EDN

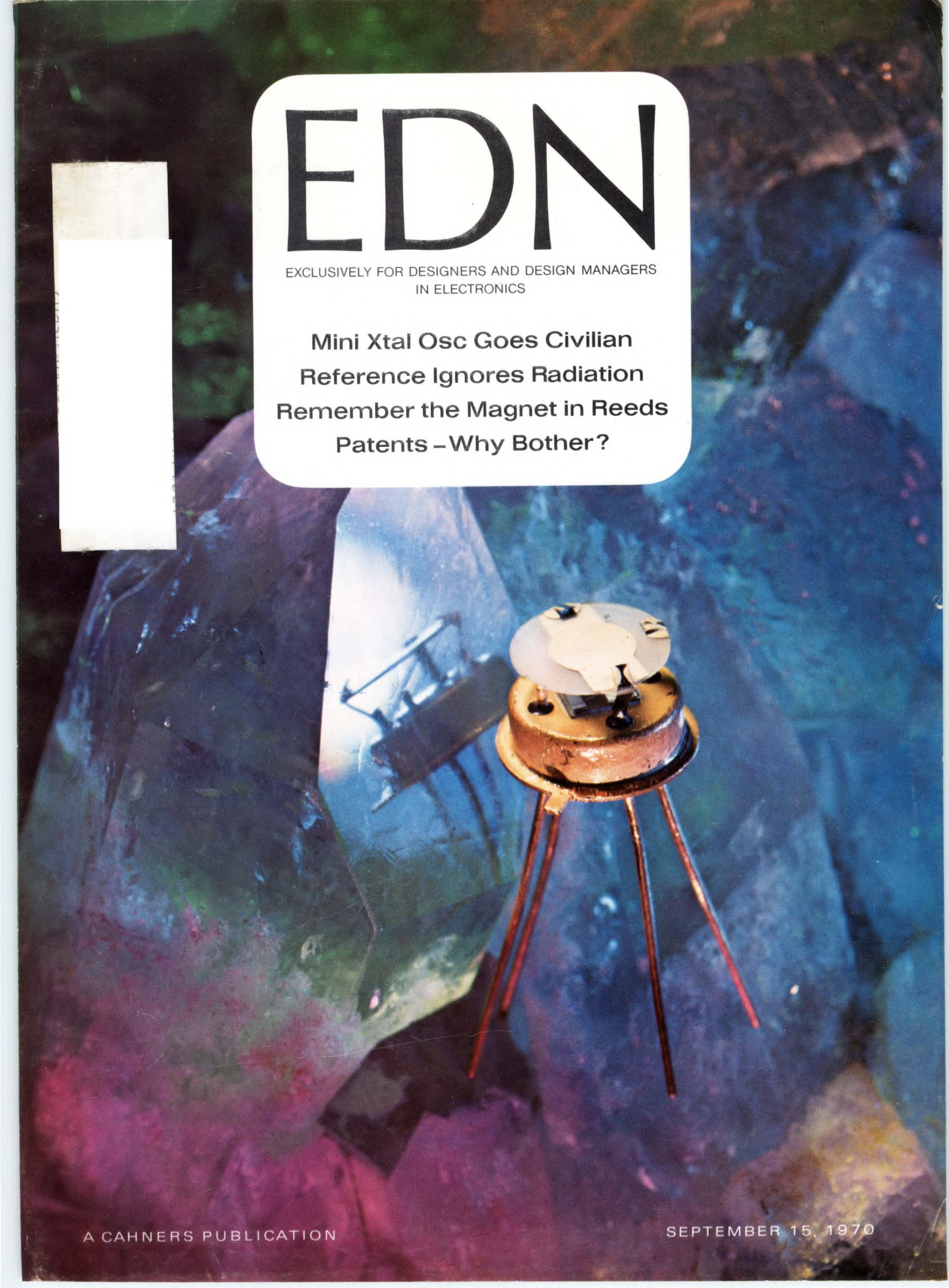
EXCLUSIVELY FOR DESIGNERS AND DESIGN MANAGERS IN ELECTRONICS

Mini Xtal Osc Goes Civilian

Reference Ignores Radiation

Remember the Magnet in Reeds

Patents – Why Bother?



A CAHNERS PUBLICATION

SEPTEMBER 15, 1970

Hmmmmmm. Let's talk about it.

An awful lot of people are buying our 42's and our 40-lead "skinny-dips" who don't need all those leads. Yet.

But with bits per pin and chip densities constantly increasing, tomorrow could be when they'll need extra leads. *Desperately!*

So with price about the same, they've wisely chosen to standardize on one of our larger Standards . . . packages we're producing in enormous volume. (We're now shipping over a *million* leads a day!)

Which makes delivery a lot easier. For *both* of us.

Why MetCeram in the first place? Because we're the leader in today's race to produce high-quality IC packages in dependable high-volume. Our no-glass, all alumina package is used for over 70% of all custom MOS devices shipped anywhere in the world!

It gives you truly external leads. No entry into critical hermetic areas. Low sealing temperatures. Extreme thermal and mechanical shock resistance. And much more.

Other packages? Diode Housings? Specials? Of course. Anything you want in metalized ceramic components. That's our business and that's our name: Metalized Ceramics Corporation, West River Industrial Park, Providence, R. I. 02904.
Or call (401) 331-9800.

Have our 40 & 42-Lead MOS/LSI packages crowded our others out of the nest?

MetCeram

CIRCLE NO. 1

What's a 500 kHz plug-in doing in a 100 MHz mainframe?

Increasing its versatility, that's what!

When you need 100 μV sensitivity, rather than 100 MHz bandwidth, HP's new dual-channel 1806A plug-in lets your 180 Scope System do the job. With the 1806A, the versatile 180 Mini-Giant becomes a powerful tool for measuring and analyzing low-level signals up to 500 kHz.

A 100 μV/div deflection factor lets you see beyond the surface of a signal – to detect ripples, discontinuities and harmonics invisible at less sensitive levels. To get the most out of the 100 μV sensitivity, drift is typically <50 μV/hr, CMRR is 100 dB, noise is <20 μV tangential at full BW – and a pushbutton lets you limit bandwidth to 50 kHz, when you need to. Yet the price of the 1806A is only $675.

For applications where you need high-bandwidth capabilities, there are a host of other plug-ins for the versatile 180 System. There's a 50 MHz, 5 mV/div plug-in for only $695. 100 MHz with 10 mV/div and 50Ω input, $1200 (10 MΩ active probe, $95 extra).

Other available plug-ins include: a differential/dc-offset amplifier, a 4-channel amplifier, and a 35 ps time-domain reflectometer that doubles as a 12.4 GHz sampler.

Today, oscilloscope technology is at a crossroads. The HP direction points to getting the best, now, at a low price – with assurance of increased measurement capabilities down the road, using existing mainframes. The new 1806A plug-in is the latest example of this approach at work.

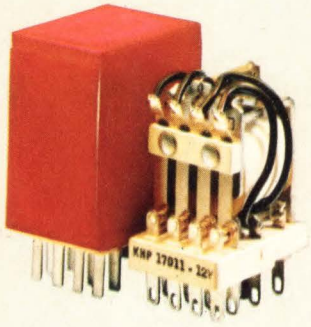
To see the 180 System, call your local HP field engineer. Or, write to Hewlett-Packard, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

080/15

HEWLETT hp PACKARD

OSCILLOSCOPE SYSTEMS

CIRCLE NO. 2



We'll stop adapting our KHP relay when you run out of new applications.

You have a tough relay requirement, right? You need a relay with the reliability of bifurcated contacts. Must have U/L Component recognition. Need .078 taper tab terminals and 400 milli-watts sensitivity. Color coded cases.

No problem. Just call us. We are all tooled and in production. Probably no other manufacturers of our KHP design can say the same.

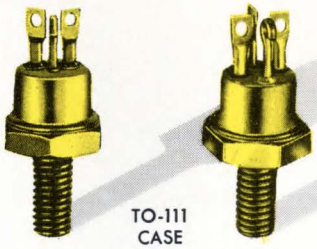
You see, we've been making this relay longer than anyone because we designed it. We've made it for more different applications than anyone else. That's why we have more combinations of contact materials, terminals, sockets, and mountings than anyone else.

Available in 2 Form C, 4 Form C or Form Z contact arrangements. Contacts rated 3-amps at 30V DC or 120V AC resistive. Choice of 8 different mountings and 8 contact materials. Coil voltages from 6 to 120 volts.

Complete specifications and ordering information are in our new 194-page Catalog '70. Ask your P&B representative for a copy today. Or write us direct: Potter & Brumfield Division of AMF Incorporated, Princeton, Indiana 47570. Or call 812 385 5251.

CIRCLE NO. 45

AMF | POTTER & BRUMFIELD



TO-111
CASE

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six JAN and six JAN-TX 5-amp types available from stock *now*!

Type	BV_{CEO} (sus)	h_{FE} @ 1A	V_{CE} (sat)
JAN-TX 2N2880 / JAN 2N2880	70	40—120	2 @ 5A
JAN-TX 2N3749 / JAN 2N3749*	70	40—120	2 @ 5A
JAN-TX 2N3996 / JAN 2N3996*	80	40—120	2 @ 5A
JAN-TX 2N3997 / JAN 2N3997*	80	80—240	2 @ 5A
JAN-TX 2N3998 / JAN 2N3998	80	40—120	2 @ 5A
JAN-TX 2N3999 / JAN 2N3999	80	80—240	2 @ 5A

*isolated collector

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A SPRAGUE ELECTRIC CO. AFFILIATE

CIRCLE NO. 4

SEPTEMBER 15, 1970
VOLUME 15, NUMBER 18

EDN

EXCLUSIVELY FOR DESIGNERS AND DESIGN MANAGERS IN ELECTRONICS

Cover

Cover photo peeks inside TRW Semiconductors' new microminiature crystal oscillator. TRW photographer Clifford Brown took this photo, as well as those in this issue's lead news story on p. 20.

Design News

Design Predictions

Design Features

Design Ideas

Design Interface

Design Products

Design Departments

EDN's DESIGN ACTIVITY FILING SYSTEM is used to classify all Design Feature and Design Idea articles. The first word indicates the *activity* discussed in the article. The second word denotes the principal product being used in the activity. The third word modifies the second word. Finally, a number is used to specify frequency, where applicable. This number is the $\log_{10}$ of the frequency in hertz.

ABP CP MCRC BPA
ibpa International Business Press Associates
DESIGN ELECTRONICS
ELECTRONICS WEEKLY
EDN
ELEKTRONIK
ELEKTRONIK-ZEITUNG
INTER ELECTRONIQUE

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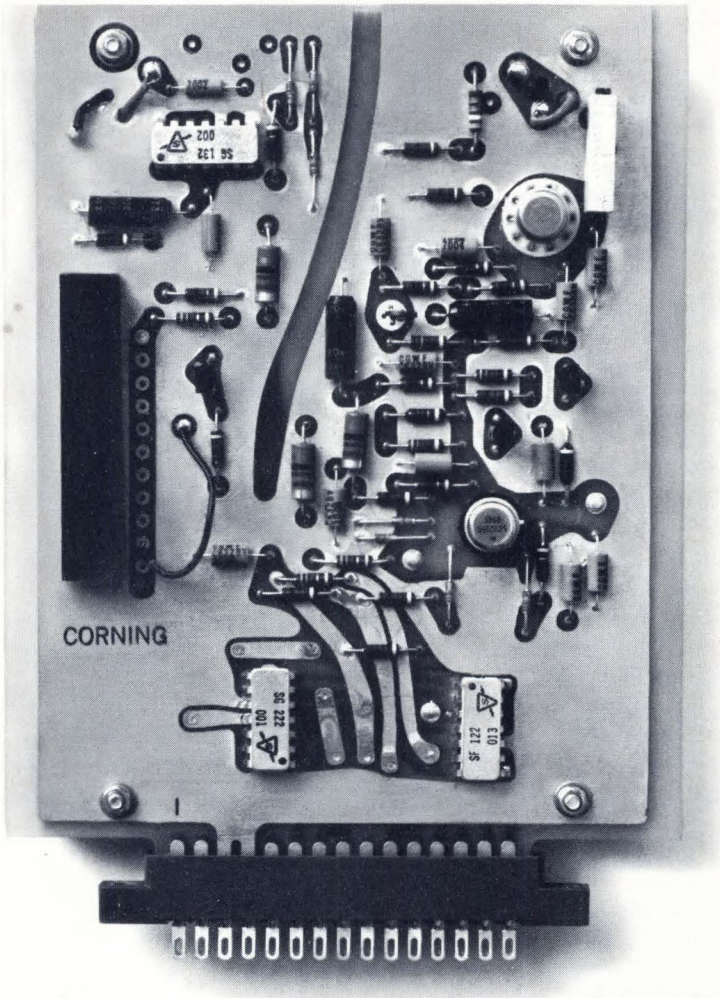
The hard-to-beat memory module:



It's hard-to-beat for economy. It's hard-to-beat for convenience. It's hard-to-beat for performance. It's hard-to-beat, period.

It's the CORNING® Memory Module. A low cost, ready-to-plug-in module, complete with all logic and interface circuitry. Its cost—less than 2.5¢ a bit for a 4096 bit module. And when you compare that price remember we're talking about a fully produced, fully tested module—not just a bag of components that still need engineering time, assembly time, and testing time to get them to work. Not even power supply conversion is needed. And the

CORNING Memory Module is TTL compatible. The standard CORNING Memory Module comes in a choice of sizes ranging up to 4096 bits. For volume orders, we'll design a module to your precise requirements of bit size and overall configuration. And include all desired circuitry such as input/output interface, re-circulation, interlace, and clock. Again, everything will be pretested and supplied as a complete, ready-to-plug-in module.

CORNING Memories are among the most reliable you can specify. They were selected for use in the Gemini and Saturn launch vehicles because of their ruggedness, and immunity to noise, radio frequency interference, and temperature variations.

From every standpoint, they're just hard-to-beat.

And that includes this offer. To make the CORNING Memory Module extra easy for you to evaluate, we'll loan you one for two months. With no strings attached.

Because it's already a complete module, you'll save all the time it normally takes to design a memory. And since we supply it from stock, you'll have none of the wait it normally takes to get memory components from other suppliers. (You can expect this same fast delivery when you move up to production quantities.)

To get started, just send in the coupon. Then plug in the new CORNING Memory Module and see for yourself why we call it the hard-to-beat memory module.

Corning Glass Works, Raleigh, N. C. 27602, (919) 876-1100

The hard-to-beat offer:

Corning Glass Works, Electronic Products Division
Dept. EDN-2, 3900 Electronics Drive, Raleigh, N. C. 27602

☐ Please loan me a CORNING Memory Module for two months* so I can draw my own conclusions.

My application is: _____

_____

_____

☐ Before taking you up on your offer I'd like to

____see a demonstration. ____look over your literature.

Name _____

Title _____

Firm _____

Address _____

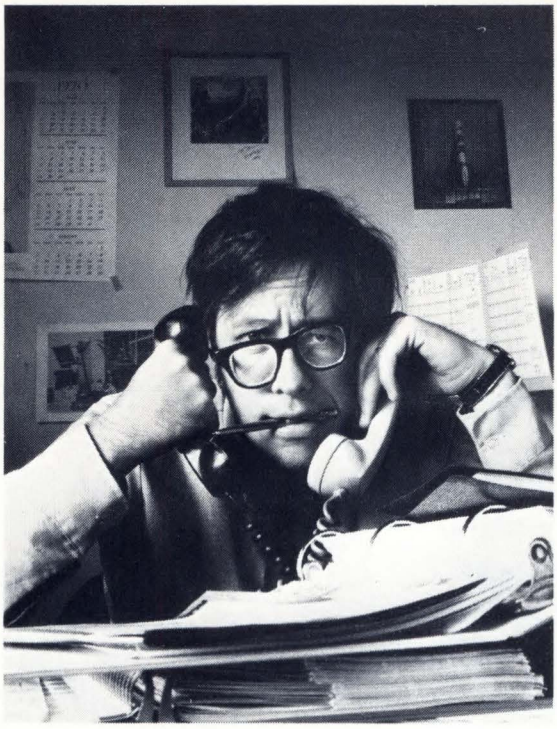
City _____ State _____ Zip _____

Phone No. _____

* If I decide to keep it longer I agree to buy it for $375. Otherwise I'll return it after two months with no obligations or costs, whatsoever.
Offer is valid until January 1, 1971.

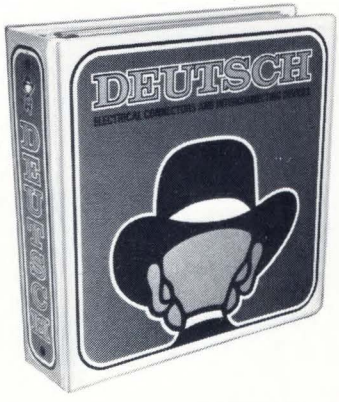
CORNING
ELECTRONICS

CIRCLE NO. 5



Before I began specifying Deutsch connectors, everybody bugged me and nobody loved me...

...they still don't love me but now they leave me alone.



The whole idea behind every Deutsch connector is that it should be easy to assemble, highly reliable and should never be heard from again. All is revealed in our brand new catalogue: lavishly illustrated, exquisitely diagrammed and painstakingly detailed. Get your copy from your Deutschman or write Deutsch, Electronic Components Division, Municipal Airport, Banning, California 92220.

CIRCLE NO. 6

Editorial

Bridge over Troubled Waters

Lately, one of the few bright spots in an otherwise lackluster market for U.S. electronic goods has been across the water. In fact, most manufacturers who are holding their ground are doing so on the strength of overseas sales.

Booming economies in Japan and Europe (notably West Germany) are indeed hungry for U.S. electronic goods. Yet the waters between our shores and theirs are something less than placid, and the bridge that accounts for a healthy trade surplus is beginning to take a battering.

