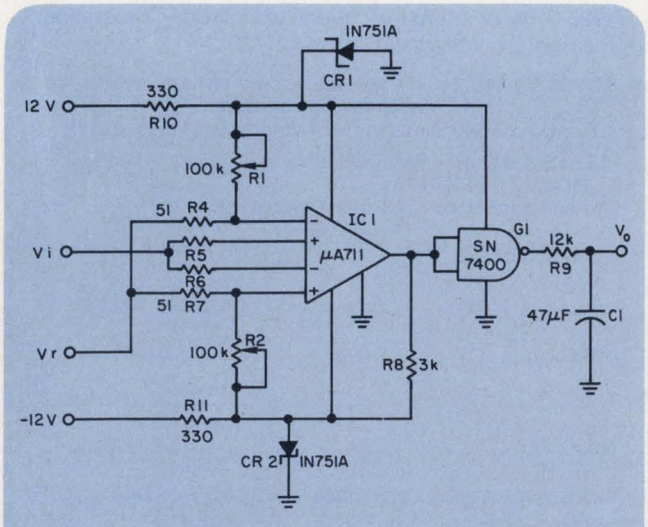
To understand the operation of the circuit more clearly, assume a sinusoidal input with V_r initially at zero (Fig. 2 top). Minimum-width pulses result at the NAND-gate output, since the slope of the sine wave is at maximum. As the voltage V_r is increased, the slope of the sine wave within the window, decreases and the width of the output pulses increases. The maximum pulse width occurs when V_r equals the peak value of the sinusoid.

All pulses have the same height and polarity. Hence the output of an R-C filter connected to the NAND gate is a dc voltage that is proportional to the time spent by the input signal inside the voltage window.

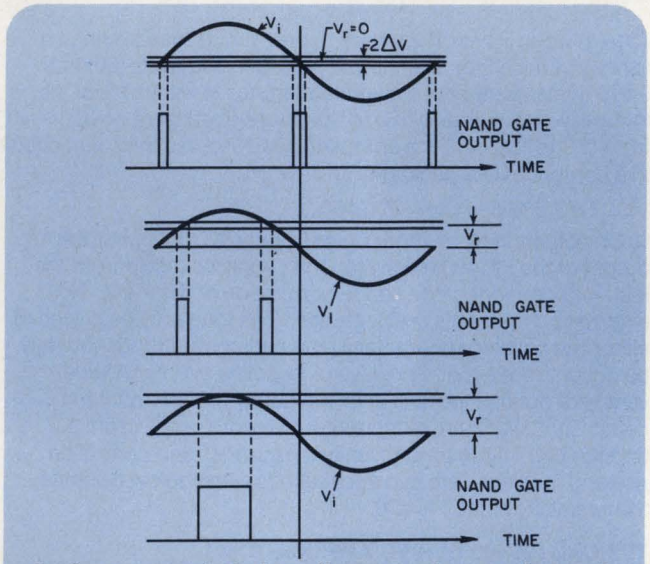
Two experimentally generated probability density functions are shown in Fig. 3: for a sinusoidal input (a) and one for amplified gaussian resistor noise (b).

J. F. Sparacio and R. S. Pierro, United Aircraft Corp., Norden Div., Norwalk, Conn. 06856.

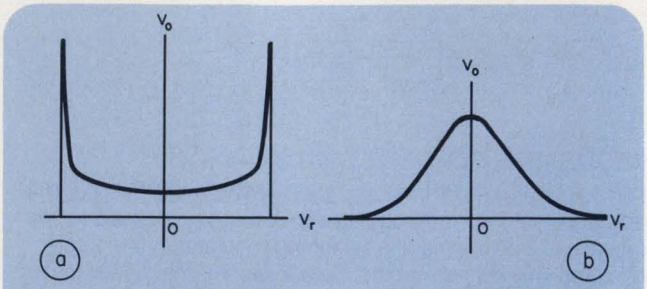
CIRCLE No. 312



1. **Window-comparator circuit** produces a dc output proportional to the time during which input signal V_i falls within a window whose position is determined by reference voltage V_r. Thus the output is an analog of the input signals probability density function.



2. **Sequence of timing diagrams** (top to bottom) shows the NAND gate output voltage as V_r is progressively raised from zero (top frame) to the height V_i of the sine wave input.



3. **Sample outputs** from a sine wave input (a) and amplified resistors noise (b) as a function of V_r show excellent agreement with the corrsponding theoretical probability density functions.

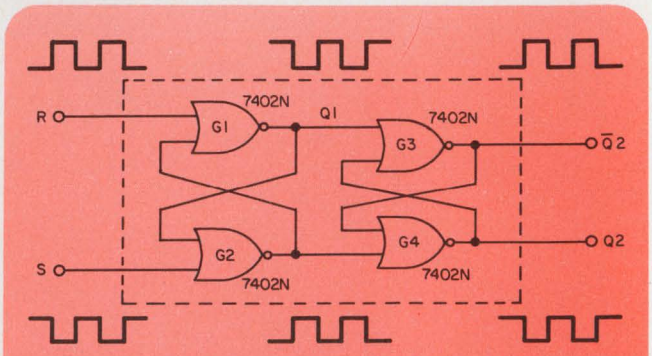
Line receiver rejects common-mode spikes but employs only 2 flip-flops

Want a simplified way to reject common-mode input spikes? By cascading only two flip-flops, you can get a differential line receiver that rejects spikes whose peaks exceed 200% of the typical logic level.

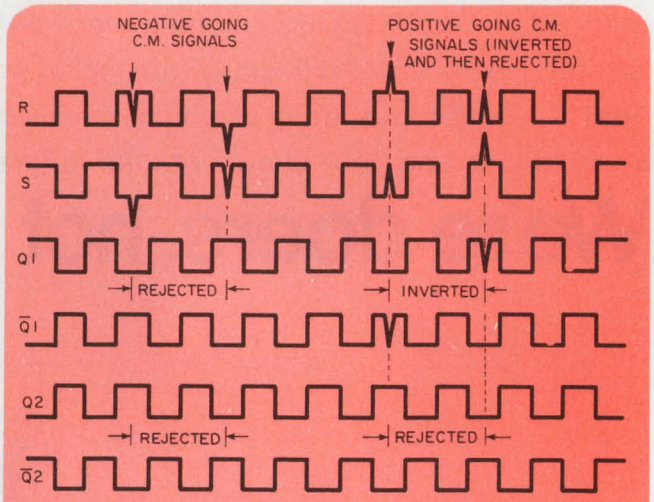
Unlike a similar circuit[1] that uses five gates, including one with three inputs, this one requires only 4 two input positive NOR gates (Fig. 1). A single 7402 package is used to configure the two reset/set (RS) flip-flops in series.

The common-mode-rejection (CMR) performance of the receiver can be best understood by considering each flip-flop separately. As shown in the timing diagram (Fig. 2), the cross-coupled gates, G_1 and G_2, are insensitive to any spurious negative-going signal at either the R or S input. This occurs while one of the inputs is high and the other is low. Any positive-going signal at R while S is high produces a negative-going signal at Q_1, and vice versa. In short, a single RS flip-flop rejects negative-going common-mode signals, and inverts positive going ones. The second RS flip-flop will reject all the inverted spikes.

The circuit was tested with common-mode noise spikes of 4 V superimposed on a signal of the same amplitude. The outputs of the receiver were completely free of this noise. As the 7402 gate has a typical logic ONE input level of 2.4 V and a maximum of 5 V, the circuit can easily reject noise at greater than 200% of the typical logic level.



1. **Circuit with two cascaded, set/reset flip-flops** rejects common-mode spikes of either polarity. Each flip-flop separately rejects negative-going spikes but inverts positive spikes.



2. **Waveform illustrates** the excellent common-mode rejection properties of the two reset-set cascaded flip-flops.

Reference:

1. Crittenden, William B., "Set-Reset Flip-Flop Rejects Input Noise," *Electronic Design 13*, June 24, 1971, p. 80.

F. Mazzaferri, Engineer, Research Laboratories, Postmaster-General's Dept., Melbourne, Australia.

CIRCLE NO. 313

IFD Winner of October 12, 1972

Maxwell G. Strange, Senior Engineer, NASA, Experiment Engineering Branch, Goddard Space Flight Center, Greenbelt, Md. 20771. His idea "Variable threshold circuit separates sync pulses from composite video signal" has been voted the Most Valuable of Issue Award.

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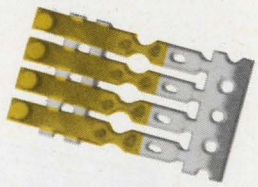

-reports **Mr. J. B. Lambert,** *Exec. V.P. of T-Bar, Inc. in addressing Design Engineering Conference*

Precision beryllium copper springs, made and heat-treated **after** forming by Instrument Specialties, are still making news. Mr. J. B. Lambert, Executive Vice President of T-Bar Inc., Wilton, Conn., referred to them again in his paper delivered before the Design Engineering Conference, terming them "essential" to his product.

T-Bar is a leading manufacturer of highly reliable switching devices for critical low level applications. The heart of each switch is one or more wafers, each consisting of 4 to 12 spring contacts, capable of switching up to 144 circuits. An assembly can consist of as many as 12 wafers.

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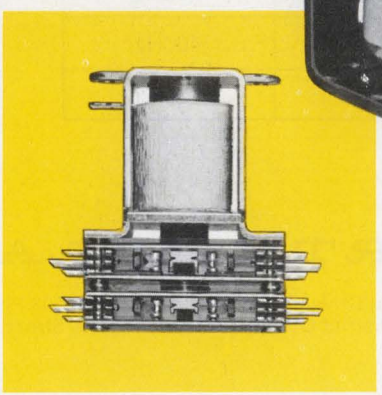

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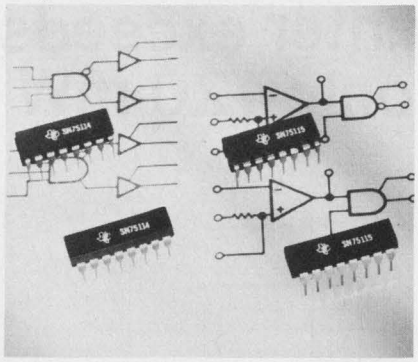
INFORMATION RETRIEVAL NUMBER 56

Driver-receiver ICs replace 9614, 9615



Texas Instruments Inc., P.O. Box 5012, M/S 308, Dallas, Tex. 75222. (214) 238-3741. SN75114N: $3.10; SN75115N: $3.41 (100 up); stock.

A dual differential line driver (SN55/75114) and receiver (SN-55/75115) are second-source products to the 9614 and 9615. The 114 driver has TTL compatible inputs as well as complementary output pairs which give AND and NAND functions of the inputs. Both the 114 and 115 operate from a single 5-V supply. The 115 recovers digital data from differentially transmitted signals. The receiver circuit features a high common-mode input voltage range of up to 15 V.

CIRCLE NO. 255

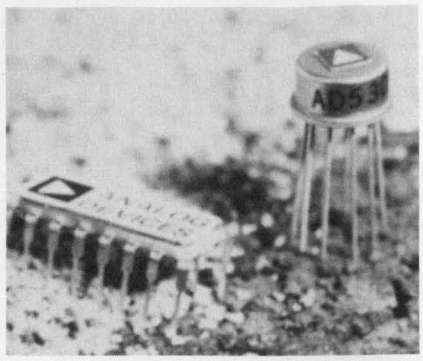
Dual 4-to-1 data selectors boost speed

Signetics, 811 E. Arques Ave., Sunnyvale, Calif. 94086. (408) 739-7700. Tentatively about $5 (100 up).

The S54S153 and N74S153 dual 4-line-to-1-line data selectors/multiplexers—monolithic Schottky-TTL circuits—are significantly faster than their standard TTL counterparts. The guaranteed delay times for the new data selectors represent approximately a 100% improvement in speed with only a 12% increase in maximum dc power consumption, according to Signetics. The data selectors/multiplexers are fully compatible for use with most standard, high-speed, and low-power TTL and DTL circuits. Full fanout to 10 normalized 54S/74S loads is available from each of the outputs at low logic levels; a fanout to 20, at high logic levels.

INQUIRE DIRECT

Multiplier boosts accuracy of line



Analog Devices, Route 1 Industrial Park, Norwood, Mass. 02062. (617) 935-5565. AD530J: $15 (100 up); stock.

A higher accuracy version of the company's AD530 multiplier, the AD530L, features a maximum multiplying error of 0.5% at 25 C, and 1.5% from 0 to 70 C, thus making it the highest accuracy IC multiplier currently available, according to the company. The manufacturer also guarantees the device's accuracy at the temperature extremes. The AD530 multiplies in four quadrants with a transfer function of XY/10, divides in two quadrants with 10Z/X transfer function and square roots in one quadrant with a transfer function of $-\sqrt{10Z}$.

CIRCLE NO. 257

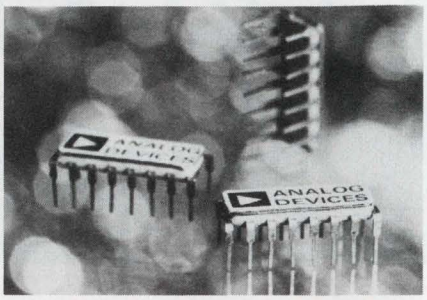
Uncommitted logic array uses CDI

Ferranti Electric Inc., E. Bethpage Rd., Plainview, N.Y. 11803. (516) 293-8383.

An uncommitted logic array (ULA) fabricated with the company's CDI process, includes sufficient components to fabricate a total of 200 gates, or a mixture of gates, flip-flops and other logic elements. Thus, a single ULA package could replace 50 quad two-input standard TTL devices. Since the individual components can also be connected to form linear circuit functions, an LSI combination of digital and linear functions is also practical. The ULA requires only a single 5-V supply. The basic gate, a three-input RTL configuration, has a 35 ns propagation delay and a 2.5 mW dissipation.

CIRCLE NO. 258

Five-bit switch for 10-bit converters

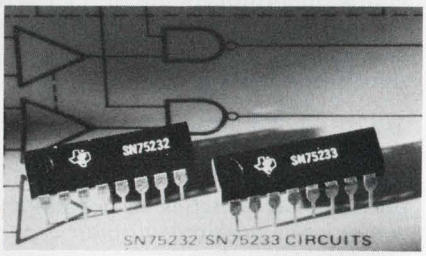


Analog Devices, Route 1 Industrial Park, Norwood, Mass. 02062. (617) 329-4700. AD552J: $2.20 (100 up); stock.

A monolithic five-bit current switch, the Model AD552, replaces discrete and matched triplet of four-bit switches for precision five and 10-bit a/d and d/a converters. The AD552 requires complementary binary input coding and features an MSB output current rating of 2.0 mA. It settles to 0.05% (±1/2 LSB) in 120 ns. Logic inputs are TTL compatible with full noise immunity guaranteed over the specified operating temperature range, independent of the base-line reference voltage.

CIRCLE NO. 259

Dual sense amps have open-collector outputs

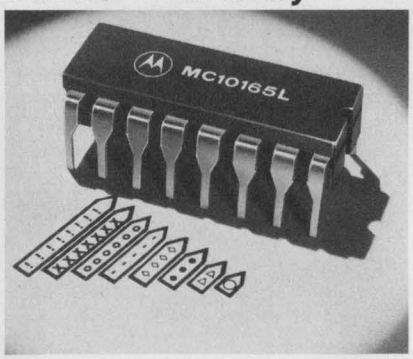


Texas Instruments Inc., P.O. Box 5012, Dallas, Tex. 75222. (214) 238-3741. SN75232N: $1.80; SN-75233N: $1.45 (100 up); stock.

Two dual sense amplifier ICs feature an open-collector output at each of the output gates. This permits two or more outputs to be connected in a wire-AND configuration. The new circuits, designated the SN75232 and SN75233, are said to be improved pin-for-pin replacements for the LM7534 and LM7535, respectively. The SN75232 has a threshold sensitivity of ±4 mV, while the SN75233 has one of ±7 mV.

CIRCLE NO. 260

Priority encoder boasts 7 ns delay

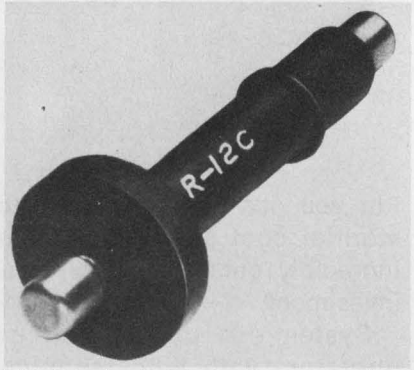


Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, Ariz. 85036. (602) 273-3466. MC-10165L: $9.20 (100 up).

The MC10165, a MECL 10,000 eight-input priority encoder, operates with a typical propagation delay of only 7 ns from data-input to coded-output. Priorities are assigned to each of the eight inputs by the logic circuit. In operation, an output code (three-bit binary) is produced corresponding to the highest-priority input that is at a logic HIGH state. Simultaneous inputs of lower priority are ignored. A fourth output is HIGH whenever one or more inputs are HIGH.

CIRCLE NO. 261

High voltage rectifier for color TV rcvrs

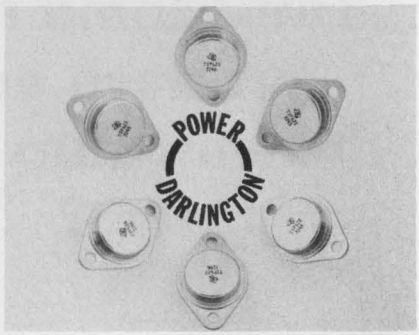


Electronic Devices, Inc., 21 Gray Oaks Ave., Yonkers, N. Y. 10710. (914) 965-4400. $9.95.

The R-12C high voltage rectifier can be used as a direct replacement for "stick" rectifiers in color TV receivers. Ratings for the R-12C include a peak inverse voltage of 45 kV, peak repetitive forward current of 200 mA, average forward current of 5 mA and voltage drop of 75 V at 50 mA.

CIRCLE NO. 262

Npn/pnp Darlington transistors offered



Texas Instruments Inc., P.O. Box 5012, M/S 308, Dallas, Tex. 75222. TIP620: $2.50; TIP621: $2.80; TIP622: $3.30 (100 up); stock.

Three npn/pnp Darlington power transistor complementary pairs are now available from the manufacturer. The npn units are the TIP620, TIP621 and TIP622; the pnp devices, the TIP625, TIP626 and TIP627. Collector-emitter breakdown voltages range from 60 to 100 V. Collector current for each unit is 5 A and gain is 1000 at a collector-emitter voltage of 3 V and a collector current of 3 A. Power dissipation is 100 W at a 25 C case temperature.

CIRCLE NO. 263

Hybrid voltage reg lists 5 V, 3 A

European Electronic Products Corp., 10180 W. Jefferson Blvd., Culver, Calif. 90230. (213) 838-1912.

A high-power hybrid voltage regulator, called the LM5000 and consisting of monolithic circuitry and a power transistor chip, has ratings of 5 V typical and 3 A maximum. For TTL and DTL ICs in control and measuring equipment, the regulator has built-in circuit protection against continuous overload and short circuits. The company states that few external components are required and no further adjustment is necessary. The LM5000 comes hermetically sealed in a TO-3 package.

CIRCLE NO. 264

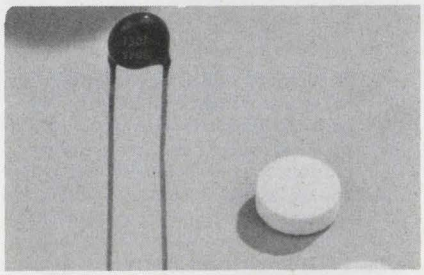
Power transistors use emitter balancing

Power Physics Corp., Industrial Way West, Eatontown, N. J. 07724. (201) 542-1393. 2N5038: $5.60; 2N5039: $3.60 (100-999); stock.

The company's 2N5038 and 2N-5039 npn planar power transistors are fabricated with a special technique called emitter balancing for a reported significant improvement in forward and reverse bias energy conditions. The transistors are passivated devices offering fast switching speeds of 0.5 μs, power dissipation of 140 W and excellent thermal characteristics, according to the company. Complements of the new devices are also offered in pnp form as the PP7535 and PP-7536.

CIRCLE NO. 265

MOV varistor geared for PC boards



General Electric Co., Semiconductor Products Dept., Bldg. 7, Mail Drop No. 49, Electronics Park, Syracuse, N.Y. 13201. (315) 456-2021. 48¢ (10,000).

A series of six lead-mounted GE-MOV metal oxide varistor models are now available for PC board use. Labeled MINI-MOVs, the new aspirin-size models range in energy handling capability from one to four joules. The six models are rated for ac and dc operation. Ac rms input voltage ratings include 130, 150 and 250 V; dc input voltages are 184, 212 and 354 V, respectively.

CIRCLE NO. 266

Skinny 3 1/2-digit DPM offers fat performance, low cost

Analog Devices, Route 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062. (617) 329-4700. $79 (100s); $120 (1-9); March (production qty).

The 3/4-inch thickness of Analog Devices' new 3-1/2-digit DPM —the AD2010—doesn't make it the smallest on the market. California Instruments' Series 8330 holds that distinction with an 11/32-inch-thick case. And the $79, 100-unit price doesn't make the AD2010 the least expensive either. Tekelec, Inc., a new vendor in the DPM market, sells its TA 305-02—a 3-1/2 digit, liquid-crystal unit—for $59.50 in 100-unit quantities.

But when the small size and relatively low price of the LED-readout AD2010 are considered together with its specifications and performance features, and then compared with those of its competitors, the scales tilt in favor of the Analog Devices unit.

Included in the price of the AD-2010 are such features as automatic zero correction, which compensates for offset and offset drift errors; automatic polarity; flashing zeros when the reading exceeds the full-scale range of ±199.9 mV; suppressed leading zeroes; selectable decimal points; and, finally, latched BCD outputs.

The 5-V powered AD2010 doesn't have true differential or isolated inputs though—it is intended for single-ended inputs only. However, the inputs can be floated in what a company spokesman terms a quasi-differential mode—provided the common-mode voltage doesn't exceed 200 mV. Within the common-mode voltage range, the CMRR is 60 dB.

Specifications of the new Analog Devices unit include a maximum accuracy error of 0.05% of reading ±1 digit, a resolution of 0.1 mV, input bias current of only 3 nA, a dc input impedance of 100 MΩ and a tempco of ±50 ppm/°C over the operating temperature range of 0 to 60 C.