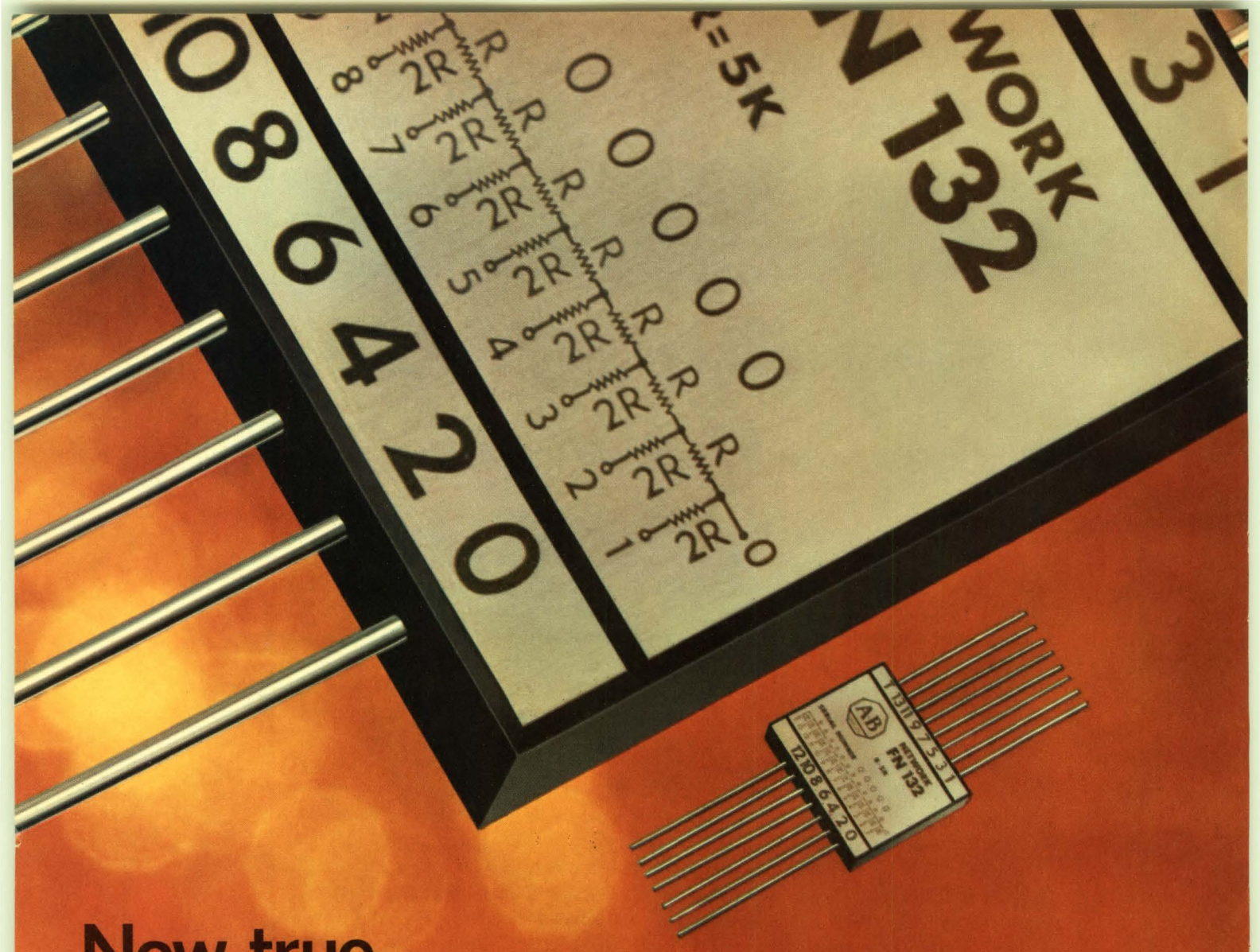
Trade barriers loom as one of the largest threats. In Europe, for example, the Common Market and Outer Seven are establishing certain standards for electronic components—standards that must be verified through qualification and inspection procedures. EDN will report on this situation as it develops. For now, it is sufficient to say that multipartite accord standards loom as a potentially crippling trade barrier.

In Japan, the situation is different, but the mechanism exists to slam the door on U.S. manufacturers. Hopefully, Government agencies and trade associations such as EIA, working hard to keep the bridge open, will be successful.

Closer to the designer's domain, and perhaps more disturbing, we keep hearing that overseas engineers more readily accept brand new technologies than do U.S. engineers. Take MOS for example. French engineers designed the first commercially successful MOS-based DVM. And it doesn't take a marketing genius to see what Japan is doing in MOS business calculators.

Overseas engineers are intent on leapfrogging U.S. equipment designs by taking quick advantage of state-of-the-art components. If they get too good at it, all that flak about trade barriers will be immaterial, because our ability to compete technically, having fallen off the bridge, will be keeping company with old Liberty ships, stale munitions and obsolete nerve gas.

Editor



Now true precision in thin film networks.

Resistance networks for A/D and D/A conversion, digital volt meters and numerical control systems demand extreme precision. Allen-Bradley can deliver. Precision that starts with a patented chromium-cobalt resistive material vacuum deposited on a substrate made to Allen-Bradley specifications. Precision based on exclusive computer drawn grids. Precision backed by extensive design and testing facilities. Precision on a continuing basis assured by Allen-Bradley's 14 solid years of experience.

Add the reliability of a single substrate, uniform temperature characteristics, much lower attachment costs and you see why Allen-Bradley thin film networks are the logical replacement for discrete precision resistors.

SELECTED SPECIFICATIONS

RESISTANCE RANGE	1K ohms to 2 megs, standard 25 ohms to 50 megs, special (Single substrate range—10,000 to 1)
TCR LEVELS −55°C to +125°C	± 25 ppm/°C ± 10 ppm/°C ± 5 ppm/°C
TCR TRACKING	± 5 ppm/°C standard to ± 1 ppm/°C special
TOLERANCES	Absolute to ± .01% @ +25°C Matching to ± .005% @ +25°C
RESOLUTION	Line width and spacing to .0001 inch
ENDURANCE	Exceeds MIL-R-10509F Characteristic E Procedure: MIL-STD-202D

Investigate the superiority of Allen-Bradley thin film networks. Write: Marketing Department. Electronics Division, Allen-Bradley Co., 1201 South Second Street, Milwaukee, Wisconsin 53204. Export office: 1293 Broad St., Bloomfield, N. J. 07003, U.S.A. In Canada: Allen-Bradley Canada Ltd., 135 Dundas Street, Galt, Ontario. Several standard networks are available through your appointed A-B industrial electronic distributors.

ALLEN-BRADLEY

NEW DIMENSION ELECTRONICS

The new HP 3480 A/B Digital Voltmeter is more than a digital voltmeter. It's an advance in the state-of-the-art. It's the omniscient triskelameter that sees all the values you are measuring. It's really a measuring instrument that is ideally suited for bench *and* systems applications.

The HP 3480 A/B is the first DVM capable of making 1000 correct dc or ohms readings per second. It takes the 3480 less than 1 ms to respond to a full scale input and digitize the input signal.

The HP 3480 A/B is the first 4-digit multifunction DVM having an ac converter that is true rms responding to eliminate large errors caused by harmonic distortion or noise and extends your measurement capability to include the rms value of non-sinusoidal wave forms. The 3480 A/B has a 100 mV range and covers from 1 Hz to 1 MHz and will measure ac *plus* dc.

The HP 3480 A/B DVM is ideal as a bench instrument. No other instrument — single purpose or multiple function — equals the 3480 A/B. Top performance in measuring dc, three-terminal dc ratio, true rms ac, ac-plus-dc in one measurement, and ohms is assured by the accuracy designed into the instrument.

You get four-digit readout plus 50% overranging which results in greater resolution and less range change. The high dc input resistance ($>10^{10}\Omega$ on the lower three ranges) reduces the possibility of loading errors.

True rms ac conversion makes the 3480 A/B immune to large errors caused by small amounts of harmonic distortion and expands the range of precision ac measurements to non-sinusoidal wave forms.

The wide bandwidth (1 Hz to 1 MHz) and the capability of making ac-plus-dc measurements gives the 3480 A/B a broader range of applications not available before. And, the high ac and dc sensitivity (100.00 mV full scale) reduces the need for preamplification.

HEWLETT hp PACKARD

never before has there
been a DVM so ideally suited
for bench and systems use as

the omniscient triskelameter

The HP 3480 A/B DVM is ideal as a systems instrument. Up to this time, DVM's have been the slowest part of a measurement system. Now, the system doesn't have to wait for the DVM. The HP 3480 A/B DVM can make up to 1000 dc and ohms readings per second. You can save automatic test time and increase production—or you can appreciably reduce computer idle time.

The 3480 A/B is fully guarded to improve common-mode rejection. There is a switchable 3-position input filter to give you the optimum trade-off between noise rejection and speed. The 3480 A/B is fully programmable including range, function and filter position.

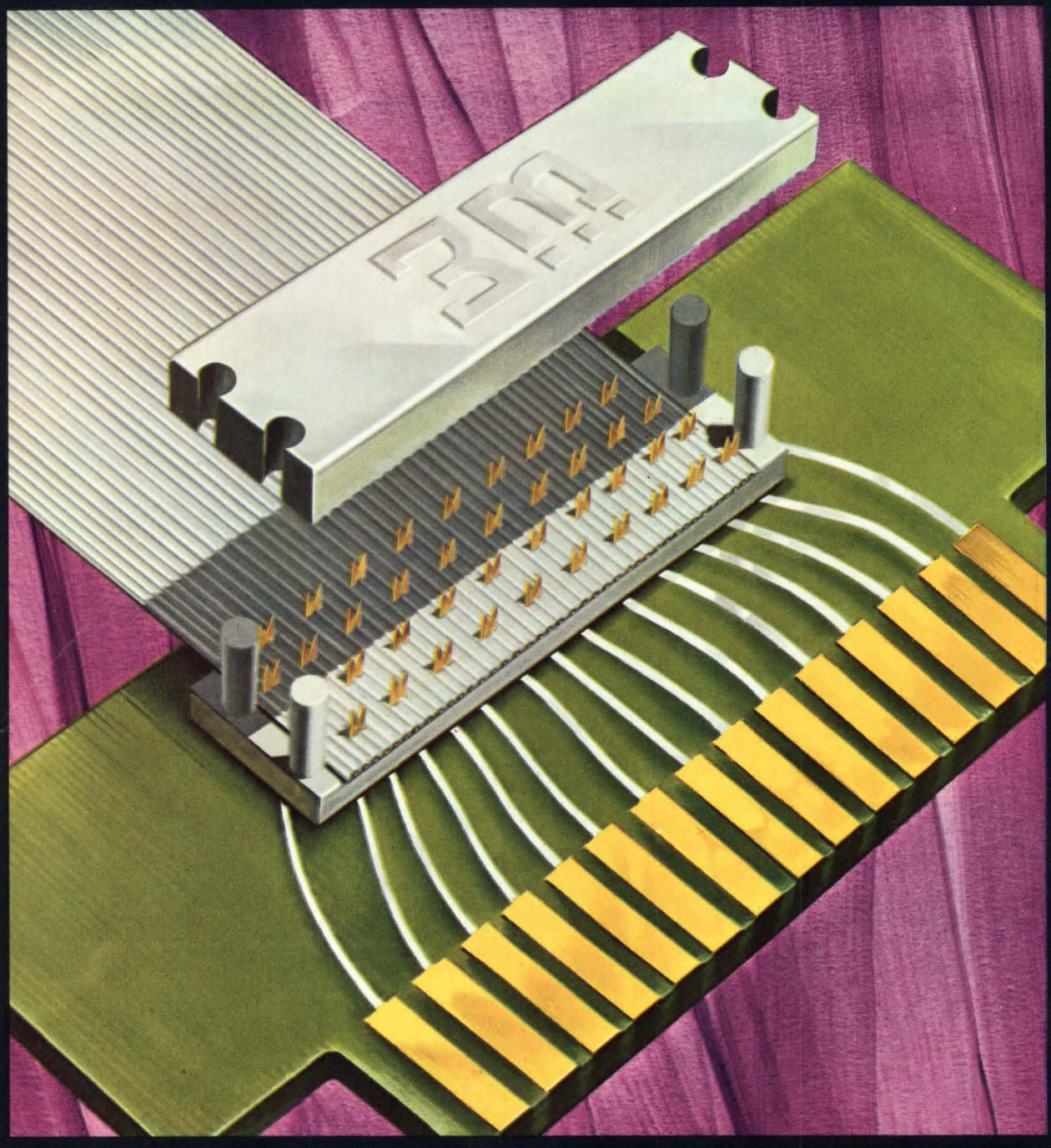
With the optional isolated BCD and isolated remote control you can reduce errors created by ground loops, improve your common-mode rejection even more, and make floating measurements into a guarded system.

Modest prices, too! All the capability packed into the 3480 A/B is not expensive. Prices range from $1150 for one range of dc to $3375 for multifunction ac, dc, ohms capabilities with isolated BCD and isolated remote control.

For the best in bench and systems DVM's, get the omniscient triskelameter—the new HP 3480 A/B DVM. Ask your local HP field engineer for full particulars, or write to Hewlett-Packard, Palo Alto, California 94304. Europe: 1217 Meyrin—Geneva, Switzerland.

090/9

CIRCLE NO. 9



3M's Flat Cable and Connectors... your systems approach to circuitry.

Speed and dependability are yours for your circuitry system assemblies. 3M's "Scotchflex" Flat Cable and Connector Systems provide fast simultaneous circuitry transitions.

"Scotchflex" Flat Cable and Connector Systems win on every count • No stripping or soldering • Reduce wiring errors • Permit easy trouble-shooting • Provide predictable electrical characteristics • Speed production. • Transitions available for printed circuit board, dual in-line plug, WWP and PCB edge card. For complete information, write: Dept. EAH-1, 3M Company, 3M Center, St. Paul, Minn. 55101.

"SCOTCHFLEX" IS A REGISTERED TRADEMARK OF 3M CO.

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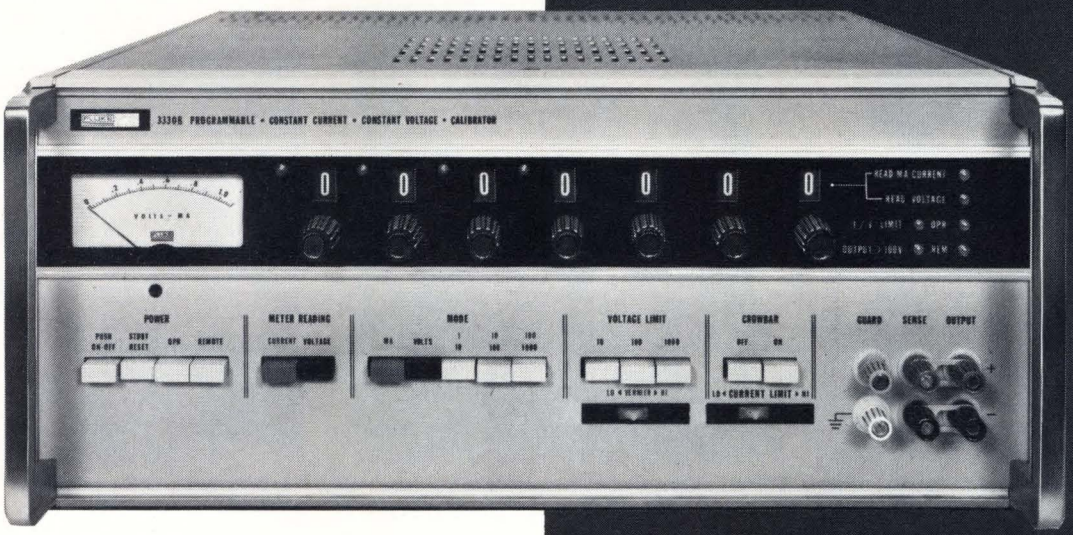
CIRCLE NO. 17



PRECISION TESTING AND CALIBRATION MADE EASY...

or how the new Fluke programmable constant current, constant voltage calibrator goes to work calibrating and testing precision instruments, semi-conductors, resistors and sub-assemblies.

For the engineer whose responsibility is checking out incoming precision components, the new Fluke 3330B Programmable Constant Current/Voltage Calibrator will shorten your day and heighten your nights. For the first time, computer programmed checkout over a wide range of voltages and currents is available with an off-the-shelf low priced quality instrument.

The Fluke 3330B is unique. It can be operated in either a constant current or constant voltage mode. Modes can be changed without turning the unit off. Voltage range is 0 to 1000 volts in three ranges with 10% overranging. Voltage accuracy is ±0.003%. Resolution is 0.1 ppm. Stability is 15 ppm per month. Line and load regulation are 2 ppm of range. Ripple and noise are less than 60 μv. Voltage trip is adjustable from 1 v to 1000 v. Output current is 100 ma in the 10 and 100 v ranges and 50 ma in the 1000 v range.

In the constant current mode, ranges are 0 to 100 ma in three ranges with 10% overranging. Accuracy is ±0.006%. Resolution is 1 ppm. Stability is 30 ppm/month. Line and load are 2 ppm of range. Compliance voltage is 1000 volts on the 1 and 10 ma ranges and 500 volts on the 100 ma range.

Crowbar effect through a programmable relay shorts output to limit voltage while changing loads.

Programmable functions are output range, mode, level and polarity, voltage and current limit, crowbar, and standby/operate. Programming time is tens of milliseconds. Price is $3,495.

For full details write or call us today.

Fluke. Box 7428, Seattle, Washington 98133.
Phone: (206) 774-2211. TWX: 910-449-2850.

In Europe, address Fluke Nederland (N.V.), P.O. Box 5053, Tilburg, Holland. Phone: (04250) 70130. Telex: 884-50237.
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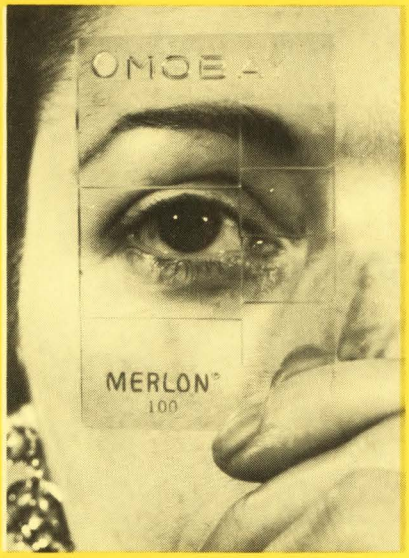
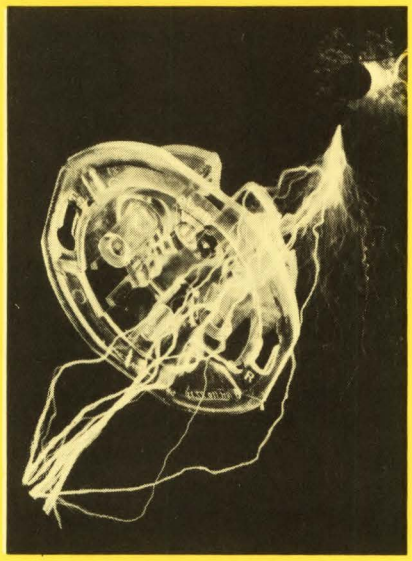
FLUKE®

CIRCLE NO. 15

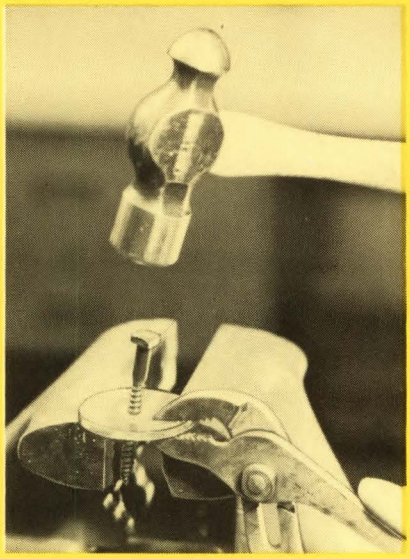
Try these Merlon® 'tests' on any other plastic... or even on any metal



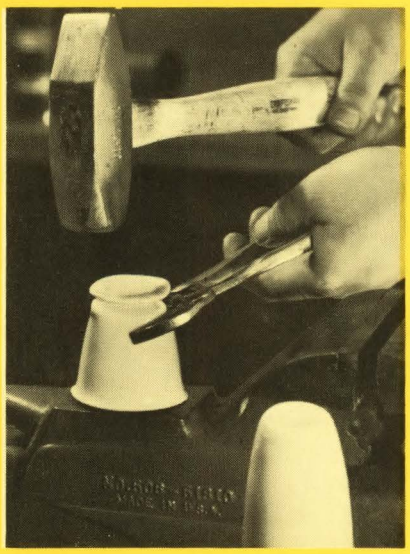
Transparent; high light transmittance with low diffusion.