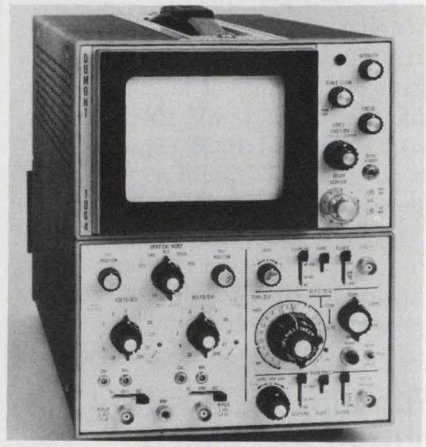
The AD2010 is tuned for a normal-mode rejection of 40 dB minimum at 60 Hz and 60-Hz harmonics. An optional model, the AD2010/R, offers an adjustable normal-mode rejection to 60 dB, as well as ratiometric operation.

Conversion rate of the AD2010 is four readings per second with the internal trigger. This can be increased to 24 readings per second with an external trigger. Normal conversion time is a maximum of 42 ms for full-scale input. In addition, the unit has an automatic mode, in which a new conversion begins automatically upon completion of each conversion.

Power consumption of the unit is 5 V at 600 mA, and the 3 × 1.8 × 3/4-inch package fits the same panel cutout as other Analog Devices DPMs. The unit is protected against overvoltage up to 20 V sustained, and 50 V momentary. Outputs of the AD2010 include a 3-digit latched BCD (8421 positive true), and overrange, overload, polarity and status-indication signals.

CIRCLE NO. 267

Scope offers 60-MHz bw, 5 mV/cm sensitivity



Dumont Oscilloscope Laboratories, Inc., 40 Fairfield Pl., W. Caldwell, N.J. 07006. (201) 575-8666. $1625; 30 days.

Dumont's new dual-trace 1064 has dc to 60-MHz bandwidth, sensitivity of 5 mV/cm, maximum sweep speed of 10 ns/cm, an 8 × 10-cm display and calibrated, delayed sweep. Integrated circuit dual modulators eliminate the triggering problems of conventional designs. Price includes instruction manual, two X10 passive attenuator probes, power cord and 3-2 adaptor.

CIRCLE NO. 271

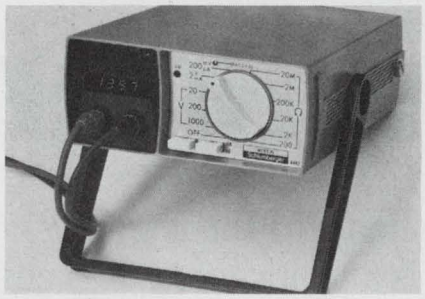
Meter displays nonlinear amplitude distortion

Hekimian Laboratories Inc., 322 N. Stonestreet Ave., Rockville, Md. 20850. (301) 424-3160. $2295; 30 days.

Model 65 is said to be the first nonlinear distortion meter. This unique instrument displays amplitude nonlinearity by measuring intermodulation distortion. It detects and logarithmically displays second and third order intermodulation distortion products generated by a dual frequency, narrowband pseudo-noise test signal. Operating over an input range of 0 to −40 dBm, it provides direct distortion readings to better than 50-dB below the input signal level. No adjustments or level difference calculations are required. The Model 65 also indicates invalid measurement conditions.

CIRCLE NO. 272

3-1/2-digit DMM weighs just 2-1/2 pounds



Weston Instruments Div., 614 Frelinghuysen Ave., Newark, N.J. 07114. (201) 243-4700. $325; stock.

The Model 4442, a battery-operated, 3-1/2-digit DMM, is small enough to be carried in a standard attache case. Weight is less than 2-1/2 pounds. The self-contained rechargeable battery pack provides up to 12 hours of continuous operation. Twenty ranges cover 200 mV (100-μV resolution) to 1000-V ac/dc, 200 Ω (0.1-Ω resolution) to 20 MΩ, plus ac and dc current. The Model 4442 features LED readouts.

CIRCLE NO. 273

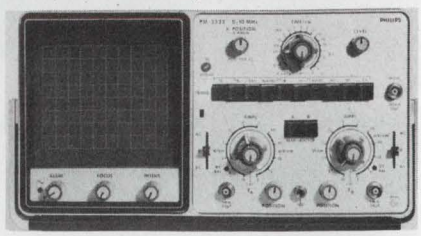
Three models offered in freq counter line

Heath/Schlumberger Scientific Instruments, Benton Harbor, Mich. 49022. (616) 983-3961. SM-110A: $495; SM-110B: $625; SM-100C: $795.

The SM-110 series is a new line of frequency counters. The SM-110A features 1 Hz to 200-MHz range, separate 1 MΩ and 50 Ω inputs, 10-mV input sensitivity and a 1-MHz crystal time base stable to 7.5 ppm/year. The SM-110B is identical to the SM-110A, and also includes a 1 ppm/year TCXO time base, complete remote programming capability and other features. The SM-110C has all the features of the A and B models and also includes a 600-MHz prescaler. All counters in the new SM-110 series feature seven-digit, seven-segment LED readout.

CIRCLE NO. 274

Dual-beam scope yields 2-mV sens., 10-MHz bw



Test & Measuring Instruments Inc., Subsidiary of North American Philips, 224 Duffy Ave., Hicksville, N.Y. 11802. (516) 433-8800. $900.

Sensitivity of 2 mV/cm across the full 10-MHz bw, plus true dual-beam operation are the major features of the PM3232, a new general purpose scope by N. V. Philips of Holland. The PM3232 also offers universal triggering facilities including automatic level, dc coupling and automatic TV line/frame selection. The CRT has an 8 × 10-cm screen and light output derived from the post-deflection acceleration system, so that even low-duty-cycle, fast-sweep signals are displayed clearly.

CIRCLE NO. 275

80-MHz, 5-digit counter is priced at $325

Ballantine Laboratories Inc., P.O. Box 97, Boonton, N.J. 07005. (201) 335-0900. $325; stock.

The first in a special line of products to be marketed by Ballantine Laboratories, Inc. through its newly-established Distributor Division is an 80-MHz frequency counter. Called the Model 5725A, the direct-reading five-digit (kHz and MHz) instrument offers input sensitivity of 75-mV rms to 40 MHz and 120-mV to over 80 MHz. In addition, the unit features totalizing; 1-Hz resolution for signals in the megahertz ranges; a crystal-controlled 1-MHz reference source with an aging rate of less than 2 ppm per month; and self-check by use of the clock output. The instrument can also be used to measure the ratio of two frequencies.

CIRCLE NO. 276

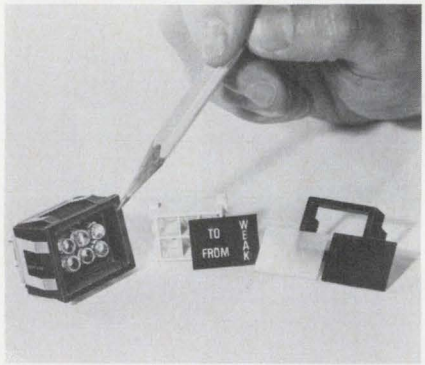
Probability analyzer samples at 2 MHz

Signal Analysis Operation, TID Honeywell Inc., 595 Old Willets Path, Hauppauge, N.Y. 11787. (516) 234-5700. $6500; 30 days.

A new 100-point, real-time digital correlation and probability analyzer is available from the new Signal Analysis Operation (formerly SAICOR), of Honeywell's Test Instruments Div. Known as Model SAI-42A, the all-digital unit operates in three modes—auto and cross correlation, probability density and distribution and signal enhancement. Features included as standard equipment are—minimum Δt of 0.5 μs or 2 MHz sampling rate, 1500 points of precomputation delay, selectable in blocks of 50, and 50 μs real-time processing rate.

CIRCLE NO. 277

Status display module shows 6 messages



Dialight Corp., 60 Stewart Ave., Brooklyn, N.Y. 11237. (212) 497-7600. Six LEDs: $6.81 ea. (1000s); Four LEDs: $5.11 ea. (1000s); stock.

Dialight's new series 556 are multilegend LED status indicators. These units can be snap-in bezel-mounted individually or side-by-side. The status indicator is offered with four or six LEDs and with adjustable light-cell barriers. A maximum of six individually illuminated messages are possible. The housing to the display can be quickly disassembled to provide convenient access to the legend and the light barriers. Terminations for the indicator are 0.025-in. square pins that interface directly with DIP IC sockets and can be wire-wrapped or hand wired. Internal resistors limit current to 15 mA per lamp at 5 V. Both the base assembly and the legend cap are available in a range of colors. The LEDs operate with standard IC power supply levels.

CIRCLE NO. 278

Low-drift op amps have 100-MHz bw's

Intronics, 57 Chapel St., Newton, Mass. 02158. (617) 332-7350. A521: $59; A522: $69; stock.

Two new op amps, Models A521 and A522, offer low drift of input offset voltage. The A521 provides 5 μV/°C and the A522 offers 1 μV/°C. Both models achieve an open-loop bw of 100 MHz. Settling time, in unity-gain inverting mode, is 1 μs to 0.01%, and 200 ns to 0.1% for a 20-V step input. Case sizes are 1.8 × 1.2 × 0.6-in. for the A521, and 1.8 × 1.2 × 0.4-in. for the A522. Models A521/M and A522/M are available for operation from −55 to +125 C.

CIRCLE NO. 279

Power-line filter has 45-dB insertion loss

Corcom, Inc., 2857 N. Halsted St., Chicago, Ill. 60657. (312) 327-6566. $4.65 to $12.10; stock.

R series rfi power-line filters are suited for low-impedance loads where rugged rfi environments are present. At frequencies as low as 150 kHz, they have an insertion loss as high as 45 dB. They are ideal replacements for Pi-type filters, at a fraction of the size and at lower cost. The R series is available in four case/termination styles and in current ratings from 1 to 20 A. They are designed for operation from 115 to 250 V ac, 50-60 Hz, have a 0.5-mA maximum leakage current each line to ground, a 10,000 pF capacitance line to ground and will withstand a 2100 V dc high-pot test.

CIRCLE NO. 280

4-quadrant multiplier has 30-MHz bandwidth

Optical Electronics Inc., P.O. Box 11140, Tucson, Ariz. 85706. (602) 624-8358. $46; stock.

Model 5050 is a four-quadrant analog multiplier having both a small-signal and large-signal bandwidth of 30 MHz minimum. The 1.8 × 1.2 × 0.6-in. module features a settling time of 60 ns maximum to 0.1%, standard signal levels of ±10 V fs, temperature range of −55 C to +100 C and dissipation of 540 mW maximum.

CIRCLE NO. 281

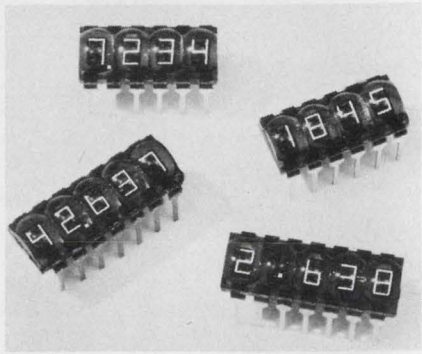
Modular power supplies mount on PC board

Burr-Brown Research Corp., International Airport, Industrial Park, Tucson, Ariz. 85706. (602) 294-1431. Start at $23 (1-9); one week ARO.

Burr-Brown is introducing a new family of low-cost power supplies aimed at OEM instrumentation markets. These epoxy-encapsulated modular power supplies are designed to be soldered onto the user's PC board along with the ICs and modules for which they provide dc power. They offer such features as current-limited outputs, output overvoltage protection, dual regulation and identical pin configuration. Dual supplies for op amps and functional modules are available at ±12 V dc, ±15 V dc, ±18 V dc and ±26 V dc with current ratings available in discrete steps from ±25 to ±200 mA. 5-V logic power supplies are available from 250 mA to 1.0 A.

CIRCLE NO. 282

7-segment displays are clustered



Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, Calif. 94304. (415) 493-1501. 3 digits: $12.75; 4 digits: $17; 5 digits: $21.25; stock.

A series of small, end-stackable solid-state displays is available in three, four and five-digit clusters. Model 5082-7400 series are seven-segment monolithic displays, 0.11-in. high. Built-in magnification increases apparent luminous intensity, thus reducing power requirements. Packages are standard 12 or 14-pin DIPs designed to be plugged into sockets or soldered into PC boards. The display can be tilt mounted up to 20° from the PC board. These displays are designed for strobed operation and are IC compatible. Decimal point is standard right-hand, or central.

CIRCLE NO. 283

Ribbon indicator is readable to 100 feet

Westinghouse Electric Corp., Westinghouse Building, Gateway Center, Pittsburgh, Pa. 15222. (412) 255-3800. $160.

The SERVOCHROME Ribbon Indicator is a servo-powered indicator display that is highly readable, from close up or at a distance of up to 100 feet. The vivid red and white ribbon gives precise readings for temperature, pressure, flow—or any other variable operating on transmitted dc signals. A selection of 10 colored frames is available for coded identification of the indicated variable. The four-inch scale is flat and close to the ribbon to eliminate parallax and expose the total scale length for easy reading. Scales snap in and out from the front of the unit.

CIRCLE NO. 284

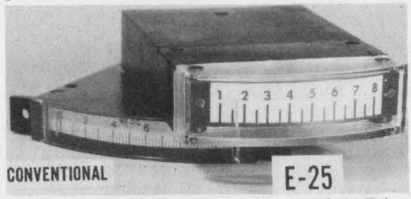
3-D display modules produce stereo images

Optical Electronics Inc., P.O. Box 11140, Tucson, Ariz. 85706. (602) 624-8358. Basic System: $297; Full System: $4332; stock.

OEI has added new units to its line of 3-D display modules. The new modules produce stereo images (righthanded and lefthanded views) on a CRT, generate a set of three orthogonal axes and allow alphanumerics to be superimposed on a graphic image. A modular system provides three deflections: a CRT beam movement vertically, another movement horizontally and a third, called longitudinal axis input, causes apparent movement toward and away from the observer. The image contains geometric perspective (the farther away an object is, the smaller it is) and aerial perspective (the farther away an object is, the dimmer it is).

CIRCLE NO. 285

Edge-reading meters provide 3/4-in. face

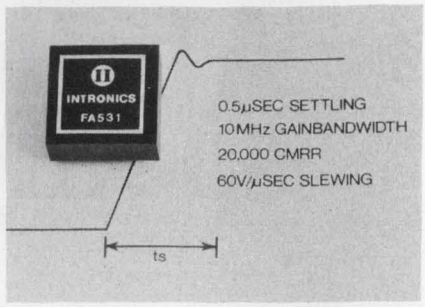


Airpax Electronics Controls Div., 6801 W. Sunrise Blvd., Fort Lauderdale, Fla. 33313. (305) 587-1100. $80; 8 wks.

Series E-25 and E1-25 "parker-meters" are designed for applications that require a wider scale face for reading ease. Series E-25 edge-reading meters provide a meter face of 3/4 × 2-1/2 in. (The actual scale length is 1.80 in.) Meter case extends 4-in. behind the mounting surface. The housing and lens are molded of polycarbonate, self-extinguishing SE-1 Lexan. Total weight of meter is less than 2 ounces. This lightweight meter is also available as Series E1-25 with scale illumination provided by two subminiature lamps.

CIRCLE NO. 286

Op amp has fast settling, low drift



Intronics, 57 Chapel St., Newton, Mass. 02158. (617) 332-7350. $46 (1-9); stock.

The Model FA531, a FET op amp, features fast settling (0.5 μs in either inverting or noninverting modes), high common-mode rejection ratio (20,000:1) and low-input voltage drift (15 μV/°C). The Model FA531 also achieves a gain bandwidth product of 10 MHz and a slew rate of 60 V/μs. In addition, the short-circuit protected output stage can deliver ±20 mA load current, with fast slew rates and a 1 MHz full-power frequency.

CIRCLE NO. 287

DATA PROCESSING

Desk-top calculator rivals minicomputer

Hewlett Packard, 1501 Page Mill Rd., Palo Alto, Calif. 94304. (416) 493-1501. $8940 (with printer).

BASIC programming language directs the Model 9830 calculator. Instructions and programs are entered from the standard typewriter keyboard and shown on the 32-character alphanumeric display. Numbers may be entered from the typewriter keyboard or from a set of duplicate numerical keys to the right of the keyboard. Editing keys permit the user to delete, modify or correct program lines or individual characters. The separate Model 9866A thermal printer operates at 250 lines/min. Other features include cassette memory for storage of programs and data, plug-in ROMs for memory expansion and a basic 4 k memory capacity. The calculator without printer sells for $5975, the printer costs $2975. A number of additional peripherals such as X-Y plotters are also available.

CIRCLE NO. 288

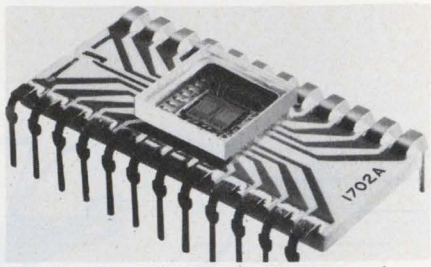
Computer-based lab system aids scientists

Digital Equipment Corp., 146 Main St., Maynard, Mass. 01754. (617) 897-5111. $17,000.

Designated the DECgraphic-11 Laboratory System, this combination of medium scale minicomputer, a/d converter system and graphics display is designed for data collection and reduction, monitoring, data logging and industrial testing. The system has the ability to provide feedback of experimental data while the scientist plots his solutions graphically. Focal-GT, a conversational type language is used to direct the laboratory system.

CIRCLE NO. 289

Erasable pROM can be programmed in two min

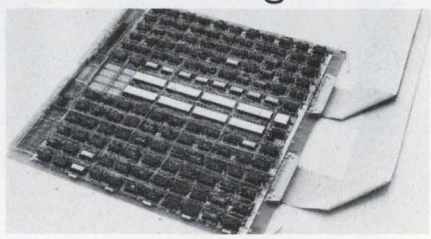


Intel Corp., 3065 Bowers Ave., Santa Clara, Calif. 95051. (408) 246-7501. $95 (100-piece).

Two minutes are all that are required to program Intel's Model 1702A 2048-bit erasable static MOS pROM. Programming in the field can be accomplished with Intel's Model 7600C tape-actuated programmer. Erasure is accomplished by shining ultraviolet light through a transparent quartz cap on the package. Access time of the Model 1702A is 1 μsec. And repeated reprogramming and erasure will not impair its performance.

CIRCLE NO. 290

Multiplexer is designed for time sharing



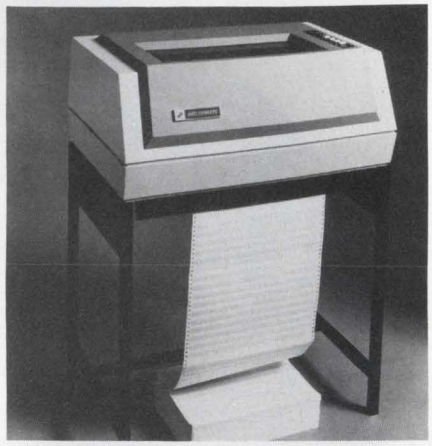
Educational Data Systems, 435 Windward Lane, Newport Beach, Calif. 92660. (714) 642-9054. $3500.

Model EDS-8 is an eight-channel multiplexer for use with any Novaline minicomputer. The data rate for each part is individually selectable under program control to any speed from 110 to 9600 baud. Thus, the unit can accommodate any combination of peripherals including CRT terminals, TTYs, electric typewriters and any other RS-232-C compatible devices. Software drivers are available to integrate the multiplexer with the company's time-sharing operating systems. Low software overhead is said to be obtained through hardware buffering of whole character strings to and from the direct memory access channel of the computer. The system is expandable to a total of 128 ports.

CIRCLE NO. 291

DATA PROCESSING

Line printer claimed lowest cost in its class



Data Products Corp., 6219 De Soto Ave., Woodland Hills, Calif. 91364. (213) 887-8000.

At 300 lines/min. with 132-column format, Model 2230 line printer is said to cost 50% less than line printers of similar size and throughput. The printer is a drum impact type and can print up to six carbons. The character set is modified ASCII, open gothic. A 64 character set standard; 86 and 96 character sets are optional. Standard fanfold paper is used. The format controls are top-of-form, single-line-advance and perforation-skip. Electronics for the standard unit include a full line buffer, TTL/DTL I/O circuitry and control logic with test print.

CIRCLE NO. 292

Modem operates at 4800 bit/s or multiplexes

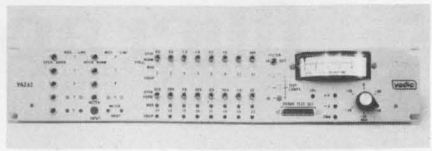
American Data Systems, 8851 Mason Ave., Canoga Park, Calif. 91306. (213) 882-0020. $2950.

Model 440/48 data modem is designed to operate over both conditioned or unconditioned voice grade telephone lines. A switching option permits operation at 2400 bit/s where line conditions preclude the 4800 bit/s transmission rate. If desired, two independent 2400 bit/s data channels can be multiplexed with a single unit. Test features include local data and line loopback plus remote data loopback for single-point system testing. OEM discounts are available; for example, the unit price for 500 card-only units is $1450.

CIRCLE NO. 293

DATA PROCESSING

Test panel simplifies data network testing

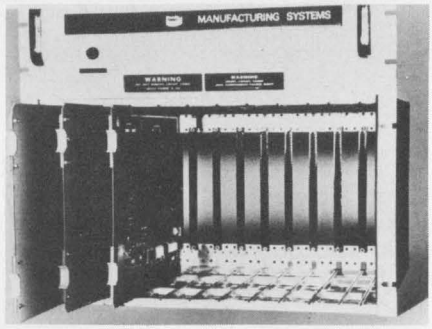


Vadic Corp., 505 E. Middlefield Rd., Mountain View, Calif. 94040. (415) 965-1620. $500; 60 days.

Designed to simplify fault diagnosis on leased or dial-up data networks, the Model VA 232 test panel can be patched into any channel of a data communications system using RS 232 interfaces. Line signal and noise levels measurements from 5 to —55 dBm are provided by the built-in panel meter. LEDs provide visual activity displays. Panel switches provide a convenient means to exercise the various modem conditions. Auxiliary interface monitors such as oscilloscopes and recorders can be connected to allow more detailed analyses.

CIRCLE NO. 294

Adaptor joins computer with ASCII peripherals

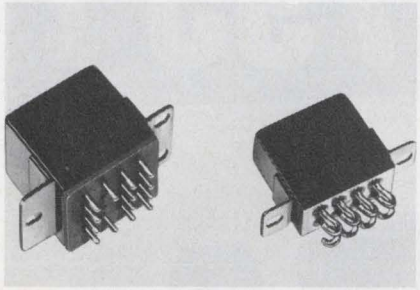


Bendix Industrial Controls Div., 12843 Greenfield Rd., Detroit, Mich. 48227. (313) 272-3710. $5700.

Designated the Bendix Communications Adaptor, the unit provides interfacing of ASCII peripherals to IBM 1800 and 1130 computers via the I/O channel. The unit supports ASCII rates from 110 to 4800 baud allowing the user to connect television monitors, medium speed line printers and teleprinters. Conversion and control electronics are supplied for driving up to eight data channels. The unit operates in conjunction with MPX or TSX software systems.