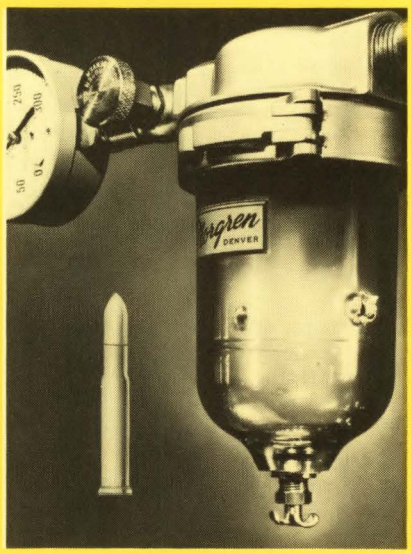
UL-listed as qualified to support current-carrying parts.



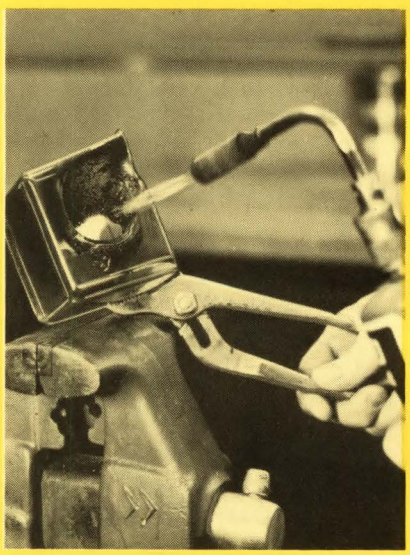
High resistance to cracking, stress, splitting or chipping.



Tremendous impact strength and metal-like ductility.



Shatter-proof, even when punctured under high pressure.



Listed as self-extinguishing by ASTM D-635 test.

With over 2000 plastics to choose from, it's easy to make the wrong choice. It's also easier than ever to make the right one. To find out how easy, write for your Merlon polycarbonate slide rule comparator that stacks up Merlon properties and performance against five other top engineering grade plastics—and tells it like it is.

engineering plastics and chemicals

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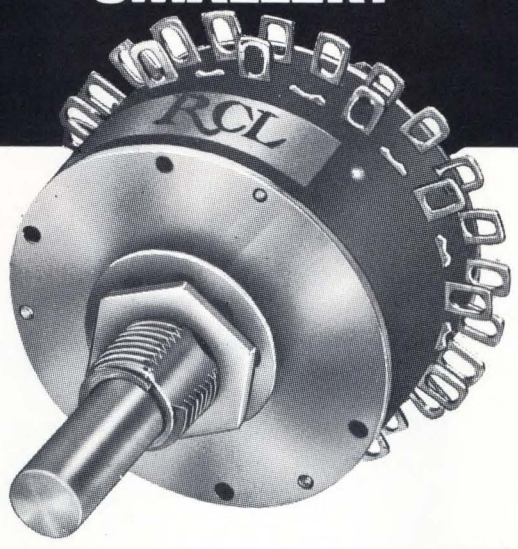
CIRCLE NO. 18

WE'RE GETTING LARGER

'CAUSE OUR SWITCHES ARE GETTING SMALLER!



A new commercial version of our MINIATURE ROTARY "E" SWITCH at a **MUCH LOWER PRICE!**

Single deck 1 pole-24 position to 3 pole-8 position MBB or BBM

Completely automated facilities and mass production tooling now makes RCL highly competitive in commercial applications with "obsolete" wafer-type open frame switches!

Equivalent performance at much lower prices than "instrument type" switches.

- The smallest enclosed MINIATURE ROTARY SWITCH available with up to 24 positions shorting or non-shorting on each deck.
- Up to 12 poles per deck.
- As many as 9 decks may be specified.
- Life expectancy—200,000 mechanical operations.
- Solder terminals will accept two .032 diam. (AWG #20) wires.

as low as

$1.96 each

in quantities of 1,000

For ordering purposes designate series "EC".

DELIVERY FROM STOCK

Write for complete technical information

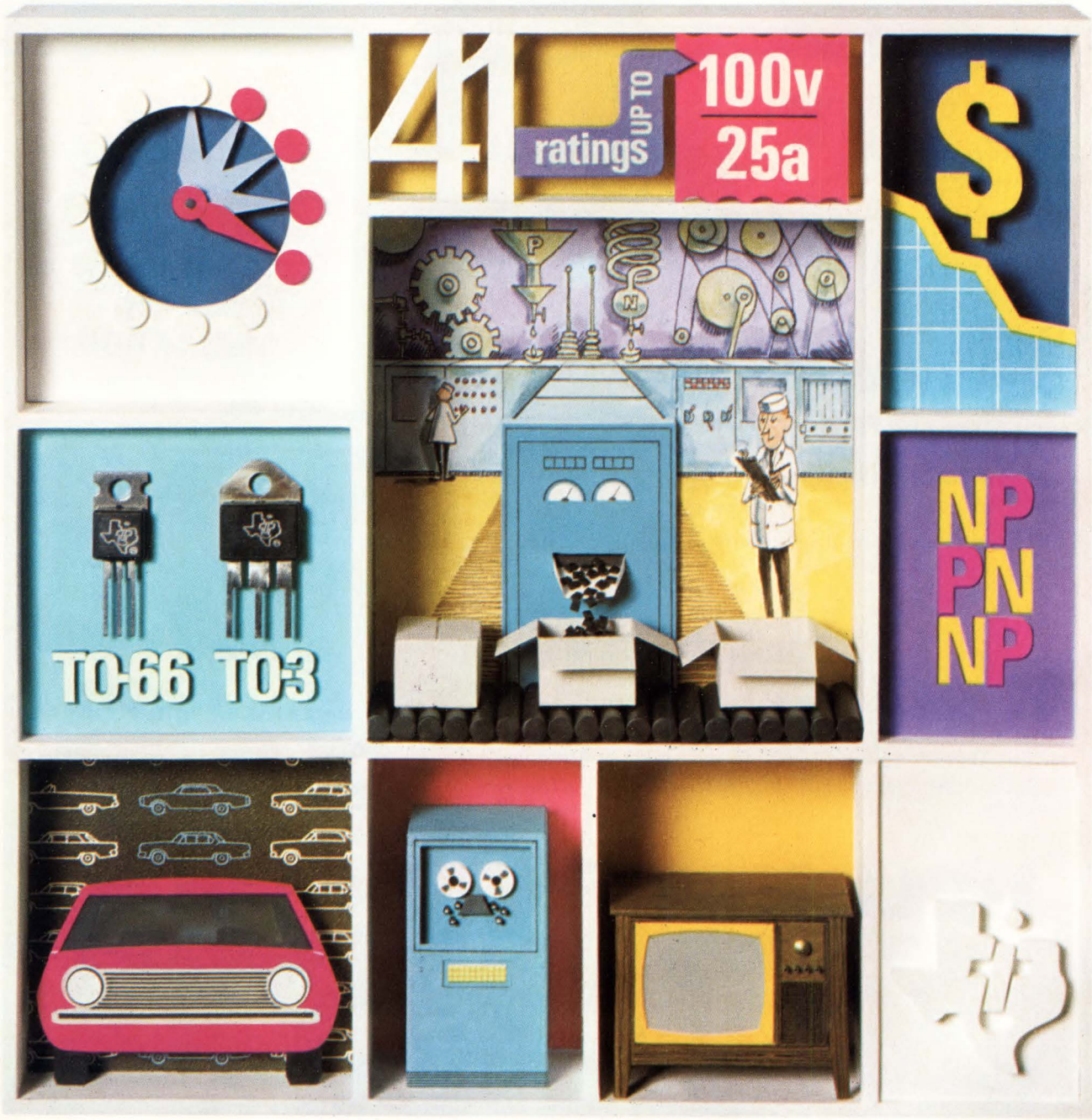
RCL ELECTRONICS, INC.

700 South 21st Street, Irvington, New Jersey 07111

U. S. Pat. #3352979

CIRCLE NO. 11

Announcing a revolutionary power transistor package:



TI triples production to bring prices down 20%, improves performance six ways, and doubles your ratings choice.

For the first time in a long time you can evaluate power transistor suppliers and find significant differences. TI's new power package provides these differences. From top to bottom, in every corner, it's completely loaded with dramatic improvements.

First, we overhauled our price and delivery structure with a revolutionary new technology for producing power transistors. It's an entirely new concept, so we designed and built new equipment to implement it. And it works. The highly-automated process cuts TI power transistor assembly time **from 8 days to an incredible 4 hours.** Right now, we're operating at triple our old capacity. Your demand could triple it again... without straining our capability.

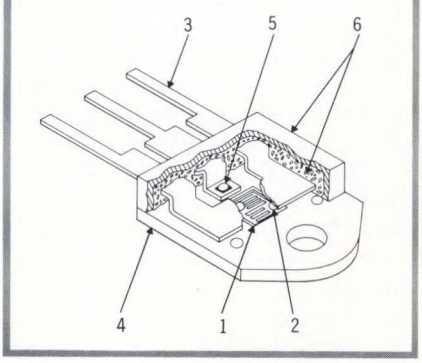
With production up, **we brought prices down.** By an average of 20%. An example: TIP 29B is priced at $0.88 and TIP 35C at $4.65 (100–999 quantities). These new industry-leading prices offer big savings over other plastic power transistors. And, since they can directly replace metal-can TO-3 and TO-66 units, savings are even greater... significantly greater ... when switching from metal-can types.

There's more to the package than price and delivery. TI's product design has been **dramatically improved six ways.** The result is a new, high-performance plastic package incorporating these important improvements:

1. A glass-passivated chip increases moisture resistance, provides lower leakage and better stability.
2. All soldered contacts–no lead wires to break or stress–boost resistance to thermal shock and vibration and also allow higher surge currents.
3. Solder-clad, copper leads facilitate solderability.
4. Nickel-plated, copper heat sink provides improved thermal conductivity.
5. Pinned and soldered collector lead eliminates intermittent collector lead problems.
6. Plastic cap and epoxy fill are features of our new design which results in an internal construction with all elements locked solidly inside the package.

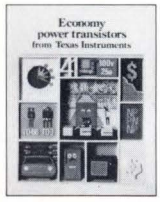
TI's family of plastic, single-diffused silicon power transistors.

	Type No. NPN	Type No. PNP	I_C Cont. Amps	V_{CEO} Volts	P_D Watts
TO-66	TIP 29	TIP 30	1	40	30
	TIP 29A	TIP 30A	1	60	30
	TIP 29B	TIP 30B	1	80	30
	TIP 29C	TIP 30C	1	100	30
	TIP 31	TIP 32	3	40	40
	TIP 31A	TIP 32A	3	60	40
	TIP 31B	TIP 32B	3	80	40
	TIP 31C	TIP 32C	3	100	40
	TIP 41	TIP 42	6	40	65
	TIP 41A	TIP 42A	6	60	65
	TIP 41B	TIP 42B	6	80	65
	TIP 41C	TIP 42C	6	100	65
TO-3	TIP 3055		15	60	90
	TIP 33	TIP 34	10	40	80
	TIP 33A	TIP 34A	10	60	80
	TIP 33B	TIP 34B	10	80	80
	TIP 33C	TIP 34C	10	100	80
	TIP 35	TIP 36	25	40	125
	TIP 35A	TIP 36A	25	60	125
	TIP 35B	TIP 36B	25	80	125
	TIP 35C	TIP 36C	25	100	125



More than **doubled the choice of ratings** in the TIP Series. There are now 41 voltage/current combinations–more choices than in any other line. The TIP Series ranges up to 25 amps and 100 volts with two package types, each featuring single-screw mounting, and fully complementary NPN and PNP pairs.

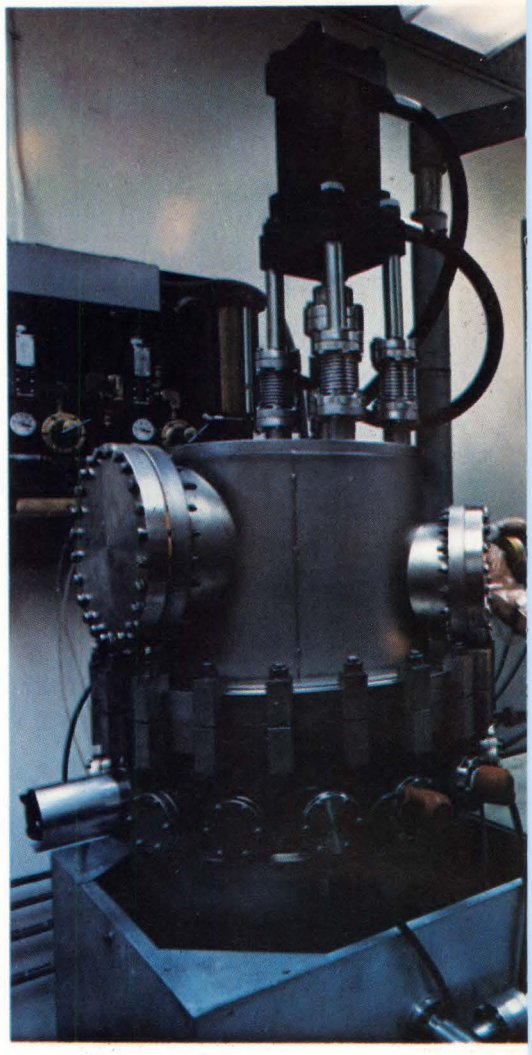
TIP 3055 is TI's new, low-cost replacement for the 2N3055. Priced at $1.00 in 100–999 quantities, TIP 3055 has an f_T of 3 MHz and fits more than 75% of existing sockets.

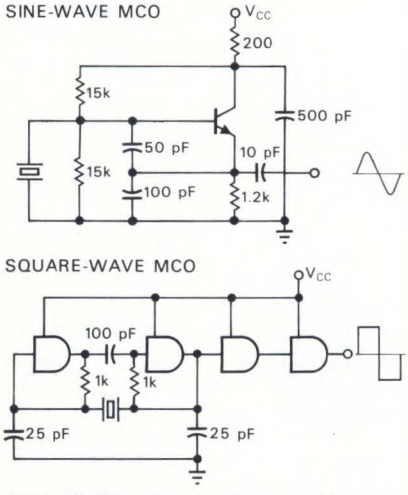


TI has put it all together. Price. Delivery. Reliability. Choice. All in one revolutionary package. For details, get Bulletin CB-124. Circle 188 on Reader Service Card or write Texas Instruments Incorporated, P. O. Box 5012, M.S. 308, Dallas, Texas 75222. Or ask your authorized TI Distributor. He's got the complete package, too.

TEXAS INSTRUMENTS
INCORPORATED

Microminiature Crystal Oscillators— Military Hybrids Go Civilian





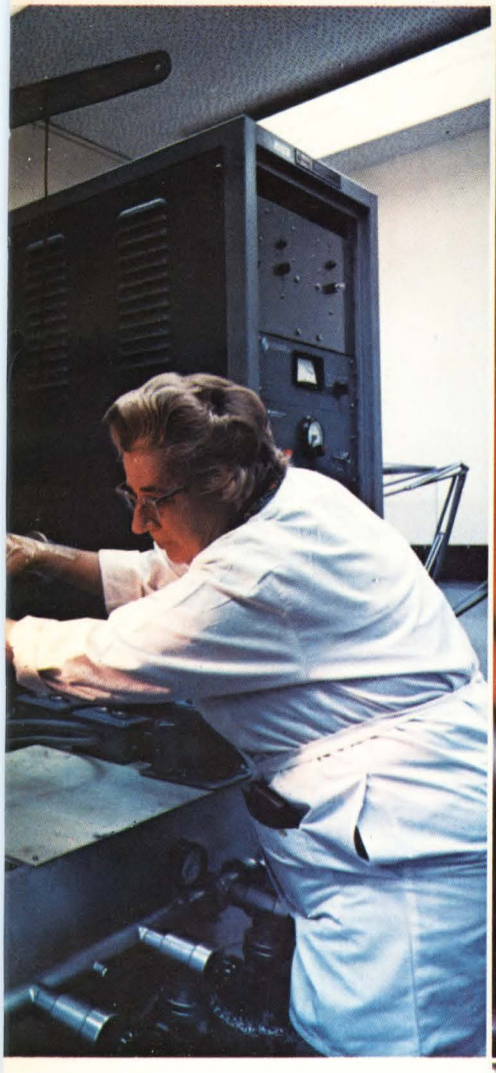
Umbrella-like, the quartz crystal is supported over the hybrid circuit with three platinum straps. Thin-film hybrid, background, employs Colpitts oscillator circuit. Diagrams show sine-wave MCO uses a transistor chip—whereas the square-wave MCO uses a TTL integrated circuit.

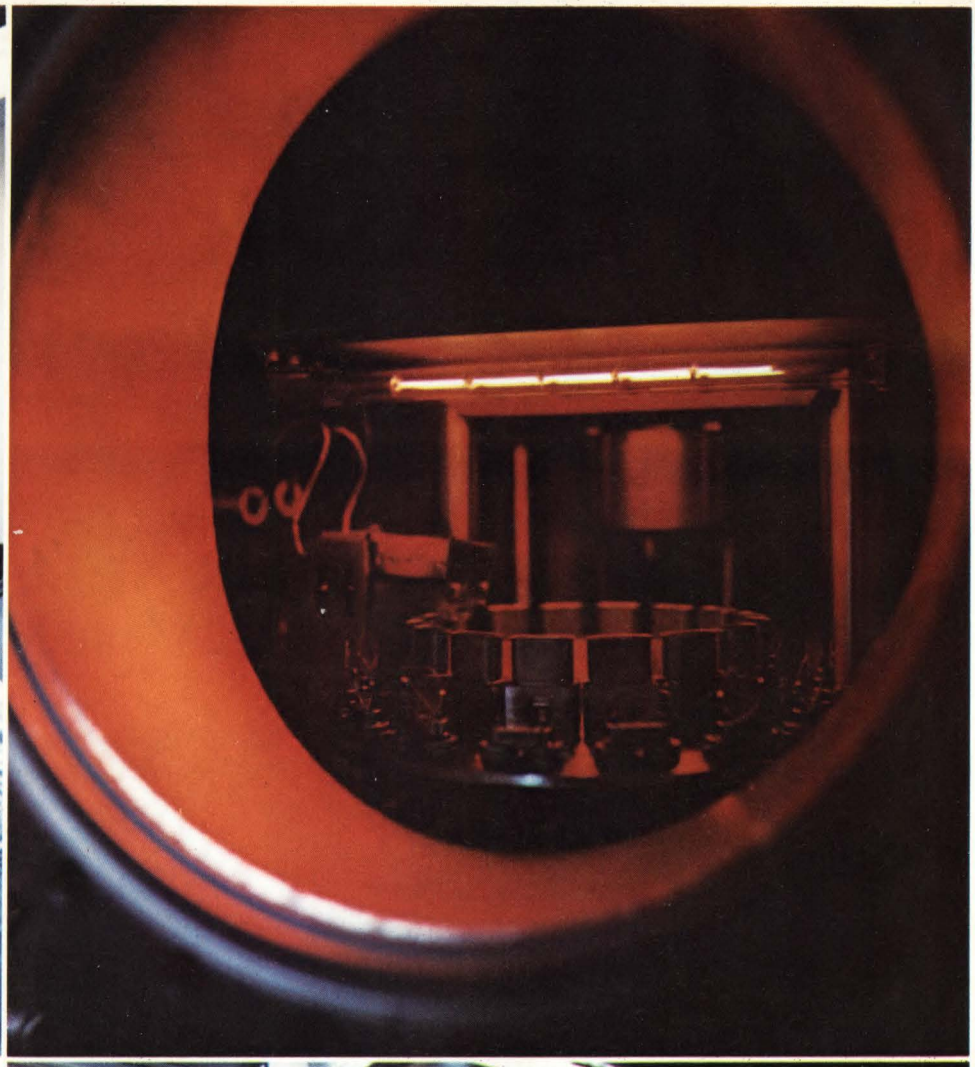
LAWNDALE, CALIF.—When the U.S. Army needed a small, rugged, stable oscillator for its helmet radio, TRW Semiconductors, Inc. answered the call with a unique combination of semiconductor hybrid and crystal technologies. In a TO-5 can that contains a hybrid oscillator circuit—plus a crystal—TRW's Microminiature Crystal Oscillator (MCO) is now being offered to the commercial market.

Along with the sine-wave MCO (5-25 MHz) developed for the Army, the West Coast firm offers a TTL-compatible square-wave version (5-15 MHz) as a complement to their new line. Because of their small size and stability, the MCOs should find widespread application in the OEM market. For openers, TRW is aiming their sine-wave MCO at the telemetry and commercial communications fields. As for the square-wave MCO, TRW sees it providing rock-stable timing for MODEMs, computer clocks, and instruments such as counters and synthesizers. For this purpose, a 10 MHz square-wave MCO will be offered as standard. Future MCOs will contain IC countdown chains to produce sub-audio frequencies.

All MCOs employ a special multilead TO-5 header which supports, in tandem, the quartz crystal and the thin-film hybrid circuit (see photo).

Temperature characteristics define the three MCO configurations as: *normal crystal* (−55 to 105°C; 30 PPM), *tight-TC crystal* (0 to 50°C; 2 PPM) and *ovencontrolled crystal* (0 to 60°C; 0.5 PPM). During MCO production, room-temperature frequency is set to within ±5 PPM. The aging characteristic after one year is specified at 5 PPM. On the tight-tolerance MCOs, a varicap provides the user with an external means to make precise frequency adjustments. In quantity orders (1000-up), a *normal crystal* MCO costs about $16—whereas the *tight-TC* and *oven-controlled* versions run between $30 and $35.

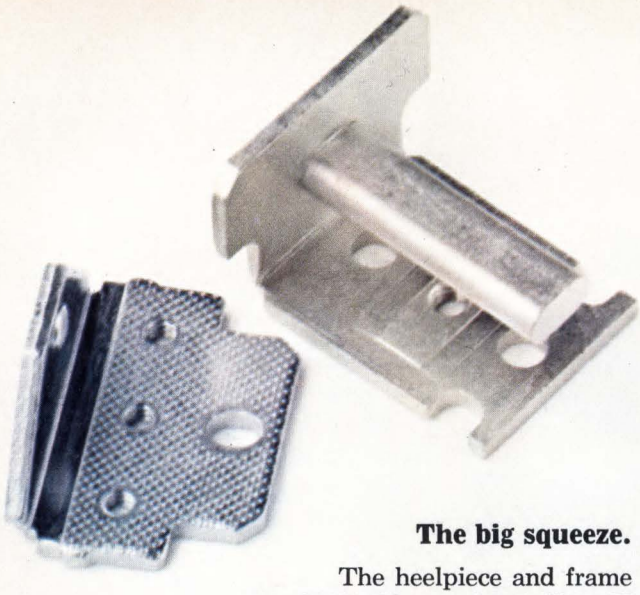




Vaclon System (top) that can create a 5×10^{-10} torr pressure exemplifies TRW's prowess for creating highly stable crystals. Through the Vaclon window, you can see crystals (foreground) that await packaging in their cans (background). Because of this contaminant-free packaging environment, TRW expects to offer crystals whose frequency will not vary more than 2×10^{-10} per week.

Resistor trimming (right) is reminiscent of intentionally blowing fuses. To adjust resistance values, the operator applies a 5V pulse via probes to blow fuse links in the thin-film pattern and disconnect resistor portions. Another novel feature of TRW's hybrid is their passivation technique. They passivate the hybrid with the same dielectric used for making the hybrid's capacitors.

Reliability is 756 little dents and one big one.



The big squeeze.

The heelpiece and frame are the backbone of our Class H relay. The slightest squiggle or shimmy out of either and the whole relay is out of whack.

756 tiny dents on the heelpiece, plus one big one on the frame, make sure this'll never happen.

They're the result of planishing, a big squeeze. Planishing is an extra step we go through in forming the pieces to add strength and stability by relieving surface strain. It also makes the parts extra flat.

This takes the biggest press in the industry and the biggest squeeze. Both exclusively ours.

A different kind of coil.

The heart of a relay is the coil. If ours looks different, it's because we build it around a glass-filled nylon bobbin. It costs us more, but you know how most plastic tends to chip and crack.

Also, moisture and humidity have no effect on glass-filled nylon. No effect means no malfunctions for you to worry about. No current leakage, either.

The coil is wound on the bobbin automatically. No chance of human error here.

We didn't forget the solder.

We use a solderless splice. That's because solderless splice connections are sure-fire protection against the coil going open under temperature changes, stress, or electrolysis.

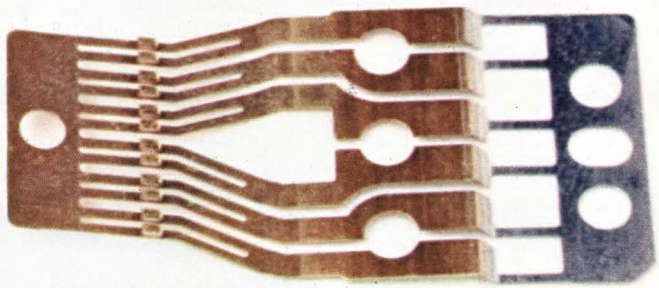
A solderless splice is more expensive to produce, so it's usually found only on the most reliable relays. AE is the only manufacturer to use this method on all of its relays.

Finally, we wrap the whole assembly with extra-tough, mylar-laminated material. A cover is not really necessary here; but why take chances?

Springs and other things.

We don't take any chances with our contact assembly, either. Even things like the pileup insulators (those little black rectangles) get special attention. We precision mold them. Other manufacturers just punch them out.

It makes a lot of difference. They're stronger, for one thing; and because they're molded, there's no chance of the insulators absorbing even a droplet of harmful moisture. Finally, they'll withstand the high temperatures that knock out punched insulators.



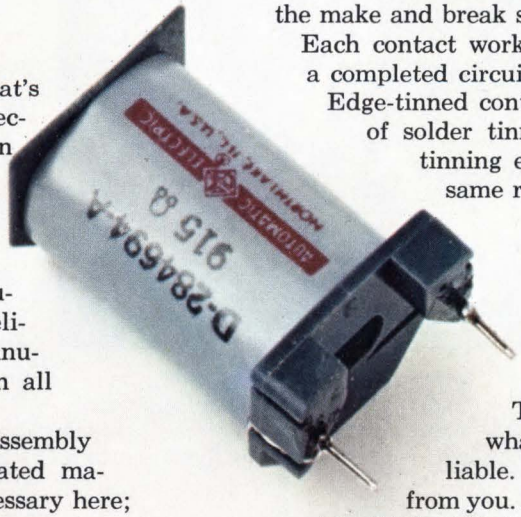
Then there are the contact springs. Ours are phosphor-bronze. Others use nickel-silver. Our lab gave this stuff a thorough check, but found nickel-silver too prone to stress-corrosion. Atmospheric conditions which cause tarnish and ultimately stress corrosion have almost no effect on phosphor-bronze.

Two are better than one.

Our next step was to make sure our contacts give a completed circuit every time. So we bifurcate both the make and break springs.

Each contact works independently to give you a completed circuit every time.

Edge-tinned contact springs save you the job of solder tinning them later. Also, edge-tinning enables you to safely use the same relay with sockets or mounted directly to a printed circuit board. A simple thing, but it takes a big chunk out of the inventory you have to stock.



Etc. Etc. Etc.

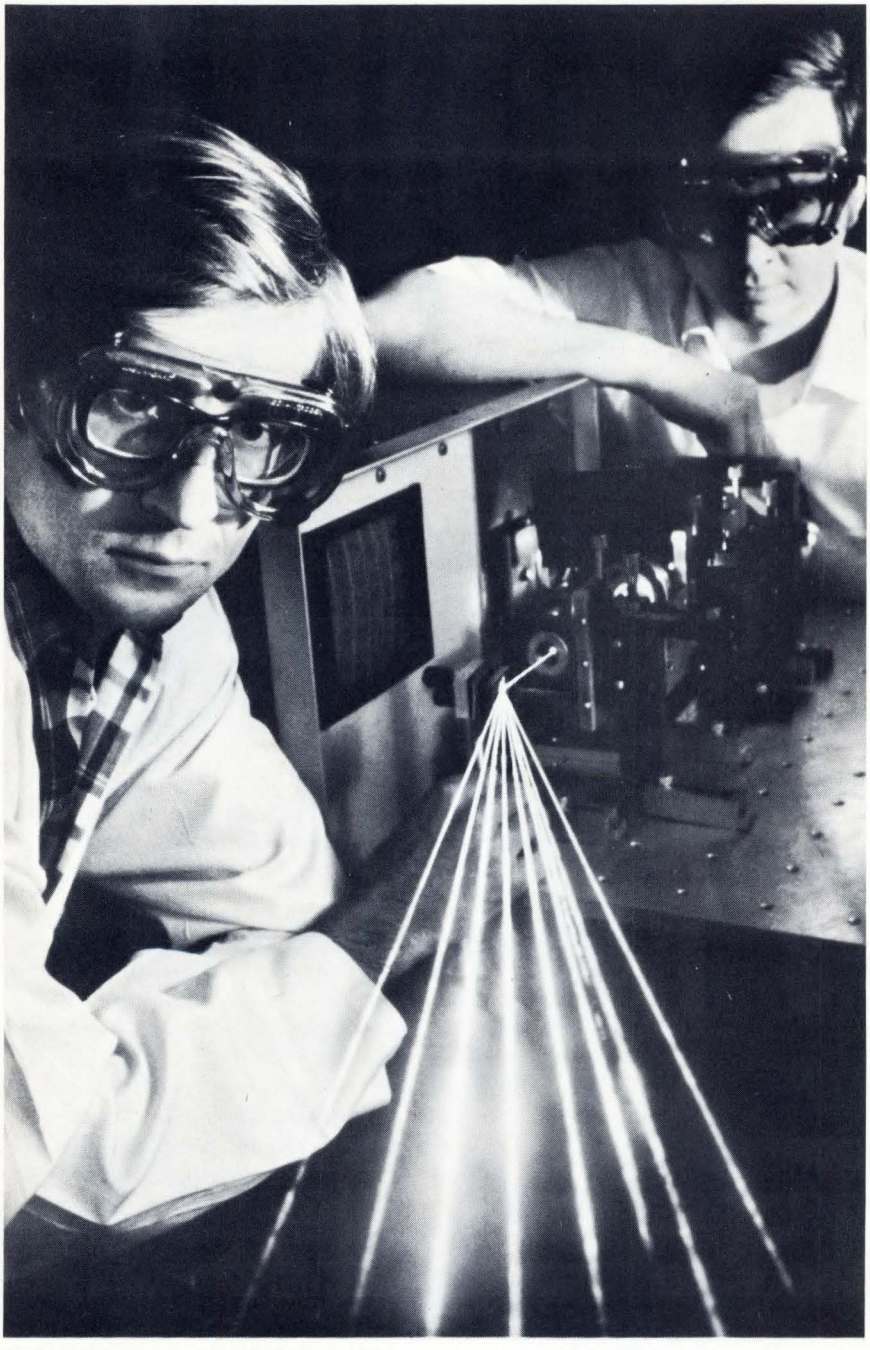
There's a lot more to tell about what makes our Class H relay reliable. Now we're waiting to hear from you. Automatic Electric Company, Northlake, Ill. 60164.

AUTOMATIC ELECTRIC

SUBSIDIARY OF GENERAL TELEPHONE & ELECTRONICS

CIRCLE NO. 14

This Laser Tunes over 1760Å



Broad-spectrum coherent light emitted by new exciplex laser is demonstrated by two of the three men who devised it at Bell Labs. Andrew Dienes (foreground), Charles V. Shank (background) and Anthony M. Trozzolo anticipate applications that include investigation of the interaction of light with other forms of matter.

MURRAY HILL, N. J. – Bell Labs, have used a unique chemical reaction that enables a new tunable laser to emit coherent light in a range of colors from near-ultraviolet to yellow. This range is four times broader than tunable emissions from any previous dye laser.

The reaction, called "exciplex" or excited state complex, occurs only in certain organic dyes such as 4-methylumbelliferone. When optically pumped, molecules of such a dye that have reached the excited state react with another chemical in the solution. This new chemical compound is known as the exciplex. In addition to the light emitted by the normally-excited dye molecules, the exciplex has its own broad range of emission wavelengths.

Once the light has been emitted, the exciplex form of the dye becomes unstable and reverts to the two components of its original form. So, exciplex forms can be created continuously in the solution by optical pumping.

By varying the concentration of dye in solution, light emission can be controlled over a range as broad as 1760Å, more than four times as great as previous maximum tuning ranges nearly 400Å wide for organic dyes.

Developers of the new exciplex tunable laser are Andrew Dienes, Charles V. Shank and Anthony M. Trozzolo of Bell Labs. They presently anticipate that the new exciplex laser will become a valuable laboratory tool for investigating the interaction of light with various forms of matter. In addition, they foresee possible applications in extremely versatile communications systems.

Survey Says MOS Market Saturated

SAN FRANCISCO – MOS production capacity presently equals demand – and by 1971, production capacity will exceed demand by a factor of two.

This is the opinion of an information service company, Quantum Science Corp., which recently presented results of an MOS/LSI study here. Industry eyebrows, already raised by the "saturation" opinion, went even higher when Quantum Science forecast a wave of price-cutting as a result of the developing situation.

The study, an in-depth look at 21 MOS companies, was made public at a conference, "MOS/LSI Impact", attended principally by firms other than those studied.

Quantum Science attributes the projected increase in capacity to new MOS company start-ups in 1970, expansion at established MOS firms and yield improvement. They conclude that these factors will create a 1971 shipment capability of 20-million units (two-shift basis), compared with a requirement for only 12-million units. Supporting their projections, the information specialists stated that the MOS industry now has an established capacity of more than 500 diffusion furnaces – enough to ship 3-million units/month (one-shift basis), with a 3% average yield.

Quantum Science contends that unrealistic and multiple ordering by equipment manufacturers has created an artificial market growth. Citing Viatron Computer Systems as one of the worst offenders, they said that this firm had double-ordered their basic requirements. Also mentioned were Seeburg and Wurlitzer, who were said to have ordered enough MOS circuits for juke boxes and electronic organs to meet total industry needs for a year.

The Quantum Science staff stated that Texas Instruments is the only company that has maintained its leadership. Fairchild, Motorola and Signetics, they contended, will not be significant factors in the MOS/LSI market through 1975. American Micro-systems and National Semiconductor will benefit most from MOS/LSI – and as a result gain an important share of the total microcircuit market, said the Quantum Scientists.

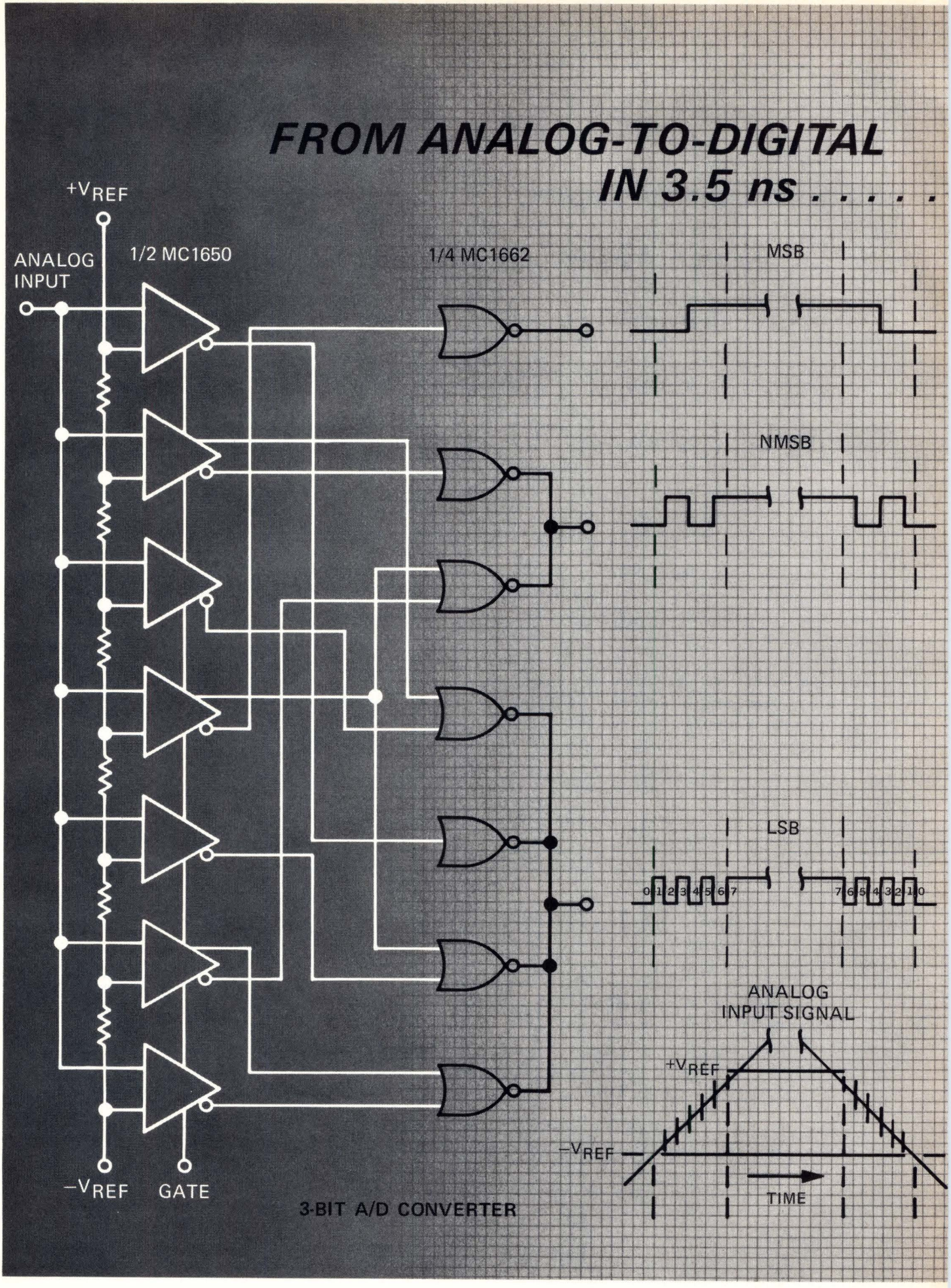
In discussing technology, Quantum Science sees complementary MOS becoming the most important technology in the second half of this decade. They credited Mostek with making the most important innovation – ion implantation techniques which have achieved greater flexibility and increased circuit density. As for packaging, they project that plastic will be used for MOS circuits in 1971 – indicating that non-hermetic packages are already being used by Cogar for sample deliveries. See chart for comparisons.