CIRCLE NO. 295

Relay's 15 A contacts withstands 350 A surges

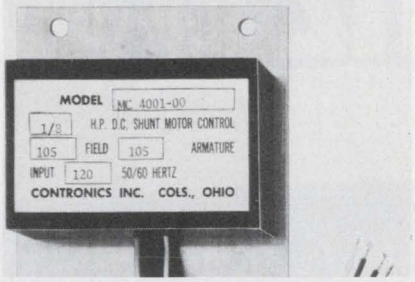


Deutsch Relays, Inc., 65 Daly Rd., E. Northport, N.Y. 11731. (516) 864-6000. Series E415: $25.97, Series E215: $18.47 (500 up).

Contacts on most relays that are used in series with circuit breakers often weld together when surges of unusually high currents pass through them. The contacts of the E415 and E215 Series relays are rated at 15 A and can withstand a surge current of 350 A, even if repeated several times, when operated with a series circuit breaker. The contacts will not weld closed. Special alloy contacts and a new design account for this unusual capability.

CIRCLE NO. 296

Motor control features no-slow-speed cogging

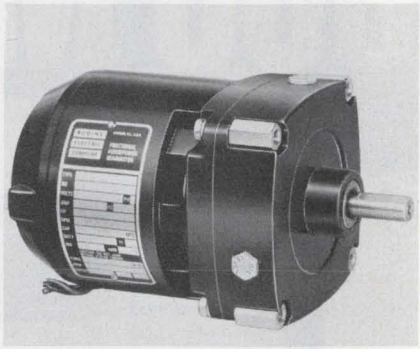


Contronics, Inc., 2629 Johnstown Rd., Columbus, Ohio 43219. (614) 471-6466. $21 (1000 up).

Model 4001 is a new solid-state motor control for use with fractional-horsepower electric motors to 1/8 hp. The control is available in both ac and dc models. Contronics claims to have eliminated slow-speed cogging. It measures 3-3/8 × 3-3/4 × 1-1/4 in. and weighs 7 oz. The control is compatible with either shunt-wound or permanent-magnet motors. Models for dc operate on 105 or 210 V for both the armature and field. Models for ac operate on 115 or 230 V at 50 or 60 Hz.

CIRCLE NO. 297

Gear-motor line offered in wide range of types

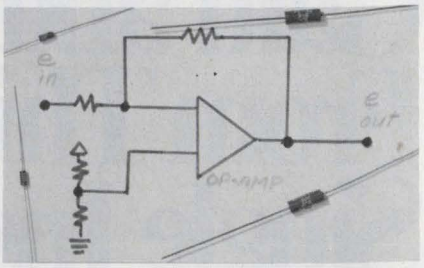


Bodine Electric Co., 2500 W. Bradley Pl., Chicago, Ill. 60618. (312) 664-8355. (Min. 100 lot).

Bodine's N-1S fractional-horsepower, in-line shaft gear motors have output speeds from approximately 20 to over 180 rpm with standard design torques to 20 lb-in. Many types, such as single-phase, synchronous and nonsynchronous units, for 115 and 230 V ac at 50/60 Hz and shunt-wound dc units for 115 V, are standard. Frame lengths start at 4.58 in. The motors are mounted on a 3.75-in. bolt circle at the face of the motor.

CIRCLE NO. 298

Film resistors claim wirewound precision

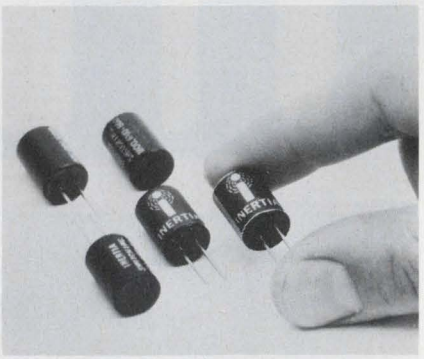


IRC Fixed Resistors, Operation of TRW Electronic Components, P.O. Box 887, Burlington, Iowa 52601. (319) 754-8491. 4-6 wks.

MAR resistors are claimed to have the reactance characteristics of thin-film devices and temperature coefficients, long-term stability and tolerances comparable to precision wirewound units. Yet these film resistors are smaller and cheaper than precision wirewounds. The units are encapsulated in solid epoxy.

CIRCLE NO. 299

Low-cost inertia switch beats resonance problem



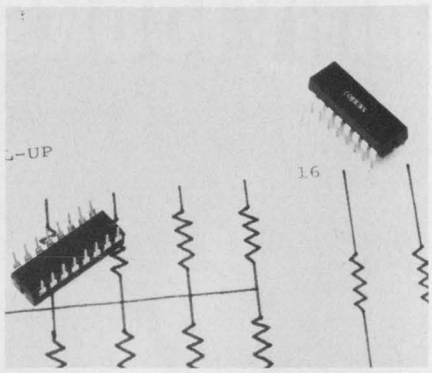
Inertia Switch, Inc., 311 W. 43rd St., New York, N.Y. 10036. (212) 586-5880. $1.80 (OEM qty).

Though originally developed for use on aircraft emergency locator transmitters, the Model 6UO-600 impact switch is low enough in cost for general applications. Its patented magnetic-restraint system is claimed to provide an accurate switching point and to eliminate the usual resonant-frequency problems inherent in conventional spring-mass systems. The unit has unidirectional sensitivity in the range of 1 to 25 g. The operating temperature range is −65 to +165 F. The switch output is a spst, NO momentary contact.

CIRCLE NO. 300

COMPONENTS

DIP networks can hold up to 23 components

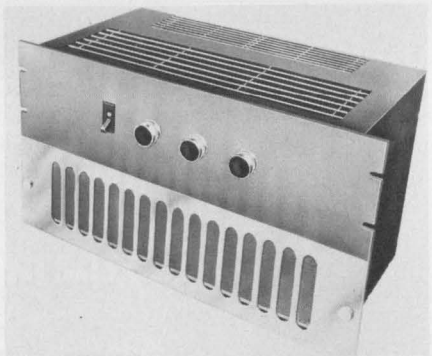


Corning Glass Works, Electronic Products Div., Corning, N.Y. 14830. (607) 962-4444. Stock.

Fourteen or 16-pin CORDIP resistor networks for pull-up or in-out functions combine up to 15 resistors in a DIP. Standard resistance values range from 50 Ω to 22 kΩ, with tolerances of ±2% and temperature coefficients of 100 ppm/°C. Custom CORDIP networks can be made with combinations of resistors, capacitors, and diodes totaling a maximum of 23 components.

CIRCLE NO. 301

Blower unit leads a double life



McLean Engineering Laboratories, P.O. Box 127, Princeton Junction, N.J. 08550. (609) 799-0100.

Need a blower that can heat or cool an electronic enclosure? When the temperature is above a set point, an internal damper automatically adjusts the unit for cooling. At the set point, neither heating nor cooling is provided. The enclosed air is recirculated. When heating is required, supplementary heaters maintain the set temperature. Pilot lights indicate which activity is taking place.

CIRCLE NO. 302

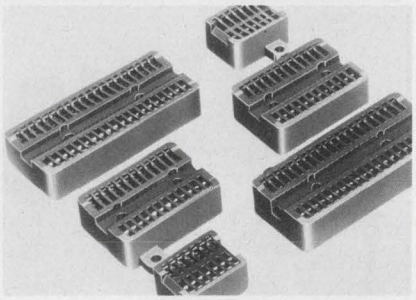
Copper laminate has positive photo resist

Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar, Calif. 91342. (213) 365-9661. $0.50 to $2.50/board; stock.

A copper laminate comes with a factory-applied positive photo resist which allows engineers to use positive art work—eliminating costly negatives and time consuming process steps. The R Series uses flame-retardant, copper-clad phenolic and epoxy-glass material, which comes either plain or predrilled for DIP packages. The advantage of the direct positive resist coating is that the user can use positive art work, eliminating the art work reversing step normally used with negative techniques. Since most pre-printed circuit drafting aids are available in positive form these may be used directly on the master for reproduction on the circuit board. Resist development is accomplished using positive resist developer.

CIRCLE NO. 305

IC test sockets used for burn-in applications

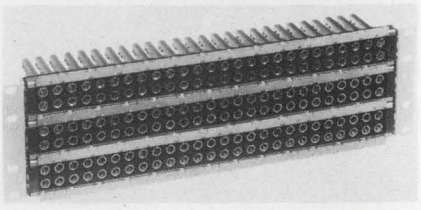


Jermyn, 712 Montgomery St., San Francisco, Calif. 94111. (415) 362-7431. $2.45 (1-24); stock.

A range of DIP sockets designed for test, burn-in and breadboarding applications includes 14, 16, 24, 28, 36 and 40 contact sockets. The bodies are molded of glass-filled polysulfone and are suitable for continuous operations up to 150 C. The contacts are gold-plated beryllium copper to provide contact resistances of less than 10 MΩ and are arranged so that the IC lead tapers between rows are maintained during test.

CIRCLE NO. 306

Jack panel assemblies come in 50 styles

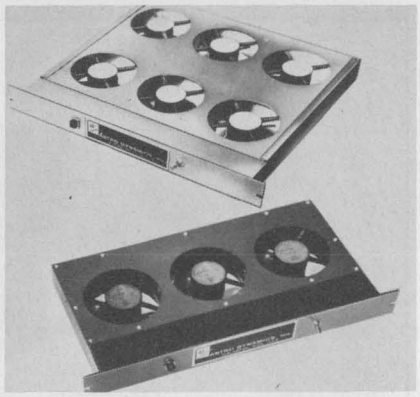


ADC Products, Inc., 4900 W. 78th St., Minneapolis, Minn. 55435. (612) 929-7881.

Up to 50 different jack panel assemblies can be selected from 14 basic long-frame panel configurations which have different panel widths, type of jacks and various kinds of designation strips. The panels are molded of black phenolic plastic and then reinforced with steel to be exceptionally strong and rigid. Panels are available with single, double or triple rows both for 19-inch and 23-inch rack mounting. Units are supplied with jacks configured for two-wire, four-wire or six-wire applications.

CIRCLE NO. 307

Cooling-air amplifier measures 1-3/4-in. high



Astro Dynamics, Inc., Second Ave., Northwest Industrial Park, Burlington, Mass. 01803. (617) 935-4944.

A cabinet cooling air amplifier features a 1-3/4-inch profile and one to six fan configuration for operation in ambient temperatures between 0 F and 110 F. The Thermiac Aire-Amplifier Series 5000 come in two basic models. The Model 5103 is 19 × 9 × 1-3/4-inches and offers 300 cfm while Model 5106 offers 600 cfm and is 19 × 16 × 1-3/4 inches. Eight types are available with from one to six fans.

CIRCLE NO. 320

Film adhesive seals IC package lids

Ablestik Laboratories, 833 W. 182nd St., Gardena, Calif. 90248. (213) 321-6252.

Ablefilm 535, a glass-supported film adhesive, is designed specifically for lid sealing of microelectronic packages. Furnished as preforms sized to fit the package configuration, Ablefilm 535 adheres to a variety of surfaces including gold aluminum, alumina and epoxy. Typical shear strength to gold surfaces is 4700 psi. The adhesive is recommended for sealing alumina, gold or epoxy packages, or any combination. Unlike previous lid sealing preforms, Ablefilm 535 does not require refrigerated storage. Anticipated storage life at room temperature is six months. Ablefilm 535 preforms are cured at 250 F. Recommended cure time is two hours.