LSI PROCESSES RANKING – 1970

	SPEED*	AREA	POWER	COMPATABILITY	COST+	EARLY LEADERS
MOS						
P CHANNEL –111 CRYSTAL	9	2	4	3	1	AMI, GI
–100 CRYSTAL	8	2	3	2	1	NSC, AMI
NITRIDE	7	2	3	2	2	GI, TI
–SIL. GATE	6	1	3	1	2	INTEL, FAIRCHILD
–ION IMPL.	5	1	3	1	3	HUGHES, MOSTEK
N CHANNEL	4	2	3	2	4	INTERSIL, COGAR
COMPLEMENTARY	3	4	2	1	5	RCA, RAGEN, SSS
SILICON ON SAPPHIRE	2	3	1	1	7	RCA
BIPOLAR	1	5	1	–	6	TI, MOT, FAIRCHILD SIGNETICS, NSC

*SPEED VARIES FROM 10 NANOSECONDS (1) TO 800 NANOSECONDS (9).
+COST VARIES BY A FACTOR OF 8–10 FOR THE 1 TO 6 RANGE SHOWN.

FROM ANALOG-TO-DIGITAL IN 3.5 ns . . . . . .



. . . . MECL III MAKES IT HAPPEN

In this computer world of rapidly accumulating data it is imperative to develop new high-speed techniques for analog-to-digital data conversion. To meet these demands Motorola now offers the MC1650 A/D Comparator, a digital integrated circuit providing faster conversion rates than any comparable IC system available today — at no increase in cost!

Basically, the MC1650 compares an analog signal to a reference voltage when the gate is in the logic "1" state. When the analog level is greater than the reference, the output (Q) of the comparator goes to a logic "1". When the analog signal is less than the reference voltage, the comparator output voltage goes to a logic "0".

The comparator will accept analog signals with slew rates up to 340 V/μs and provides digital information at rates up to 200 megabits per second, at the least significant bit (LSB). And the MC1650 features a built-in memory whereby the gate input, when taken to a logic "0" level, will cause all bits of digital information to remain in the present state, regardless of a change at the analog input. The MC1650 incorporates two comparators in one package and operates at MECL III logic levels. Other features include a typical delay of 3.5 ns and complementary outputs which increase flexibility of design.

In the 3-bit A/D converter illustrated, the analog signal is represented as a straight line, but may assume any form as long as the maximum slew rate is not exceeded. The incremental steps are determined by the bias values supplied by resistors between $+V_{REF}$ and $-V_{REF}$. Equal values for all resistors (assumed here) will break the analog sensitivity of the system into equal increments, while different values result in unequal increments.

Apply the MC1650 to instrumentation applications such as frequency measurement, high-frequency sample and hold, and peak voltage detection. In navigation and aviation use the comparator for application in altimeters, peak detectors, and electromechanical system-control interfacing. And consider the high-speed applications for computer terminals and memory translation and amplification.

For complete MC1650 specifications write to Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, Arizona 85036. Your local Motorola distributor has evaluation devices available now. Evaluation will introduce you to the latest concept of high-speed A/D data conversion where MECL III makes things happen.

MECL — Trademark of Motorola Inc.

MOTOROLA MECL
the only way to go . . . FASTER

CIRCLE NO. 13

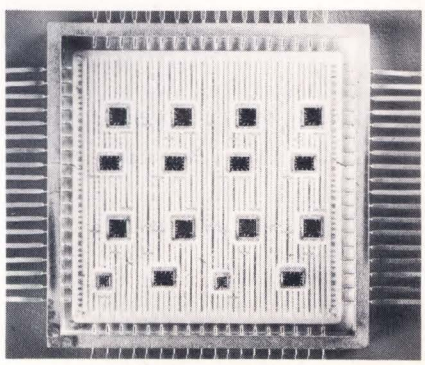
Grid Substrate Holds 40 Chips

LEXINGTON, MASS.—A method of fabricating gridded thick film substrates to hold as many as 40 IC chips has been developed by the Microelectronics Group of MIT Lincoln Labs. Reported at NEPCON by Helmut H. Pichler, the resulting substrate makes possible low-cost, fast-turnaround hybrid circuit breadboards, or even fast-turnaround production.

Key to the process was the development of a basic circuit board that reduces the time and cost of producing custom layouts for individual circuit designers. The board consists of a gold ground plane, 39 gold bottom lines, insulation and 22 gold top lines that provide 858 crossovers and 907 openings to the bottom conductor for wire bonding. This network is screened and fired on a 1- by 1- by 0.025-in, 96% alumina substrate.

For circuit arrays, dielectric pads with gold metallization are screened and fired onto the basic circuit board. IC chips are mounted either by silver epoxy or alloy preforms. Chip interconnections to substrates are made by thermocompression bonding and cut into the top and bottom conductor lines. The complete integrated array can be mounted in a 72-lead package and hermetically sealed.

Major drawbacks of the system are the limited number of chips per substrate (up to 40), number of package leads (72) and the necessity of a heat sink for high power applications.



Preprocessed Multilayer Substrates Speed Custom LSI

BOSTON, MASS.—Techniques for preprocessing multilayer substrates in order to speed production of custom LSI interconnection networks were described by Allen Chertoff, assistant chief engineer, and James Foti, manager, Microelectronics Labs. of Loral Electronics Systems at the 1970 IEEE Eastern Electronics Packaging Conference.

The techniques described are based on a single programmable interconnection network that combines the high densities provided by multilayer interconnection methods with a system of topologically structuring these multilayers. Thus, all subterranean conductive routings are predetermined and can be preprocessed (**Fig. 1**). This preprocessed substrate is customized by appropriate programming and subsequent etchback of the outer surface only (**Fig. 2**). This concept, named QTA (Quick Turn Around), results in a truly custom-universal interconnection network.

QTA has advantages that begin in design phases and carry right through breadboard, prototype and production. Flexibility offered by this concept reduces time required for system partitioning, and standardized interconnections lends it to design automation. Standardization also permits layout and artwork preparation with the same methods used for single and double-sided interconnection systems.

As many as four interconnection assembly levels can be customized simultaneously; this plays only a minor role in effecting job completion. It results in reaction times of only 2 weeks from logic equations to finished hardware.

Substantial savings in early program stages result from an order-of-magnitude reduction in tooling costs and 50% reduction in design costs. In production, recurring costs for all interconnection hardware have been reduced as much as 35% compared to conventional multilayer packaging assemblies.

Also described was a multicellular IC array containing all the interconnection capabilities above. The chip provides fast turnaround for MSI.

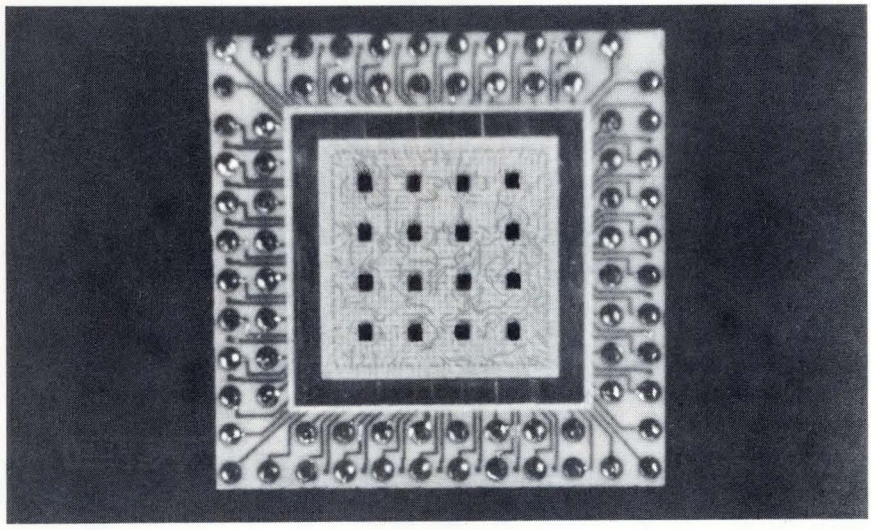


Fig. 1—**Progressive of multilayer substrate.** Substrates can be made by either of two different techniques: combinational thick and thin film on ceramic, or co-fired monolithic ceramic. In the substrate shown, four standard internal conductive layers are thick film and top custom pattern **(Fig. 2)** is thin film, vacuum deposited through a mask. Final preprocessed substrate at bottom is stocked, waiting attachment of MSI/LSI arrays and custom interconnection pattern.

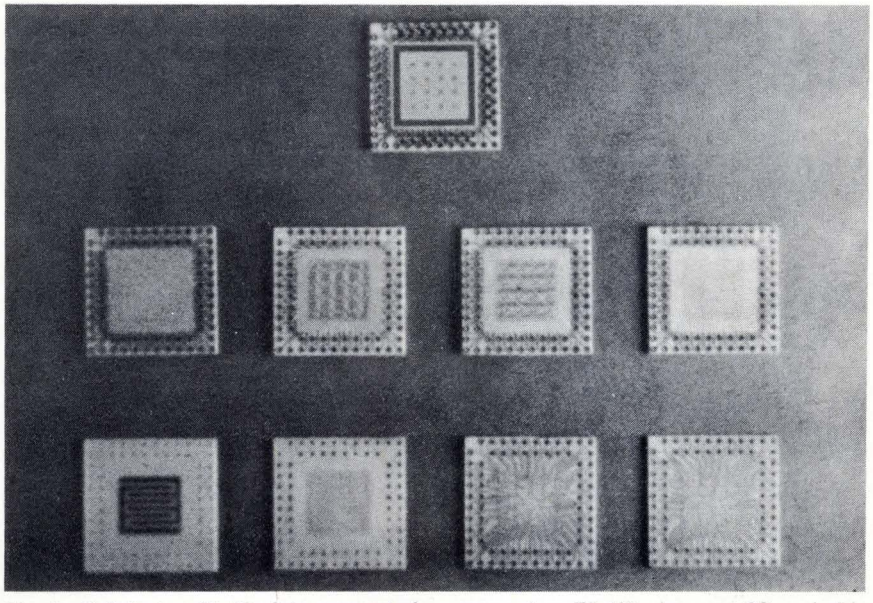
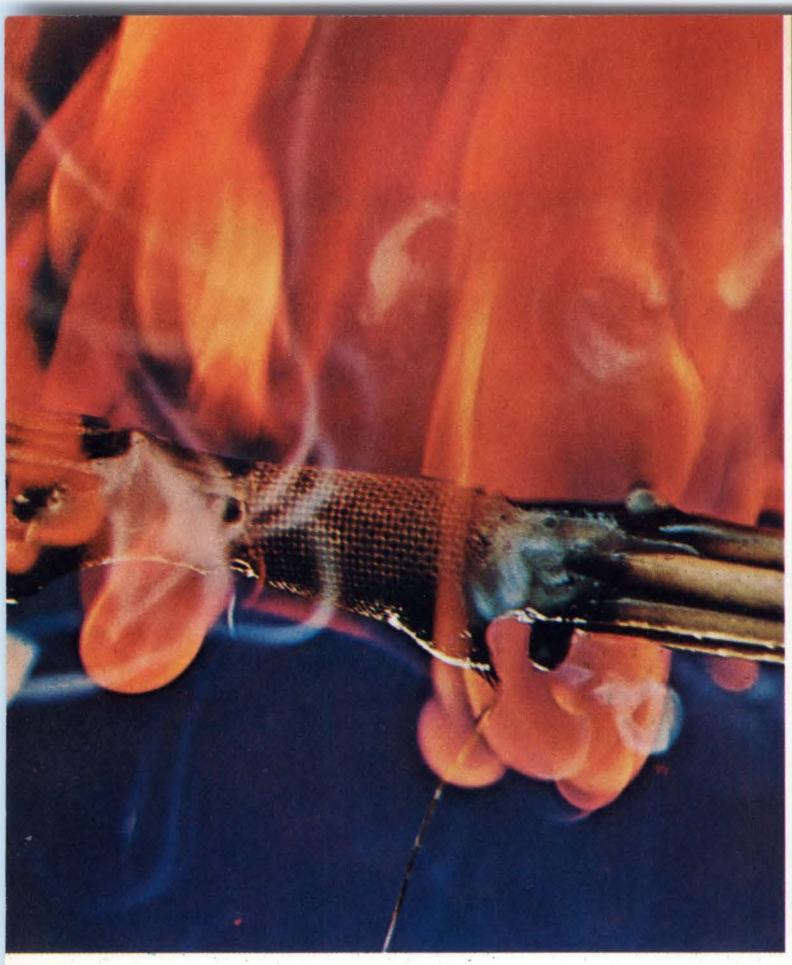
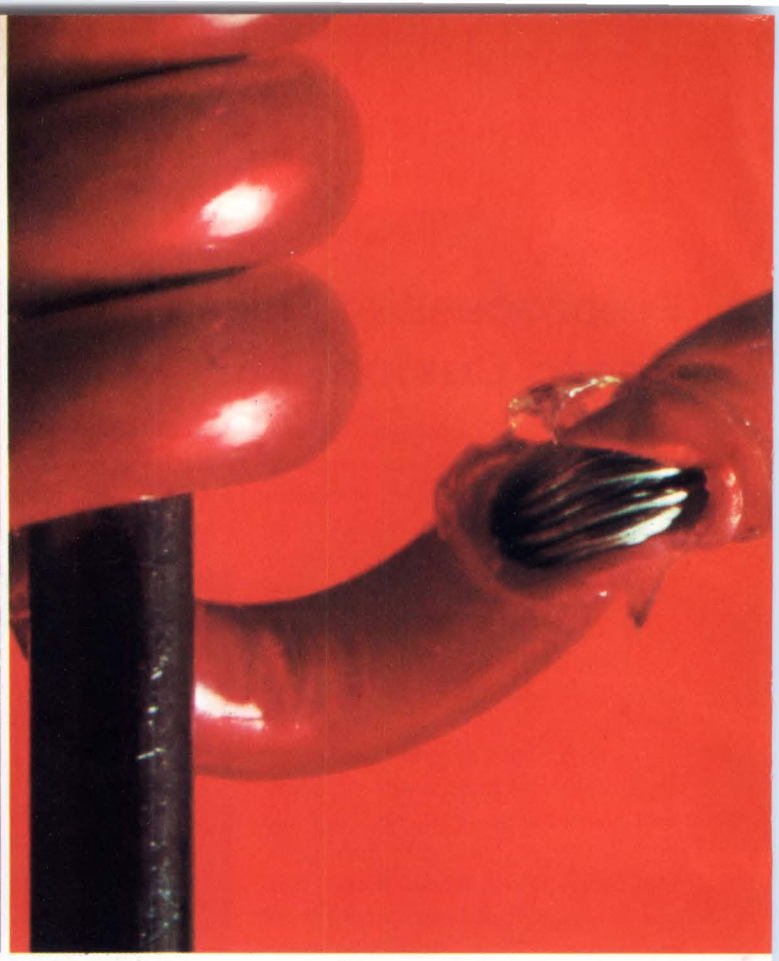


Fig. 2—**Substrate with ICs interconnected** with top surface customization programming subterranean conductor routings. This production **LISA** holds up to 16 MSI arrays, has 75 I/0 pins and 28 probable test points. A Kovar cover is attached to metallized outer ring to complete the hermetic package.





In a world where things

like this can happen–

it's a good thing there's TEFLON.

Wire insulation of TEFLON: You can install it and forget about it. You can forget about the hazard of flammability, the hazard of embrittlement or stress cracking under thermal aging, the hazard of solder-iron damage during installation, the hazard of heavy smoke emission under electrical overloads.

You can count on this unbeatable combination of protective properties . . . and on superb electrical properties that remain unchanged over a wide range of temperatures and adverse environments. You can count on unsurpassed resistance to corrosives and chemicals. In composite constructions you can get whatever extra resistance to cut-through and abrasion you may need.

Consider insulation of TEFLON for any electrical, electronic or aerospace application that calls for reliability and dependable performance. Ask your wire and cable supplier about the type and construction that best meet your needs. For specific information, write us, mentioning the application you have in mind. Address: Du Pont Company, Room 8745 I, Wilmington, Delaware 19898.

DU PONT REG. U.S. PAT. OFF. **TEFLON®** fluorocarbon resins

CIRCLE NO. 12

Two Computers Are Cheaper Than One

NEWTON, MASS.—It may sound far-fetched, but in actual practice, it costs less to operate two minicomputers that manage separate high-speed data handling devices than to have one very large computer do the same work.

"Data Processing Elephant", the general purpose on-line business management information system recently announced by Telefile Computer Corp., stores over 500-million characters of information and can handle up to 56 terminals at virtually the same time, each terminal with its own different user application—at half the cost of doing the same thing with one large computer.

Besides gobbling up huge bits of information, the system also goes a step in the right direction and removes the customer from system architecture. The software for system operation is designed in, so that the user need only develop his specific application program in real-time COBOL.