CIRCLE NO. 321

DIP socket measures only 0.4 × 0.7 × 0.2 in.

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

A low-profile Skinny DIP production mounting socket has dimensions measuring only 0.4-inch wide by either 0.7 or 0.8 inch in length by 0.2-inch over-all height, and provides a 15-mil standoff for cleaning after soldering. The one piece glass-nylon body is fitted with gold-plated beryllium-copper, closed-entry contacts.

CIRCLE NO. 322

Electrically conductive elastomers use pure AG

Technical Wire Products, Inc., 129 Dermody St., Cranford, N.J. 07016. (201) 272-5500; stock.

Three electrically conductive elastomers, called Consil, Consil-F and Consil-G contain only pure silver to provide high electrical conductivity. Consil is a fine network structure of continuously-contacting pure silver particles with all openings in the silver lattice filled with resilient silicone rubber. Consil-F and Consil-G are homogeneous elastomers containing pure silver-coated inert particles uniformly dispersed. Consil-F is fluorosilicone, Consil-G is silicone.

CIRCLE NO. 323

LED encapsulants maintain optical clarity

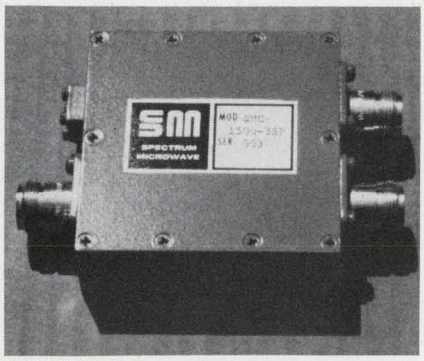
Hysol Div., Dexter Corp., 211 Franklin St., Olean, N.Y. 14760. (716) 372-6300.

A line of clear, light-stable liquid epoxy compounds for encapsulating LEDs includes C74 and C75 encapsulants and maintains optical clarity at continuous exposure to 125 C. Handling properties range from low viscosity compounds for straight casting applications to higher viscosities for casting and the self-crowning approach to lens forming. The products are also formulated in various hardnesses. Semiflexible materials are chosen for larger devices such as digital displays or where thermal shock requirements are more severe.

CIRCLE NO. 324

INFORMATION RETRIEVAL NUMBER 102 ►

Hybrid power splitter handles 10-W

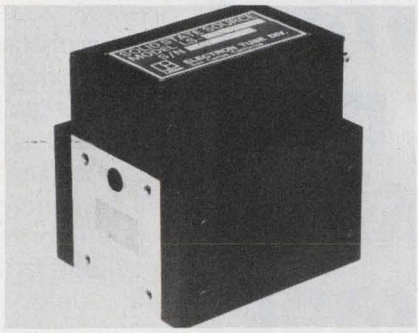


Spectrum Microwave Corp., 328 Maple Ave., Horsham, Pa. 19044. (215) 672-9191. $275 (small qty.); stock to 4 wks.

The Model SMC-1500-3SP power splitter—a stripline 3-dB hybrid device that can also be used as a power combiner—comes complete with a load termination for 10 W CW power. Specs include center frequency of 1.5 GHz, bandwidth of 100 MHz min, coupling of 3 dB ±0.5 dB, VSWR of 1.25:1 max, insertion loss of 0.2 dB max and isolation of 18 dB min.

CIRCLE NO. 325

Gunn source provides 2 W at X-band

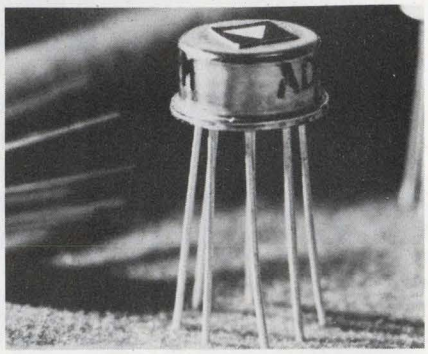


Litton Industries Electron Tube Div., 960 Industrial Rd., San Carlos, Calif. 94070. (415) 591-8411.

A solid-state source using Gunn diodes, termed the LS-1431, provides 2 W CW power output at 10.7 to 11.5 GHz and is mechanically tunable with a single knob across more than 850 MHz at X-band. Frequency modulation and AFC are provided by a varactor that is linear for at least 30 MHz. Over a ±10 MHz peak deviation, the incidental AM has been measured at less than 0.1 dB and the linearity is better than 1%.

CIRCLE NO. 326

Op amp boosts accuracy of series

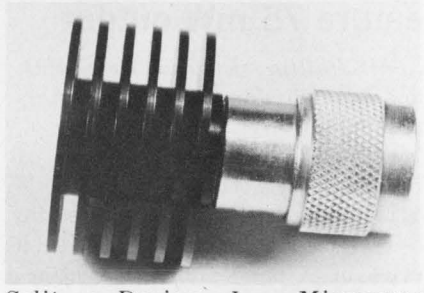


Analog Devices, Route 1 Industrial Park, Norwood, Mass. 02062. (617) 329-4700. $6 (1-24).

A high accuracy version of the company's popular 101A op amp series provides a new high in overall accuracy, according to the company. Designated the AD301AL, the op amp offers guaranteed offset voltage below 0.5 mV, offset voltage drift less than 5.0 μV/°C, bias and offset currents below 30 mA and 5 mA, respectively, and common mode rejection above 90 dB.

CIRCLE NO. 327

Type N terminations handle 10 W

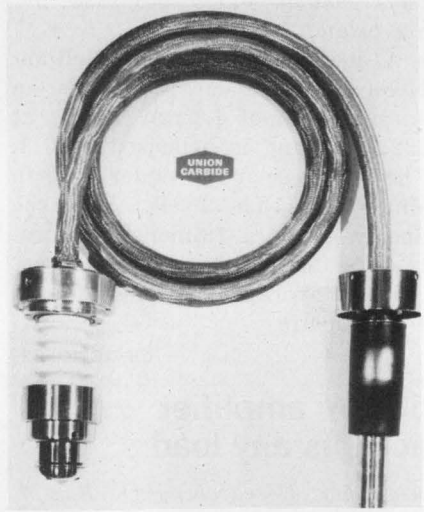


Solitron Devices, Inc., Microwave Connector Div., Cove Rd., Port Salerno, Fla. 33492. (305) 287-5000. $23 (250); 6-8 wks.

A Type N termination connector for high-power applications, the 5090-0001, has a 10 W capacity at 25 C and meets or exceeds MIL-C-39012. The nominal impedance is 50 Ω with typical VSWRs of 1.15 max, from dc to 5.5 GHz, and 1.25 max, from 5.5 GHz to 10 GHz.

CIRCLE NO. 331

Electron-beam system improves EB welders



Electron Research, Inc., 17282 Eastman St., Santa Ana, Calif. 92705. (714) 546-7341.

A lightweight miniature electron-beam gun system, complete with electronics and power supply, expands the usefulness of present EB welders. The system is rated at 7.5 kW. When installed in an existing chamber having a fixed gun, the new system permits welding in all positions, and can double the linear weld capability, according to the company. Moving gun EB welders similarly can be improved by retrofitting them with the new system.

CIRCLE NO. 332

application notes

Semi fuse handbook

The "Semiconductor Fuse Applications Handbook" aids circuit designers in the use of semiconductor fuses. It contains over 100 pages, with numerous graphs, ratings, tables and circuit diagrams. The handbook is divided into four chapters: fast-acting fuses, fuse characteristics, coordinating fuses with semiconductors and applications. An appendix contains definitions and examples of fuse protection for both external and internal faults. International Rectifier Corp., Semiconductor Div., El Segundo, Calif. 90245.

Sequential control systems

"Designing Sequential Control Systems Using Tenor Stepping Drum Programmers" describes three basic steps involved in designing control systems for sequential operations—listing each operation to be performed, preparing the program chart and preparing the ladder diagram. Applications, schematics and diagrams are included. Tenor Co., New Berlin, Wis.

CIRCLE NO. 335

Precious metal recycling

"In-Plant Sampling Procedures for Profitable Precious Metal Recycling," follows step-by-step procedures in estimating precious metal scrap at the customer's facilities. The brochure explains fully the procedures to be followed in the analysis of gold in gold-plating solutions and in (ion-exchange) PM-79 resin. Resin sampling procedures are also described. The Sel-Rex Co., Precious Metal Recovery Div., Nutley, N.J.

CIRCLE NO. 336

Diodes in hybrid ICs

Various diode package styles for integrated circuits are described in an eight-page application note. The booklet details advantages and disadvantages of using chips, beam-lead devices, ministrip, leadless inverted devices, E-series and microstrip post configurations. Hewlett-Packard Co., Palo Alto, Calif.

CIRCLE NO. 337

Analyzing cure behavior

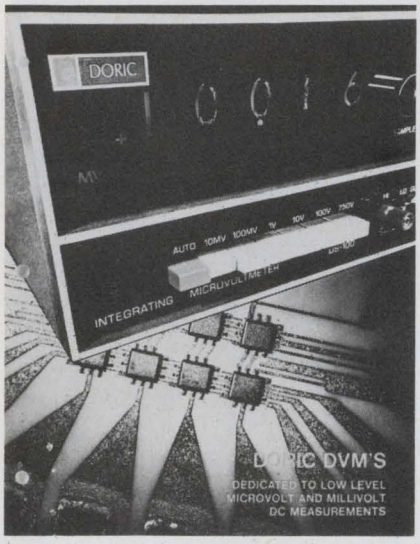
Practical ways of using differential scanning calorimetry (DSC) to help analyze curing behavior problems in electronic parts molded of diallyl phthalate-type materials are described in an illustrated report. The pocket-sized report discusses the use of DSC as a tool to determine the degree of cure of both compounds and molded parts. DSC can measure a compound's exothermic values under static conditions and also the amount of heat still available in partially cured parts. Typical molding applications are cited and illustrated. FMC Corp., Organic Chemicals Div., New York, N.Y.

CIRCLE NO. 338

Phase measurements

An application-oriented monograph explains the importance of proper signal conditioning to accurate phase measurements in dynamic studies of mechanical and electrical phenomena. Applications of the technique include structural behavior and integrity studies, modal studies, torque measurements and noise and vibration analysis of rotating machinery. Included is an explanation of the theory behind the "zero i-f" tracking filter and operating characteristics. Spectral Dynamics Corp., San Diego, Calif.

CIRCLE NO. 339



Digital microvoltmeter

Digital microvoltmeters are described in a bulletin. The bulletin outlines the design philosophies and a section is devoted to Auto-Zero and dual slope true integration. Doric Scientific Corp., San Diego, Calif.

CIRCLE NO. 342

Instrument buyers guide

The Metermaster Line Guide contains cross-indexed listings of leading manufacturers of panel meters, test equipment, digital panel meters, recorders, frequency meters, meggers, ammeters, timers, counters, shunts and many others by make. Availability of meter and test equipment modification, repair and calibration is also listed. Metermaster Div., Kierulff Electronics, Inc., Los Angeles, Calif.

CIRCLE NO. 343

Disc drive

An eight-page brochure provides a description of D-3000 series disc memory drives available in single or dual disc versions, on both top and front loading configurations, 2315 or 5440 cartridges. Contained in the brochure are interface descriptions and specific input/output lines in addition to configuration features and detailed specifications. Pertec Corp., Chatsworth, Calif.

CIRCLE NO. 344

Portable potentiometers

A line of portable potentiometers, including the Versapot which takes the place of five different measuring instruments, is illustrated and described in an eight-page, two-color bulletin. The bulletin lists applications, ranges and gives specifications for each model, and illustrates and describes a number of accessories. James G. Biddle Co., Plymouth Meeting, Pa.

CIRCLE NO. 345

Polyester resins

"Celanex: The Balance of Power" describes "electrical/electronic applications of thermoplastic polyester resins. The six-page, four-color pamphlet contains electrical, mechanical and thermal data on five of the company's formulations, including glass-reinforced, unreinforced and self-extinguishing grades. Color photos of several electrical applications are included, as well as information on solvent resistance and economics. Celanese Plastics, Newark, N.J.

CIRCLE NO. 346

Microelectronic packages

Microelectronic packages are described in a 20-page catalog. Dimensional drawings and materials specifications for over 85 standard packages in flat pack and DIP configurations are included. Minimum die attach areas, lid and preform part number are cross-indexed with data on number of leads and package size. Metal, glass, alumina and Berlox base types are included. National Beryllia Corp., Haskell, N.J.

CIRCLE NO. 347

Keyboard switches

"Switches and Keyboards" covers precision snap-action switches, electronic data-entry keyboards, thumbwheel and leverwheel switches and matrix selector switches. Specifications, ordering information and drawings are included in the 72-page catalog. Cherry Electrical Products Corp., Waukegan, Ill.

CIRCLE NO. 348

Semiconductor heat sinks

Distributor Products Catalog No. 103 describes semiconductor heat sinks and thermal products. The 52-page catalog includes an index and technical descriptions. Thermal retainers for mounting devices on coolers or chassis are described as are insulating wafers, mounting hardware, standard extrusion shapes and liquid-cooled plates. Wakefield Engineering, Inc., Wakefield, Mass.

CIRCLE NO. 349

Card guides

A 12-page catalog describes a line for packaging PC boards. Included are metal and plastic Unitrack card guides, Versa-Cage card racks, Versamount brackets and Pak-Rak storage or shipping containers. Dimensional data, prices and test results are given. Unitrack Div. of Calabro Plastics, Inc., Upper Darby, Pa.

CIRCLE NO. 350

Semiconductors

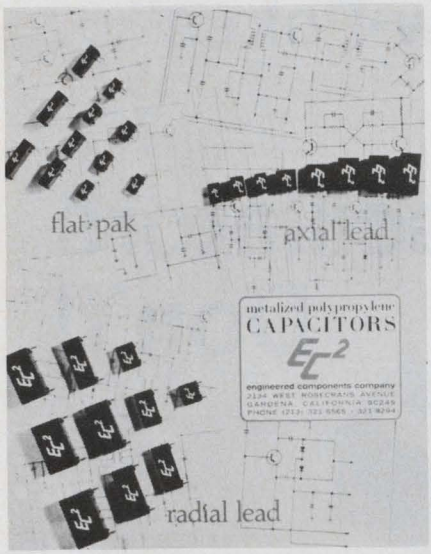
A 44-page condensed catalog lists detailed specifications on more than 6000 semiconductor devices. Included in the catalog are temperature compensated reference diodes, zener diodes, high-speed, high-power switching transistors and silicon transient voltage suppressors. The catalog also has complete JEDEC cross-reference listings for zener diodes. General Semiconductor Industries, Inc., Tempe, Ariz.

CIRCLE NO. 351

Data modems

Features, benefits and capabilities of Series 103, 201 and 202 Bell-compatible data modems designed specifically for the end user of data communication systems are described in three 4-page brochures. Table-top and rack-mounted versions are illustrated with photos and are described in terms of operating speeds, line requirements, modes of operation, options and provisions for performing remote and self-test operations. Summary tables are provided. Intertel, Inc., Burlington, Mass.

CIRCLE NO. 352



Polypropylene capacitors

A line of 100-V flat-pack, axial and radial-lead metalized polypropylene capacitors, offering nearly 100 capacitance values, is described in a six-page, two-color brochure. Engineered Components Co., Gardena, Calif.

CIRCLE NO. 353

ICs and discretes

A 16-page catalog describes a line of p-channel MOS and JFET multiple channel switches, MOSFET analog drivers and FET switches and amplifiers. Also described are linear, digital and CMOS ICs plus custom LSI capabilities. Siliconix, Inc., Santa Clara, Calif.

CIRCLE NO. 375

Cathode-ray tube phosphors

A brochure describes many different phosphors which can be supplied in cathode-ray tubes. The 32-page publication helps buyers select a CRT with the optimum phosphor to meet any of a wide variety of application requirements. Spectral and persistence characteristics and typical applications are given for over 50 standard and special phosphors. A brief explanation of the use of phosphors in CRT screens and glossaries of terms and symbols are included. Westinghouse Electric Corp., Pittsburgh, Pa.

CIRCLE NO. 355

Proximity switches

An eight-page booklet lists the prime features of the Bulletin 870 switch, explains the theory of operation and range of applications. Also included is a description of the unit and its optional configurations. Drawings show approximate dimensions and shipping weight. Allen-Bradley Co., Milwaukee, Wis.

CIRCLE NO. 356

Counters and controls

Precision counters and counter systems are described in a 36-page catalog. A comprehensive section of technical information and application tips is included. Product sections are presented in three major categories: totalizers, counters for various control functions and customized counter assemblies. Hecon Corp., Eatontown, N.J.

CIRCLE NO. 357

Permanent magnets

Complete mechanical specifications and holding forces on its standard permanent magnets are contained in a catalog. The 16-page publication includes 31 sizes, many in cast Alnico 8 and 9 and sintered Alnico 8, as well as information on all types of Alnico, Indox and Cunife magnets. Dimensions, shapes and weights are presented for all magnets, plus application descriptions. General information on magnetic properties magnetization and tolerances is included. Indiana General, Magnet Products, Valparaiso, Ind.

CIRCLE NO. 358

Environmental maps

An illustrated pamphlet describes the techniques used in generating maps from remote sensor data from spacecraft (Apollo, etc.,). The booklet describes how the Model 55C reflecting projector simplifies and speeds up the job of reducing data to usable form in required scale. Described also is an analysis of the application for mapping coastal zones of the U.S. for environmental studies. Map-O-Graph Div., Art-O-Graph, Inc., Minneapolis, Minn.

CIRCLE NO. 359

RCA ICs

The SSD-200A six-volume, 3400-page set of 1973 Databooks include quick selection guides and charts; cross-reference indexes and subject indexes to data and application notes in all volumes. The entire set may be ordered for $12 or volumes may be ordered individually at the following prices: SSD-201A—Linear Integrated Circuits and MOS Devices (Technical Data): $2.50; SSD-202A—Linear Integrated Circuits and MOS Devices (Application Notes): $1.50; SSD-203A—COS/MOS Digital Integrated Circuits: $2; SSD-204A—Power Transistors and Power Hybrid Circuits: $2; SSD-205A—RF Power Devices: $2; SSD-206A—Thyristors, Rectifiers and Diacs: $2. RCA Solid State Div., P.O. Box 3200, Somerville, N.J. 08876.

Tool handbook

Catalog 572, "Tools for Electronic Assembly and Precision Mechanics," includes a glossary of terms and sections on engineering drafting supplies and electronic chemicals. A tool kit section features kits for field engineers, service engineers, technicians and hobbyists. Jensen Tools and Alloys, Phoenix, Ariz.

CIRCLE NO. 360

EIA standards

"Minimum Standards for Land Mobile Communication FM or PM Receivers, 25 to 470 MHz," details definitions and measurement of characteristics of mobile receivers in fixed or vehicular installations and costs $5.25. "Racks, Panels and Associated Equipment (Revision of RS-310)" covers critical dimensions ensuring compatibility between racks, panels and the equipment. It is priced at $2.50. "Liquid Rosin Fluxes" characterizes rosin fluxes and provides test methods. It is available at $1.30. "Reel Packaging of Components with Axial Leads" covers body and lead-tape reel packaging requirements for components and is priced at $1.20. Electronic Industries Association, 2001 Eye St., N.W., Washington, D.C. 20006.

NEW LITERATURE

Customized panel meters

Standard panel meters and accessories plus a customized panel-meter service are featured in a 28-page catalog. User net prices are provided. Complete electrical specifications and dimensional drawings of the panel instruments and their mountings are given along with basic characteristics and tolerances. Sales representative organizations and service centers are listed. Triplett Corp., Bluffton, Ohio.

CIRCLE NO. 361

Solid-state contactors

What is claimed to be the industry's first standard line of high-power solid-state contactors (SSCs) is described in a bulletin. The devices, available in ratings from 20 to 200 A for 120, 240 and 480 V operation, are provided in single-pole and two-pole configurations. The literature contains three circuit diagrams for typical applications, outline drawings and selection tables, as well as performance curves. General specifications and a photograph are provided. International Rectifier Corp., Crydom Controls Div., El Segundo, Calif.

CIRCLE NO. 362

Debugging

"Debugging Microprogrammed Systems," a four-page leaflet, tells how flaws can be removed from computer memories. The leaflet describes how to check out a complex microprogrammed system with 1024 words of microcode in less than one week. Signetics Memory Systems, Sunnyvale, Calif.

CIRCLE NO. 363

Backplane test system

A 12-page illustrated brochure describes the N151 computer-operated backplane test system. The N151 is a self-programming system that requires only a two-cable connection to the backplane under test, even with backplanes containing many thousands of points. The brochure includes a system description plus sections on fixturing, error diagnostics and applications. Teradyne, Inc., Boston, Mass.

CIRCLE NO. 364

Solid-state switches

The design and application of a series of solid-state switches are described in a two-color, six-page brochure. The brochure details theory of operation, the standard and custom designs available and switch configurations. It is illustrated with photos and diagrams and includes typical circuits and specifications. Magic Dot, Inc., Minneapolis, Minn.

CIRCLE NO. 365

Relays

Dimensioned drawings, specifications and ordering data on hundreds of the company's products are shown in a 20-page catalog. The catalog is divided into four easy-to-use sections: relays, steppers, solenoids and solid-state controls. Guardian Electric Manufacturing Co., Chicago, Ill.

CIRCLE NO. 366

Pushbutton switches

Illuminated pushbutton switches, indicators and annunciators are described in a 58-page catalog. Detailed information on all of the firm's products, plus helpful sections on problems of over-specification, line switching, low-level (dry) circuits, U.L. recognition and lens color are provided. Marco-Oak, Anaheim, Calif.

CIRCLE NO. 367

Variable transformers

A variable transformer guide is complete with specifications on 70 different models. This eight-page brochure illustrates voltage-control devices designed for inputs of 40 V, 120 V and 240 V, 50/60 Hz, with corresponding output voltages, and ratings from 0.8 A to 50 A. Staco, Inc., Dayton, Ohio.

CIRCLE NO. 368

Relays

Over 740 stock relays for custom applications are described in a 32-page, two-color catalog. Included are photos, dimensional drawings, specifications, prices and ordering information. Magnecraft Electric Co., Chicago, Ill.

CIRCLE NO. 369

bulletin board

National Semiconductor Corp., 2900 Semiconductor Drive, Santa Clara, Calif., has expanded its CMOS line with the release of ten **54C/74C logic devices.** The devices are functionally equivalent to and pin-and-power supply compatible with standard and low-power 54/74 series TTL. All 54C/74C types operate from 3 to 15-V power supplies, have a power dissipation of 10 nW typical and typical noise immunity of 0.45 V_{cc}. The CMOS devices have a guaranteed noise margin specification of 1 V over the complete power-supply range.