Clever system design is the basis for such extravagant claims. It is divided into three sections: a communications link that can handle up to 200 lines, an execution module that can effectively execute up to 56 different user programs plus four secondary batch-processing programs and a file module that can store over 500-million characters.

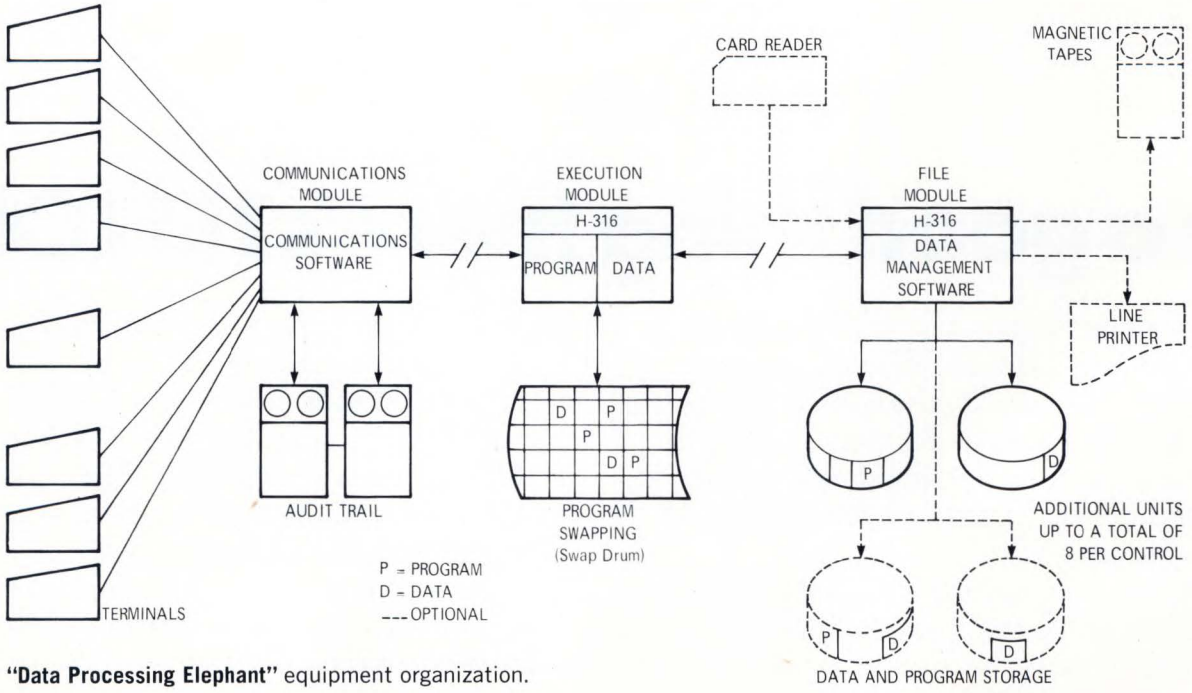
The key to success is two Honeywell H-316 minicomputers, each managing a high-speed data device; one a swap drum operating at 176,000 bytes/s and the other a disc file running at 312,000 bytes/s.

Basically, the swap drum is a time-sharing device that constantly rotates each active user program through core at a given rate (6-1/2/s). What it does is to distribute processing power among active programs by granting each a segment of execution time called a *quantum*. A program will cease to execute when it reaches the end of its assigned *quantum*, or because some condition dictates termination of the *quantum*. The program then shifts to a "wait" status, and the control passes to the next active user program waiting for processing. However, the swap drum and computer work at such a speed that each terminal seems to be serviced separately.

The file module, consisting of a high-speed disc file and the second H-316, provides on-line storage of user's data and programs. If a terminal calls for data not in the swap drum, it will be transferred to the swap drum from disc and then processed on the next cycle.

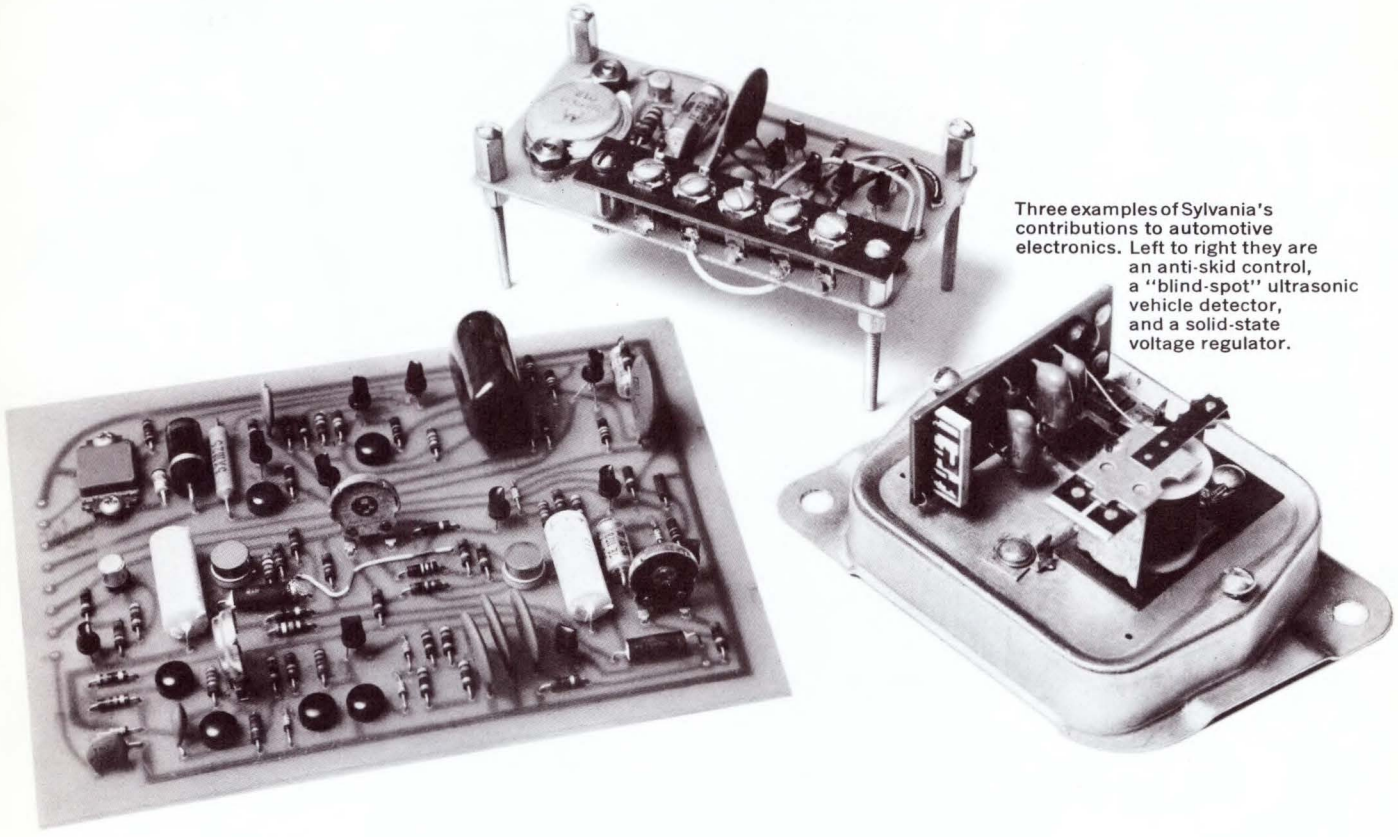
Four batch programs on the swap drum are used to handle batch processing whenever any part of the on-line system is idle. Inputs for batch processing can be optional card readers, magnetic tapes, or additional disc storage.

Terminals run the gamut from a standard "Teletype" to the new Viatron System 21.



"Data Processing Elephant" equipment organization.

Component and Circuit Design **IDEAS** FROM SYLVANIA



Three examples of Sylvania's contributions to automotive electronics. Left to right they are an anti-skid control, a "blind-spot" ultrasonic vehicle detector, and a solid-state voltage regulator.

CIRCUIT MODULES

Zeroing in on transportation electronics.

Our new development laboratory, geared specifically to transportation electronics, is closely tied in to our high-volume production facilities.

One area of great potential for the electronics industry is the transportation systems field. Trucks, subway trains and passenger vehicles are foremost in this area.

Our new Wakefield Development Laboratory facility has been set up with the specific charter of meeting these needs from system concept to volume production.

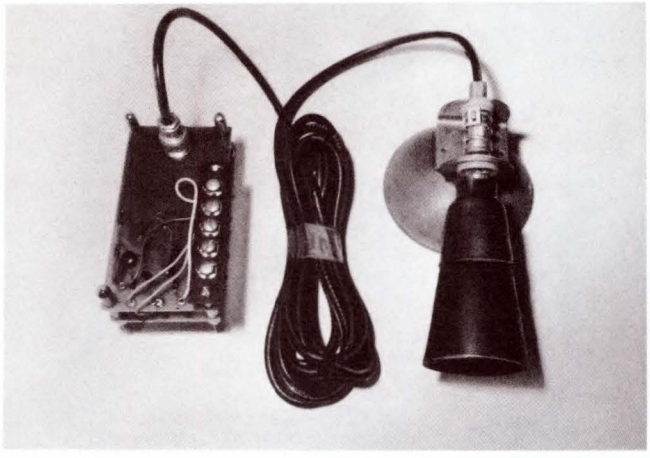
Today's automobiles are using more and more electronics, and over 100 potential electronics applications have been identified. As of now, more than twenty functional systems are either in use or are undergoing field testing. These range from clocks, turn signals, voltage regulators and automatic temperature controls to electronic fuel injection and anti-skid braking systems.

Other potential applications include electronic monitoring units for oil, water and fuel levels, electronic ignition, electronic speedometers and, eventually, total electronic control by a small on-board computer.

So far, in its short existence, the Wakefield Laboratory has come up with a number of interesting practical systems for cars, including an ultrasonic "vehicle" detector, an anti-skid control system and an electronic voltage regulator.

The ultrasonic "vehicle" detector was designed to meet the requirements of a large automobile manufacturer. System requirements were tough. Wanted was a system that would detect vehicles in the blind zones within 30 feet of the rear of the car and would cover an area

This issue in capsule



Passive ultrasonic "blind-spot" detector with directional horn.

only slightly larger than a single lane. The system had to ignore such things as tunnels, fences, signposts and billboards while also being impervious to rain, snow, dust, salt, shock and vibration over a broad temperature range. On top of that, the system had to be inexpensive.

Our Wakefield engineers investigated radar, active ultrasonic and infrared approaches and discarded them because of their inability to discriminate. A simple active system cannot distinguish between a real target vehicle and a stationary object.

Needed was a system that could respond to a characteristic inherent in the operation of a moving vehicle. The characteristic we picked was noise. We decided on a passive ultrasonic detection system to give us control over range and directivity as well as discrimination. The system, illustrated in the diagram and photograph, responds only to those sounds generated by a moving vehicle, such as its engine and tire noise.

With a detector horn mounted in each rear taillight assembly, a vehicle approaching from either side will cause a small bulb to light on the appropriate side of the rearview mirror.

To avoid nuisance display in bumper-to-bumper traffic, the system is designed to respond only at speeds above 35 mph, which makes it especially useful in high-speed traffic on multiple-lane expressways.

We can't claim original design for the anti-skid systems we've made, but we can claim fast delivery and drastic system improvement. One customer brought us a six-card, 600-component, hand-wired, prototype of his anti-skid system. He needed the six cards in printed circuit form within three months. Our elapsed time, from receipt of schematics to delivery of hardware, was only two months.

Now this same customer has asked us to redesign and cost-engineer his original system. With this effort nearing completion, it appears that we will have reduced the component population by 30% and the system cost by 50%.

Another customer requested redesign and cost engineering of their anti-skid module. Within three months, component population was halved and cost was cut by two-thirds. This same customer has now requested assistance in the basic design and engineering of a more advanced system.

These examples highlight the technical competence and fast response this group offers to serve our customers.

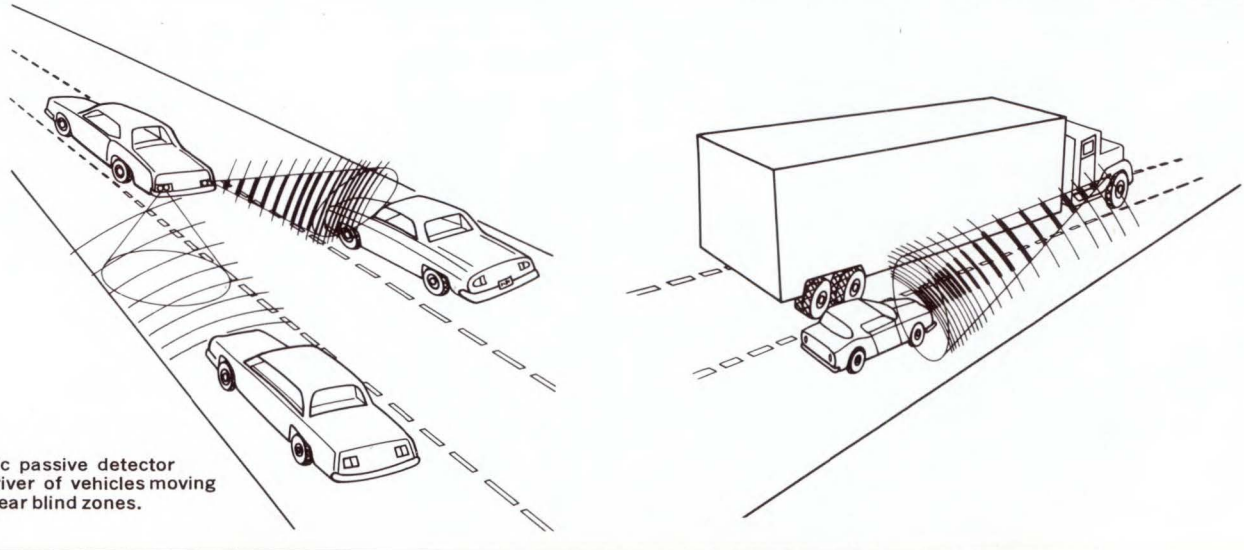
Although electronic voltage regulators are not new, most existing ones have drawbacks. The electromechanical regulator has proved unreliable and just can't carry the higher field currents of the newer, more powerful alternators. Regulators using germanium transistors require extensive finned packages for heat sinking and still won't take present underhood temperatures. Microcircuits have not been able to meet the severe automotive environment and be cost competitive.

In addition, all previous solid-state regulator designs were subject to catastrophic failure if the battery was disconnected while the engine was running. This could happen during routine servicing or as the result of a loose battery cable.

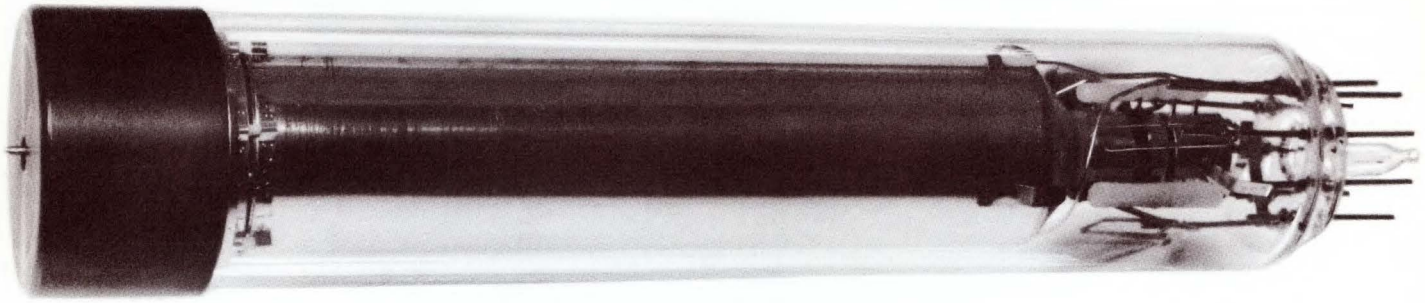
Our design is able to withstand the transients caused by battery disconnect. In addition it has passed severe testing in the field and is going into volume production.

These are only a few of the new developments that are coming out of our Wakefield Lab and entering production at our custom module facility. If you need an electronic system for anything that moves on tracks, road, water, or in the air, we've got the people who can design and produce your system at the lowest cost and with the shortest lead time.

CIRCLE NUMBER 300



Ultrasonic passive detector warns driver of vehicles moving into the rear blind zones.



CRTs

Silicon target storage tube gives high resolution.

Mosaic target of silicon oxide storage islands provides resolution better than 1,000 TV lines/diameter with high writing speed and long retention times.

A new 1½″ silicon mosaic target storage tube, developed by our Advanced Technology Laboratory, is ideally suited for scan conversion, video frame storage, computer output buffers and display refreshing. It may be selectively updated, thus requiring only that changes in information be transmitted from the source. Low speed transmission systems, such as those for facsimile printers, can advantageously use this device. The tube will find applications in many information processing and data display systems.

Advantages of the new 1½″ silicon storage tube include: resolution of better than 1,000 TV lines/diameter, retention times of over 15 minutes with gray scale capability, high writing speeds, and low cost. Images can be held for several days or longer with the beam turned off.

The structure of the tube is shown in the diagram. It is similar to a magnetically focused and deflected vidicon. The storage target is a mosaic of insulating SiO_2 islands, as shown in the photograph. In operation, a charge pattern established on the islands during writing is used to control the landing of the primary beam current at local areas during reading.

During the erase cycle the target is held at +15V and scanned. The beam charges the insulating islands to cathode potential (0 V), since the secondary emission ratio is less than one. The charge storing islands are now at —15V with respect to the n-type substrate.

For writing, the target is held at +250V, and the beam current is modulated by applying the signal to control grid G_1. Where the beam strikes, the high-energy incident electron beam creates a secondary emission ratio greater than unity. Thus, the islands become less negative in proportion to the beam current striking them. Islands not struck by the beam remain at —15V with respect to the substrate.

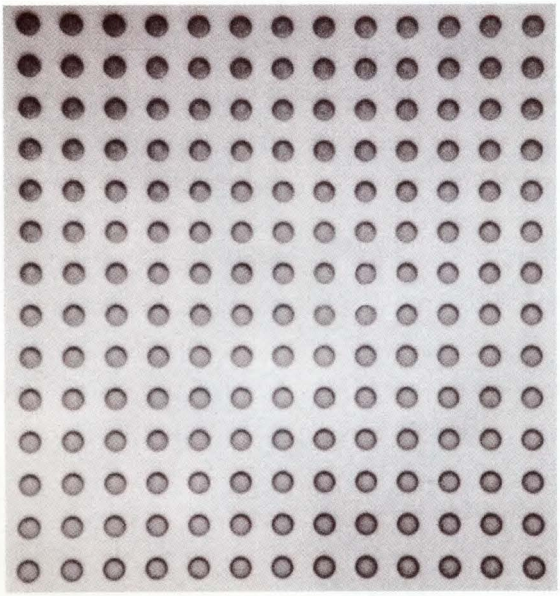
In the readout mode, target voltage is reduced to +5V. With respect to the beam potential of 0V, the oxide islands will range from —10V (if not written upon) and will approach 0 V (if maximum "white" signal was applied to G_1).