INQUIRE DIRECT

Signetics, 811 E. Arques Ave., Sunnyvale, Calif. 94086, has developed a program called **SUPR DIP,** which it claims substantially upgrades the quality and reliability of ICs encapsulated in silicone plastic.

INQUIRE DIRECT

The problem-solving computer language—**BASIC**—is now available from **Datacraft Corp.** Because it is re-entrant, BASIC is particularly suited for real-time and time-sharing applications and is supported by the company's disc monitor system. BASIC requires one or more terminal devices, such as a CRT or keyboard printers. The price is $500.

CIRCLE NO. 370

The Digital Products Div. of Fairchild Camera & Instrument Corp. has added 12 devices to its line of **Schottky TTL ICs.** The units include five gates, four J-K flip-flops and three MSI functions. The MSI devices include the 93S05 variable modulo counter, the 93S41 arithmetic logic unit and the 93S42 carry-lookahead device for use with the ALU.

CIRCLE NO. 371

Motorola's Semiconductor Products Div. has announced two advances in its CMOS line—the **introduction of plastic-packaged devices and the addition of nine CMOS devices;** three available in ceramic packages and six available in both ceramic and plastic. The plastic-packaged devices have the same electrical specifications as the standard ceramic series and are specified to operate over the extended commercial temperature range of −40 to +85 C. The plastic devices are priced 10% or more lower than the ceramics.

CIRCLE NO. 372

Price reductions

An across-the-board reduction of 5% on **D-116 mainframes and memories** has been announced by **Digital Computer Controls, Inc.** A D-116 central processor with 4-k of core memory, DMA, programmer console, power supply, external I/O connector and slots for five additional subassemblies has been reduced to $3800 from $4000.

CIRCLE NO. 373

Dialight Corp. has announced the addition of **gallium arsenide phosphide LED readouts** to its 730 series. The readouts are available in a character height of 0.625 inch which the company claims is the largest seven-segmented LED character in the industry. The new models are priced 20% lower than the previous devices—the GaAsP Model 730-1003 readout; $4.95 each (1000-up) vs GaP Model 730-0003; $5.80 each (1000-up).

CIRCLE NO. 374

Zeltex, Inc., has announced low-cost **modular power supplies** which offer direct electrical replacement for the ZM and ZP series. Model Z15AT100DP, a dual-output supply offering precision regulation of ±15 V at 100 mA, is priced at $37, substantially less than the price of the ZM-15100 which is listed at $49.

CIRCLE NO. 376

vendors report

Annual and interim reports can provide much more than financial-position information. They often include the first public disclosure of new products, new techniques and new directions of our vendors and customers. Further, they often contain superb analyses of segments of industry that a company serves.

Selected companies with recent reports are listed here with their main electronic products or services. For a copy, circle the indicated number.

Thermo Electron Corp. Air monitoring instruments, pollution control systems, medical electronics and organic Rankine engine.

CIRCLE NO. 377

The Aerospace Corp. Nonprofit aerospace consultants.

CIRCLE NO. 378

Pertec Corp. Digital magnetic tape transports, key-to-tape data-entry systems, COM systems, disc drives and impact printers.

CIRCLE NO. 379

Odec, Inc. Impact line printers, sonar performance monitoring systems and digital phasemeter.

CIRCLE NO. 380

Analogic Corp. Instruments, function modules and subsystems.

CIRCLE NO. 381

Polarad Electronics Corp. Microwave instruments, spectrum analyzers, avionics, pocket calculators, Loran receivers and components.

CIRCLE NO. 382

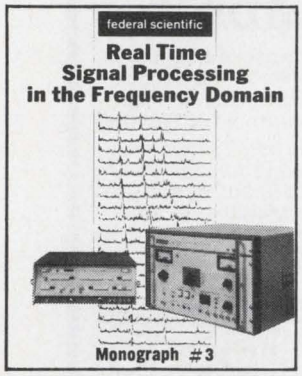
Adams-Russell. CATV and TV, components, avionics, communications, microwave assemblies, packaging, signal processing and analysis.

CIRCLE NO. 383

Design Data from Manufacturers

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

Free Monograph on Real-Time Data Processing Techniques



A new publication by Federal Scientific, originators of the Ubiquitous® Spectrum Analyzer, covers general and specific signal processing techniques and theoretical constraints.

- Random data processing and statistical certainty of Power Spectral Density Estimates
- Constraints in frequency analysis due to bandwidth, sampling and signal length
- Time domain weighting, with charts of theoretical performance using different weighting functions
- Theory of operation of time-compression analyzers
- Cross-property analysis and application in determing transmission and transfer functions by correlation and cross-power spectral density
- Processing of Transient data

CIRCLE NO. 171

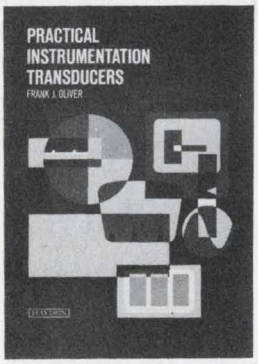
Federal Scientific Corporation
615 West 131st Street, New York, N. Y. 10027
(212) 286-4400

EXTRUDED HEAT SINKS WALL CHART

Now available is a short form catalog that opens into a convenient wall chart featuring 107 popular standard models of TOR[tm] aluminum heat sink extrusions. Accompanying a drawing of each model is the size of the dissipating surface, thermal resistance and weight. Also included are the various standard hole patterns, stud clearance hole options and extrusion tolerances. The introduction of Models 1722A and 1722B Forced Convection Heat Sinks is featured in the catalog. Incorporating new ideas in heat sink design, units are half the size and weight of conventional units at a 20% to 40% cost reduction. CIRCLE NO. 172

Heat Sink Division
PRECISION DIPBRAZE TOR, INC.
14715 Arminta Street
Van Nuys, California 91402
(213) 786-6524

Practical Instrumentation Transducers



A thorough, authoritative information source on transducer selection and use. This well-planned guide by Frank J. Oliver covers virtually every known device for industrial or aerospace application. Stressing topics neglected elsewhere, it clarifies such areas as interference problems in hard-wire telemetry systems, and transducers as feedback devices in servo systems. Hundreds of diagrams, charts, and tables included. **352 pp., 7-1/8 x 9-3/4, illus., cloth, $20.00. Circle the reader-service number for 15-day examination copies.**

CIRCLE NO. 173

Hayden Book Company, Inc.
50 Essex Street
Rochelle Park, N.J. 07662

Electronic Design

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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advertiser's index

product index

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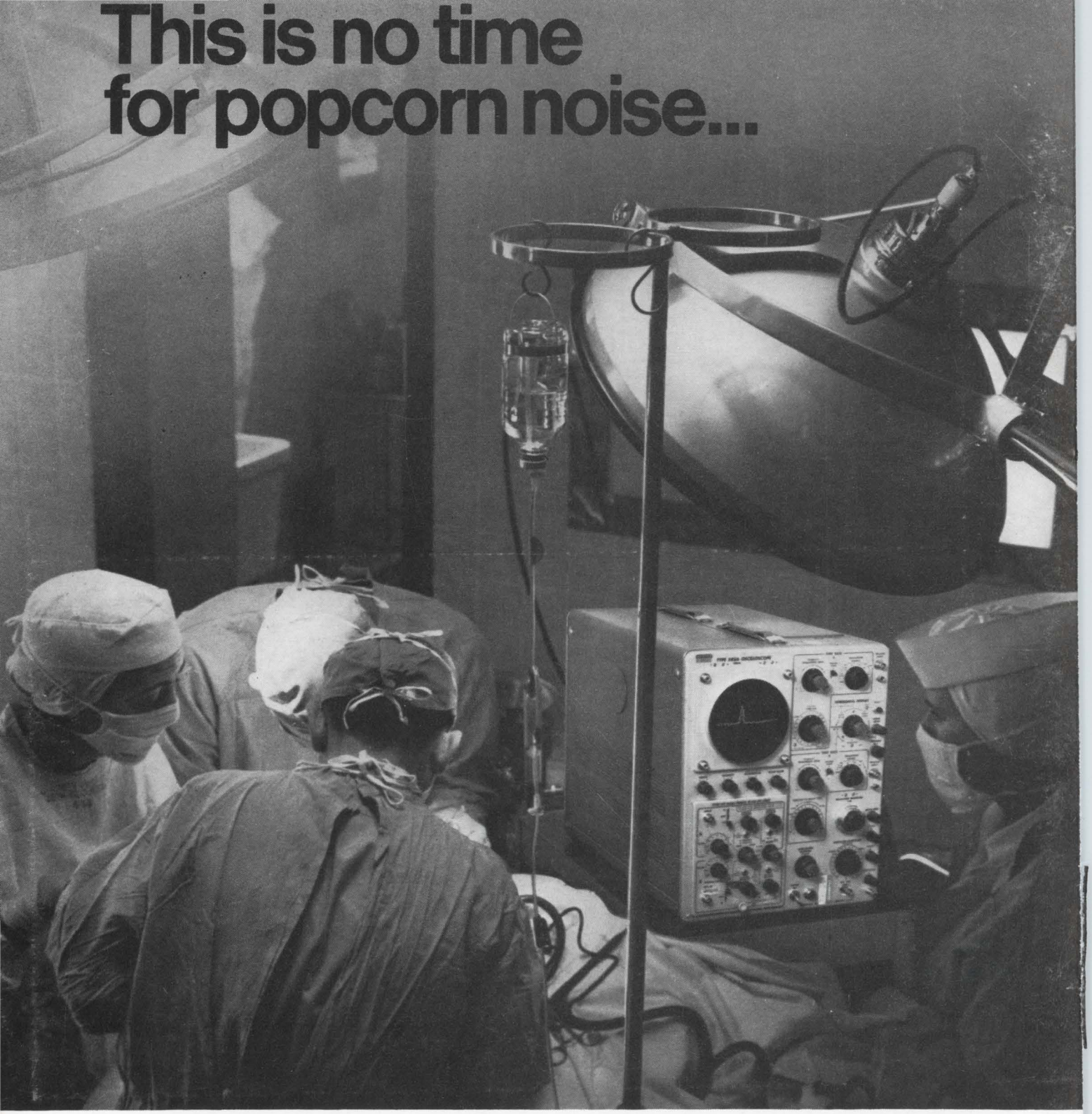
new literature

application notes

This is no time for popcorn noise...



In fact, no time is acceptable for Popcorn (burst) noise, if you're designing a system to handle extremely small signals.

So RCA is announcing a new micropower, low noise operational amplifier. It's a designer's dream.

Our unique process gives you a monolithic silicon op amp that not only exhibits low burst noise but operates from a single 1.5-volt cell with a power consumption of 1.5 microwatts.

How low is the noise? Every CA6078AT op amp that leaves RCA must operate with equivalent input burst noise less than 20uV (peak) at $R_S = 200{,}000$ ohms.

That's not all, the CA6078AT features output short-circuit protection through built-in output resistors, input voltage range ($\pm$ 15V max. for $\pm$ 15V supply) wide dif-mode range ($\pm$ 6V), and low offset-voltage nulling capability.

So go ahead! Design the CA6078AT into your system...and relax. Because you can be certain that with the new RCA micropower op amp, no time is acceptable for popcorn (burst) noise.

Want more data on the CA6078AT or CA3078AT (the low cost version of the CA6078AT for less critical applications) or the CA6741T, RCA's low-burst-noise 741? See your RCA Representative or Distributor and ask for Technical Bulletins, File No. 530 and 592 and Application Note ICAN-6732. Or write RCA Solid State, Box 3200, Somerville, N.J. 08876. Phone (201) 722-3200.

RCA Solid State

products that make products pay off

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