The reading beam is split into two components: i_r current "reflected" to the collector mesh, and i_l, the current landing on the substrate. The landing current, i_l, through the output resistor, provides the required output signal.

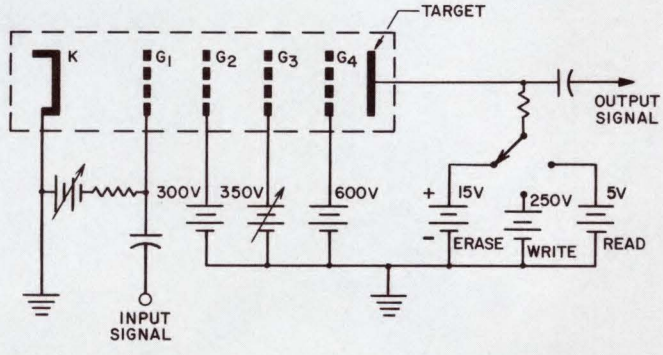
Since the reading beam is prevented from landing on the islands because of their negative potential relative to the cathode, the target can be scanned repeatedly without appreciable deterioration of the stored information. Operation is possible with both conventional raster scanning, or random X-Y addressing.

Our 1½″ silicon mosaic storage tube is now available in prototype form. We are presently designing complete storage modules to meet specific customer applications. These will be self-contained units requiring only an input signal and line power.

CIRCLE NUMBER 301



Enlarged section of silicon mosaic island pattern.



Circuit diagram of silicon mosaic target storage tube.

INTEGRATED CIRCUITS

How to design a character generator for ASCII address decoding.

Here's how to use read-only memories as code converters for addressing a memory containing the 64 characters of the popular ASCII code.

In a typical character display using a 5 x 7 pattern, as shown in Fig. 1, each character is made up of 5, 7 or 8-bit words. There are available so-called character generators with bit patterns for storing the alphabet, numerals and other characters. Actually they use 256-bit read-only memories (ROM) containing 32 eight-bit words with binary addresses from 0 to 32. Numeral 1 would be stored in locations 0 to 4 and numeral 2 would be stored in locations 5 to 9, etc. Thus, to generate the numeral 2, a binary 5 is used as the starting address and is positively incremented four times by one until the value reaches nine.

These ROM's would be very easy to use if the code for 1 is 0 and the code for 2 is 5. However, most codes do not follow this pattern. In fact, there is an unlimited number of address codes that can be used for character generation.

One of the simplest ways to overcome this problem is to use additional ROM's as code converters. Here is a simple method for applying this technique to the popular ASCII code.

Figure 2 shows the ASCII code with its associated characters arranged in ascending numerical order without regard to the most significant character of the code. Also, for this discussion each character will be stored in five adjacent locations in a memory which must be large enough to handle the full 64 characters. Thus, 64 x 5=320 storage locations must be available which can be provided by ten 32 x 8 ROM's.

The ASCII code is converted to binary numbers which incremented by five for each unit change in the ASCII code. This conversion can be done in two ROM's where the five lower order bits of ASCII are used as the address and the sixth bit is used to select which ROM's are used.

For example, the six-bit value in ASCII for the letter A is 000001 which will decode to 00000101, or five, while the letter B, 000010, will decode to 00001010 etc. The eight bits from the decoder ROM's are then preset into a counter whose output is used to select the locations in the 320 x 8 bit memory. Four clock pulses can then be added to the counter to advance the character generator through the five desired locations. Figure 3 shows the logic to do this.

This technique makes optimum use of the character generator for all locations that are used. That is, although each ROM contains 32 locations or can store 6-2/5 characters, the 2/5 of a character can be used. This means that some characters are split between ROM's but only 10 ROM's are required instead of 11 for the character generator.

This method is very straightforward but a reduction in logic can be achieved by putting some constraints on the character locations in the character generator.

An examination of the least significant bit of the ASCII code shows that one-half of the characters have an even-number code and the other half have an odd-number code. This would imply that it is only necessary to decode

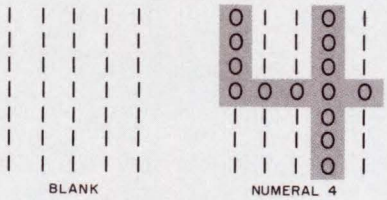


Fig 1. Typical ASCII address for numeral four.

300	@	320	P	240	SPACE	260	Ø
301	A	321	Q	241	!	261	1
302	B	322	R	242	"	262	2
303	C	323	S	243	#	263	3
304	D	324	T	244	$	264	4
305	E	325	U	245	%	265	5
306	F	326	V	246		266	6
307	G	327	W	247	'	267	7
310	H	330	X	250	(	270	8
311	I	331	Y	251	)	271	9
312	J	332	Z	252	*	272	:
313	K	333	[	253	+	273	;
314	L	334	1	254	,	274	<
315	M	335	]	255	-	275	=
316	N	336	↑	256	.	276	>
317	O	337	←	257	/	277	?

Fig. 2. ASCII code and its numerical equivalents.

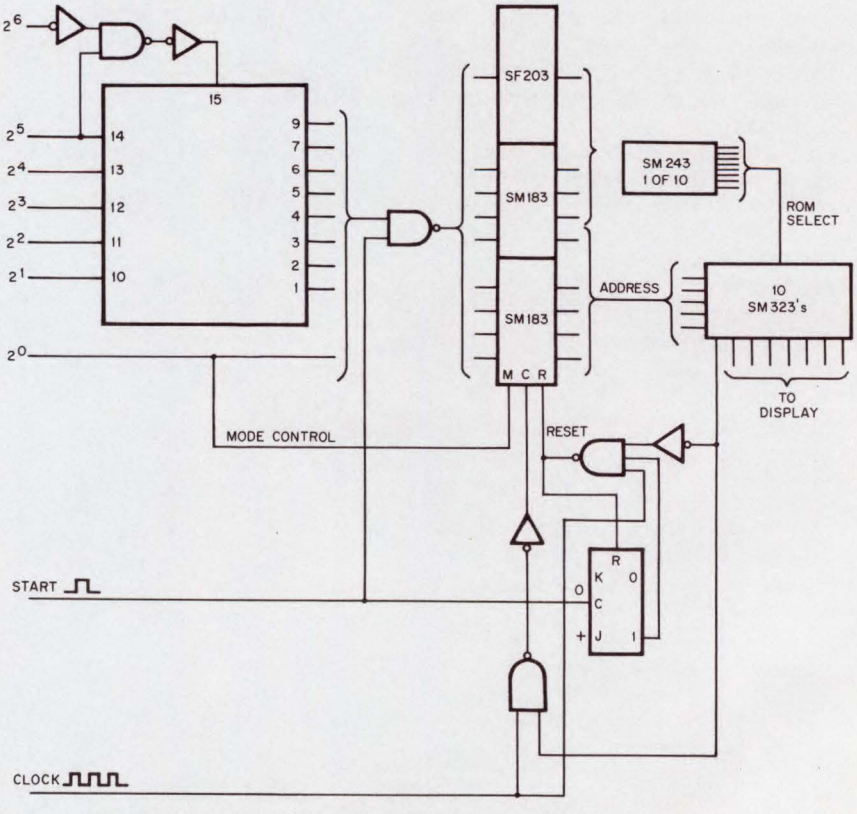


Fig. 3. Logic system for decoding ASCII code using ROM's.

32 values of the ASCII code if in each pair of characters one will start in an odd location and the other will start in an even location. Since each ASCII character requires five locations in memory, adjacent characters will always have one even and one odd address.

For example, B has an ASCII code 02 and C has a code of 03. If B has a starting address of ten and C has a starting address of fifteen, then one is even and one is odd. However, the remaining bits of the address are not the same. This problem is easily overcome if B has a starting address of fourteen, 1110, and the address counter counts down to ten on four count pulses, and if C has a starting address of fifteen, 1111, and the address counter counts up to nineteen on the four count pulses.

Figure 3 also shows the logic to do this where bit 2^0 controls the mode of the up/down counter. In addition if a 5 x 7 format is used for each ASCII character, then the eighth level or line can be used to control the count pulses. This is also shown in Fig. 3 where, for the letter B with a starting address of 14, there will be a one stored in the 8th line for locations 14, 13, 12, and 11 which will enable clock pulses to the up/down address counter. The eighth line for location 10 will have a zero stored in it which, when inverted and NANDed with the clock, will reset the address counter to zero and reset flip-flop A. Since the zero location in memory will contain a zero in the 8th line, it is necessary to inhibit additional reset pulses to the address counter to avoid a race condition. Flip-flop A does this function and holds the character generator in the "off" condition until the next start pulse. The gating to the chip enable for the address decoder is to inhibit the character generator for commands such as tab, line feed, return, etc.

This technique of address decoding for ROM's and also for random access memories can be used where more than one word out of a memory is required for a given address. If, for example, one address is to call out four successive words, the first address could call location four in the memory and then count down to one while the next address could call out location five and count up to eight. In this case the zero location of the memory would not be used but the simplified decoding would more than justify this method. It is not necessary that each address call out the same numbers of words, or sets, to use this method. However, the starting address for each set in a pair must only differ by one.

CIRCLE NUMBER 302

HYBRID MICROCIRCUITS

Interface circuits solve TTL-to-MOS matching problems.

Translating current-oriented TTL outputs to voltage-sensitive MOS inputs is a job that hybrid circuits can easily handle.

One of the main advantages of hybrid microcircuits is design flexibility, and one of the major places where this flexibility is of value is in interfacing between two different types of logic systems. Translating between TTL and MOS circuitry is one important place this flexibility can be used.

For example, our MS-303 interface driver, shown in Fig. 1, will accept a TTL input and translate it to a signal capable of driving MOS circuitry with output currents of +500 mA with voltage swings of up to 30 V.

Figure 2 shows the MS-303 with the external circuitry required to give two typical rates of t_{on} and t_{off}. If these don't meet your needs, we'll be glad to help you design a circuit that will.

And that is one of the advantages that we offer in hybrid circuit design. If you can't meet your requirements with our off-the-shelf devices, we'll be glad to give you a custom design that will do the job. Don't let the phrase "custom design" turn you off. Because we know these circuits inside out, we can make a custom design at a cost comparable to off-the-shelf designs.

Another hybrid microcircuit that can solve interface problems is our MS-302 dual-phase clock driver shown in Fig. 3. By connecting external capacitors, you can control clock pulse widths over a wide range. Figure 4 shows two typical configurations and the table shows the circuit characteristics operating at two different frequencies using different values of capacitance.

Like all Sylvania hybrid microcircuits, these units are available to meet both industrial and military specifications. They use thick film and hybrid techniques and are packaged in hermetically sealed enclosures for high reliability.

Of course, neither of these circuits may solve your interface problems, but don't let that worry you. We have off-the-shelf designs, but we know how to customize them at minimum cost. If you have an interface problem, we're willing to face it.

CIRCLE NUMBER 304

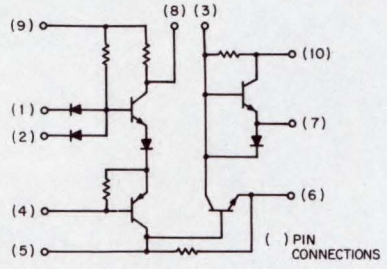


Fig. 1. Basic circuit of MS-303 interface driver.

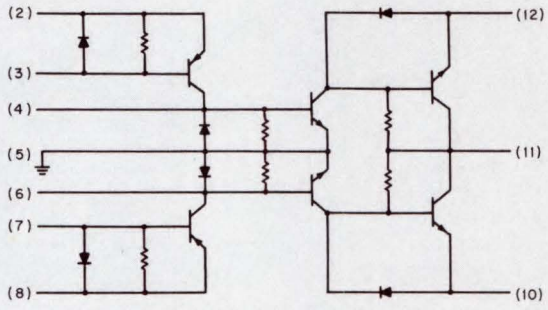
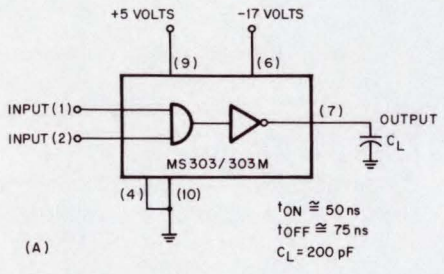


Fig. 3. Circuit of MS-302 dual-phase driver.



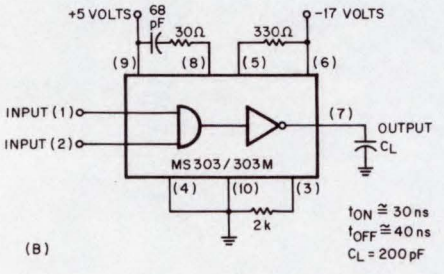


Fig. 2. External circuitry for MS-303 for different operating speeds.

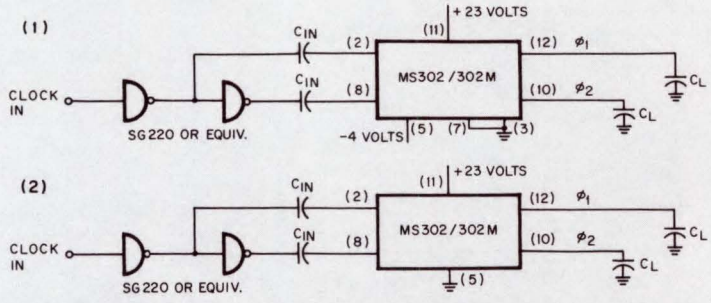


Fig. 4. Two configurations for using MS-302 dual-phase driver. Table shows typical characteristics for both configurations using specific values for frequency and capacitance.

	Configuration 1		Configuration 2	
	Condition 1	Condition 2	Condition 1	Condition 2
t_r (ns)	77	30	59	23
t_f (ns)	55	21	41	17
t_d (ns)	50	27	41	22
t_{pw} (ns)	440	134	363	125
Power (Mw)	815	495	680	444

Condition 1, f=0.5 MHz, C_L=1000 pF, C_{in}=2200 pF

Condition 2, f=1.0 MHz, C_L=200 pF, C_{in}=600 pF

MICROWAVES

We're bringing beamleads to microwaves.

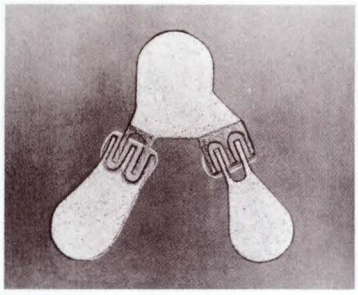
Our full family of beamlead devices offers a lot of advantages to designers of microstrip circuits.

Capacitors, tunnel diodes, PIN diodes and Schottky diodes are now available from Sylvania in both beamlead and chip form.

The SC-9001 beamlead capacitors are high-temperature thermally grown, silicon devices. Their very high Q and small size makes these devices ideal for microwave applications. Units are available in a capacitance range from 0.5 to 100 pF at 1 MHz.

The beamlead tunnel diode family, DTB-5724, 5725, is designed for use as low-level amplifiers and oscillators in microstrip systems. They are also used in satellite and phased-array antenna systems. The tunnel diode, itself, consists of a circular, passivated, germanium substrate with two metal leads. The lengths of the leads are different to allow identification of the cathode as the shorter lead. Overall length is 30 mils and the substrate is 8 mils in diameter. The cathode beamlead contributes less than 0.1 pf to the total capacitance.

Our beamlead microwave PIN diodes are essentially voltage-dependent variable resistances, which makes them valuable for switching, limiting and controlling microwave power. The D5840 PIN diodes are surface-oriented beamlead silicon devices consisting of a p+ type and an n+ type separated by an intrinsic layer. Breakdown voltage is 60V, and forced minority carrier lifetime is typically 15 ns. The graph shows change of resistance with forward current for a typical PIN diode.



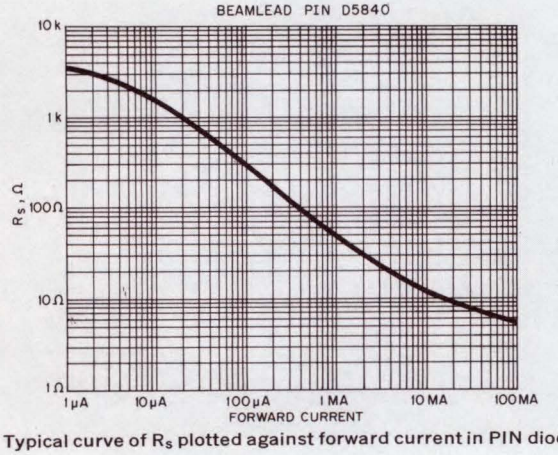
Photomicrograph of dual Schottky diode.

Beamlead Schottky diodes are available in three frequency ranges: S-band, X-band, and K_u-band. Although used primarily as mixers, Schottky diodes can also be used as detectors, modulators, low-power limiters and high-speed switches.

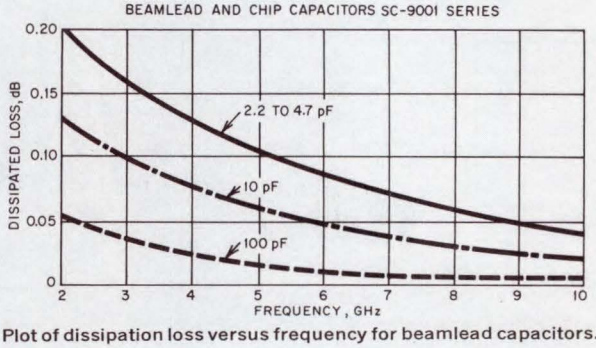
Our beamlead Schottky diodes are made by depositing a suitable metal on an epitaxial silicon substrate to form a junction. The process and choice of materials results in low series resistance, and a narrow spread of capacitance values for close impedance control. These devices also feature a low forward-voltage knee which makes possible efficient operation at low local-oscillator drive levels, or for low-level detection.

All of these beamlead microwave devices are also available in mounted or unmounted chip form. We have the most complete line of microwave beamlead and chip device diodes in the industry. So why look further? Just talk to us.

CIRCLE NUMBER 305



Typical curve of R_S plotted against forward current in PIN diode.



Plot of dissipation loss versus frequency for beamlead capacitors.

MANAGER'S CORNER

A philosophy for the future of cable communications.

Cable television is a booming industry. At the present time there are over 2,000 systems in operation and an equal number under construction. In addition, there are over 2,300 applications under consideration in various cities throughout the United States.

All of this means big business for cable equipment suppliers, but it poses problems for the equipment buyers. The problem is not what type of equipment to buy for operation today, but what type of equipment to buy that will be usable in the future.

And the future of cable television is as exciting as it is unpredictable. Visionaries of the industry predict completely wired cities with all television programming coming over cable. They see the next logical step as interconnection of the wired cities to form a network throughout the nation. With this growth they predict an expansion of the use of cable television beyond the usual entertainment programming. Data transmission, facsimile transmission, educational and special interest programming (such as courses for doctors) are among the exciting possibilities of the future.

For the CATV operator, all of this means that the future will demand greater channel capacity. And that is where the Sylvania design philosophy comes in. We have designed our complete line of cable TV electronics, amplifiers, directional couplers and baluns, to meet the needs of the future. All of these units are broad spectrum equipment, covering the entire range from 50 to 270 MHz with "hands off" total automatic control. For bi-directional service, the Sylvania equipment also covers the sub-VHF 6 to 30 MHz band.

This broad spectrum capability means that Sylvania equipment won't have to be replaced to meet the changing needs of the future. Regardless of the future direction cable television may take, you can be sure our equipment won't become obsolete.

Our Components Group is applying this same advanced engineering philosophy in the design of other equipment for cable television. You can get the cable system of tomorrow from Sylvania, today.

J.L. Dangremond
Product Marketing Manager, CATV-Special Products.

E5

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Lunar TV

Briefcase-sized communications system which could permit full-color television coverage of the Apollo Lunar Module lifting off from the moon is being developed for NASA by RCA. The portable Lunar Communications Relay Unit (LCRU) will transmit voice, telemetry and color TV from moon-walking astronauts and receive transmissions from earth, without the signals being relayed through the lunar module. With a TV camera, the system could provide "live" color views of the LM's lunar blast-off for earth audiences. The $2.4 million development contract also contains options for production units.

Collision Avoidance

Preliminary design of a unique, low-cost collision avoidance system for aircraft ranging from crop dusters to the largest commercial and military planes has been demonstrated in the laboratory to be feasible, and the total concept has been proven through computer simulation, says Irving K. Kessler, executive vice president, RCA Defense and Commercial Systems. He said the system will offer three compatible equipment configurations fitted to varying operational requirements and cost. The simplest version is expected to be priced between $500 and $1000. Designated SECANT, for Separation Control of Aircraft by Nonsynchronous Techniques, the system works this way: All SECANT-equipped aircraft within range of one another exchange radio signals. By measuring characteristics of signals received in response to its interrogations, an aircraft can determine when a collision threat arises. Each SECANT aircraft would have a remitter, a combination transmitter-receiver, which would continuously transmit interrogating probes and reply to probes from other aircraft. A signal processor separates valid signals from spurious ones. The only valid signals to a SECANT aircraft are those received in response to its own probes. However, a remitter would receive and respond to signals triggered by all aircraft in its range. Therefore, the processor performs the vital function of identifying the valid signals and thereby preventing the sounding of false alarms.

Clean Machine

A combination of ultrahigh vacuum and a moderately low temperature may offer an attractive solution for decontamination of unmanned spacecraft. An experiment conducted by The Boeing Co.'s biotechnology organization indicates there is a critical temperature between 12 and 39°C (59-102°F) which can kill up to 90% of the microbes present in an ultrahigh vacuum. Experimenters evaluated reducing a spacecraft's germ population with solar radiation, space vacuum and spacecraft temperatures experienced during interplanetary cruise.

Color Camera Automates

An automatic color television camera announced by Marconi Communication Systems Ltd. eliminates tedious manual alignment and color balancing and subsequent adjustments by a miniature computer built into the camera channel. It is reputed to be smaller, lighter and more mobile than any other broadcast quality color camera, and it incorporates a first-line fault-finding capability.

Technical advances include use of only three pick-up tubes to ensure minimum size and weight. With the automatic registration and equalized color lag, they give the performance associated with four tube cameras.

The camera is designed to use new versions of the English Electric Leddicon camera tube which incorporate features to overcome the problems of 'lag' smears on fast moving objects, and uncontrollably burnt-out highlights. It can also use the Philips Plumbicon tubes which are already in wide use.

The tube deflection coils are constructed in the form of printed circuits on cylindrical glass tubes, to provide greater accuracy and stability in the registration of the pictures from the three camera tubes.

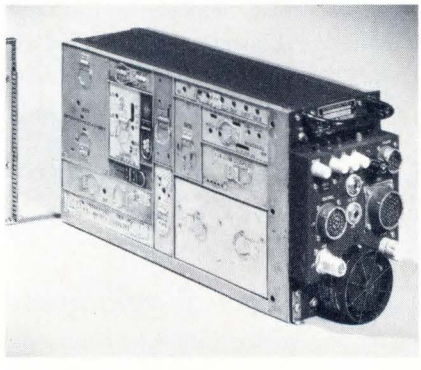
Laser Rangefinder

Portable, lightweight laser rangefinder, accurate within 3 ft at distances up to 3 mi has been delivered by Kollsman Instrument Corp. to the Naval Training Device Center, Orlando, Fl. to be field tested by the Marine Corps.

The system consists of an optical unit, which is operated from the shoulder, and a belt pack, which contains batteries, power supplies, control circuits and a time interval counter. The latter component produces the range readout by measuring the interval between the transmission of the laser pulse and its return from the target. The readout is provided to the operator in approximately three-quarters of a second from the time of pulse transmission.

Down Time Cut

A new family of ultra reliable UHF radio sets, developed for the U.S. Air Force by Electronic Communications, Inc. (ECI) of St. Petersburg, Fla., is designed to dramatically reduce flight line maintenance and greatly lessen logistic support requirements. A spokesman for ECI said mean time between failures is approximately 10 times greater than that of previously available military UHF radio equipment. All-solid-state with extensive use of microcircuitry, they are electronically tuned and are designed with replaceable modular subassemblies and built-in confidence check capability. Both the ARC-145 and ARC-151 have 25-kHz channel spacing, effectively doubling the number of usable channels in any given frequency range.



Thin is Beautiful

A very sharp interface between substrate and epitaxially deposited layers has long been considered essential for achieving reproduceability and optimum electrical characteristics in thin layer (1-10 μm) devices like voltage variable capacitors (VVC), IMPATT diodes, microwave transistors, and pressure-sensitive devices.

Silane epitaxy is one attractive method recognized by American and Japanese manufacturers to achieve the above conditions; however, since silane is spontaneously inflammable, the process is potentially dangerous, and most manufacturers have reverted to a less satisfactory but safer chlorinated silicon source.

As part of its program to mass produce ion-implanted VVCs (EDN, June 1, 1970), KEV Electronics Corp., Wilmington, Mass., developed an expertise in silane epitaxy and is now making silane deposited epitaxial wafers with uniformly thin deposits and hyperabrupt interfaces. First shipments of wafers ranging from 1-1/4 to 2-in diam have been made to semiconductor producers including Sylvania and GHz Devices.

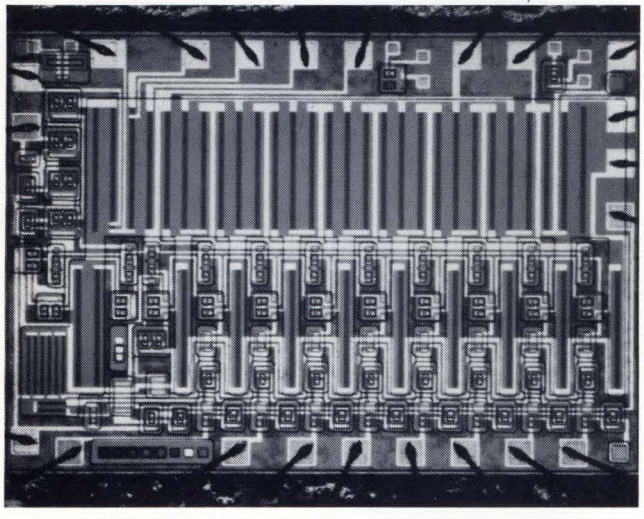
School Lab Hazard

HEW has put a regulation into effect setting maximum X-ray emission level for certain electronic tubes used in high school and junior college science classes. One type of tube is used to demonstrate the phenomenon of X-rays. The other is used to demonstrate scientific principles, such as the ability of electrons to produce heat, and is not intended to emit X-rays.

Microwave Ovens

Microwave cooking ovens will be given pre-production checks for radiation emission potentials under a cooperative testing agreement between HEW and the FCC. The tests will permit possible radiation problems to be called to the attention of oven manufacturers before new models go into production. Tests will be made by the HEW Environmental Health Service's Bureau of Radiological Health in a Federal Communications Commission laboratory at Laurel, Md. The FCC already tests prototype microwave ovens there to keep interference to communication devices low. Recent surveys showed some microwave cooking ovens emit radiation above the voluntary industry standard of 10 mW/cm^2.

THE ONLY 8-BIT GUARANTEED MONOLITHIC D/A



- Guaranteed performance from −55° to +125° C.
- Incorporates an internal resistor ladder network on the same chip.
- Operates in bipolar, unipolar positive or unipolar negative modes.
- 1 μs typical settling time to ±½ L.S.B.
- $82.50 in quantities of 100 to 999.
- Available off-the-shelf in 24 lead dual in-line or flat-pack packaging.

Do we mean "guaranteed?" You bet we do. The RI-1080 has its own thin-film resistor ladder network built right on the same IC chip as the bipolar switches. Without that, any guarantee would be meaningless. With it, the RI-1080 is the only D/A converter that has a guaranteed 8-bit performance over the entire military range from −55° to +125° C.

Not only that, but by using current-mode switching, the converter ladder bus can be returned to voltages off-ground for high versatility. Current switching reduces ringing in output and reduces power-supply transients. The converter is capable of conversion rates in excess of 10^6 words/sec. Just check our specs with any other D/A — monolithic or hybrid — and we think you'll agree that the Radiation RI-1080 offers the *best price/performance on the market.*

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CIRCLE NO. 20

PLATED WIRE STICKS ITS FOOT IN THE DOOR!

Plated wire is the material for aerospace memories, states William A. England, head of memory system engineering at Honeywell's Aerospace Div.—Florida. It's unbeatable for its properties of nondestructive readout (NDRO), compatibility with MSI and tolerance of nuclear radiation.

Noting that plated wire was used in both Poseidon and Minuteman III missile computer memories, England foresees its rapid acceptance for aerospace computer memories ranging from small, high-speed scratch-pads to medium-speed main-frame and slower mass memories.

He bases his prediction on several interlocking trends and developments. (1) Complete compatibility between the latest 2-mil-diam "Mini-wire" memories and MSI circuitry. (2) Plunging prices of MSI. (3) Improvement of plated-wire lifetime expectancy to decades instead of years. (4) Dramatic increases in production yields as a result of in-process testing. (5) Shrinking memory-system size, weight and power when 2-mil-diam wire is used.

Because some early plated-wire houses did not exercise sufficient in-process control, their production yields were disappointing and the product suffered from shorter-than-needed lifetime expectancy. However, plated wire has such useful inherent qualities that it is bound to win out. Its prime virtue is that it provides nondestructive readout (NDRO), but some of its other assets such as nonvolatility and parameter stability over a wide temperature span are mighty important.

Military requirements dictate that memories and other equipment operate reliably over wide ranges of temperature, humidity, vibration and shock. Space vehicle applications impose additional severe constraints on volume, power consumption, and reliability. Add to these already-strict requirements the possibility that such equipment may have to face a nuclear environment, and you have a really tough set of specs to meet. Faced with any of them, a memory not only must survive, but also must retain its information. Plated-wire elements and their associated system parameters become very attractive for these environments. Because no flux switching takes place during the read or interrogate mode—eliminating the need for a rewrite cycle—these elements can provide high informational rates while using relatively little power. For example, present-day 200,000-bit environmental plated-wire memory systems accessing 24-bit words require only 2W of power at a repetition rate of 300 kHz, or 18W at 3 MHz.

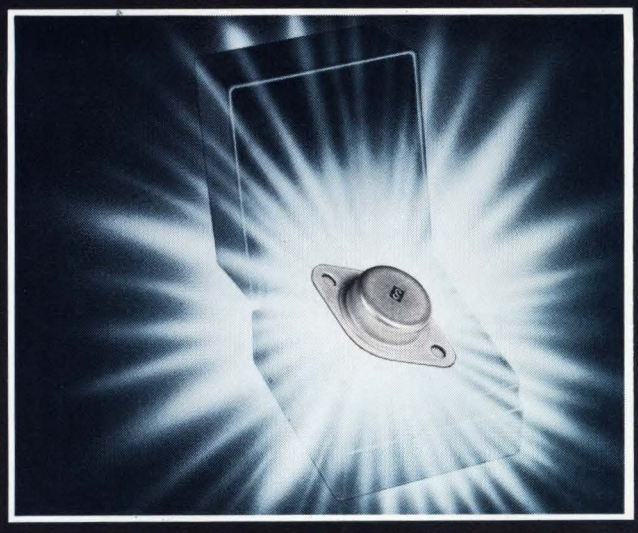
Operating current of plated elements is only slightly affected by temperature changes, so memories using them operate satisfactorily over the military temperature range without the need for expensive current-compensation techniques. The simple word circuitry and wide NDRO electrical tolerances of the element permit designs that will retain stored data during nuclear exposure, when all the associative circuitry may be considered conductive.

With the recent development of 2-mil-diam "Mini-Wire", 200,000 bits of information can be packed into less than 120 cubic inches. Also, the reduced current requirements in both the word digit and sense dimensions permit the exclusive use of semiconductor medium-scale integrated circuits (MSI). This enhances system reliability by reducing the number of semiconductor elements—the major cause of failures in magnetic memories. It also shrinks the packaging volume and the power supply requirements—and lowers the cost of plated-wire memory systems.

Implied by the volume production anticipated for aerospace plated-wire memories is narrowing of the price difference per bit between cores and plated wire. The implication is clear—cores will have vigorous competition!

"a real Joule"

FROM SOLITRON



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TYPE NUMBER TO-3 CASE	h_{FE} @4.0V V_{CE}				V_{CE} (sat)	V_{BE} (on)	V_{CEX}	V_{CEO}
	I_C=3.0A		I_C=4.0A		I_C=4.0A	I_C=4.0A	VOLTS	VOLTS
	Min	Max	Min	Max	I_B=4.0V	V_{CE}=4.0V		
2N3055/1	20	—	—	70	1.5V	2.0	40V	30V
2N3055/2	10	—	—	70	1.5V	2.0	40V	30V
2N3055/3	20	70	—	—	1.5V	2.0	100V	60V
2N3055/4	30	—	70	—	1.5V	2.0	30V	20V
2N3055/5	—	—	14	—	1.5V	2.0	30V	20V
2N3055/6	—	—	15	70	1.1V	1.8V	100V	60V
2N3055/7	14	—	—	70	1.1V	1.8V	100V	60V
2N3055/8	—	—	70	—	1.1V	1.8V	100V	60V
2N3055/9	14	—	—	70	1.1V	1.8V	55V	45V
2N3055/10	—	—	70	—	1.1V	1.8V	55V	45V
SDT9201	—	—	20	70	1.1V	1.8V	55V	45V
SDT9202	—	—	20	70	1.1V	1.8V	100V	80V
SDT9203	—	—	20	70	1.1V	1.8V	120V	100V
SDT9204	—	—	20	70	1.1V	1.8V	140V	120V

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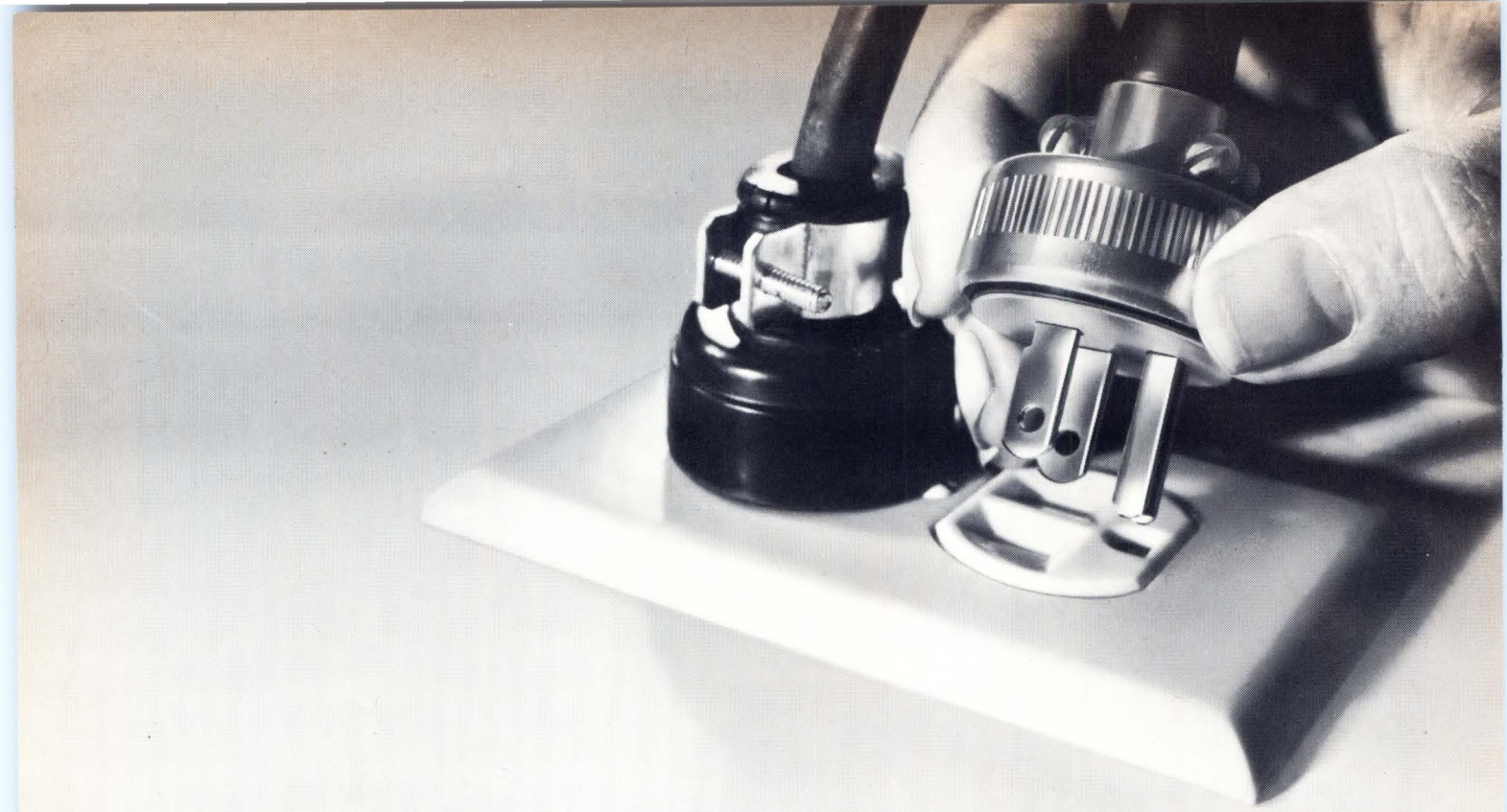
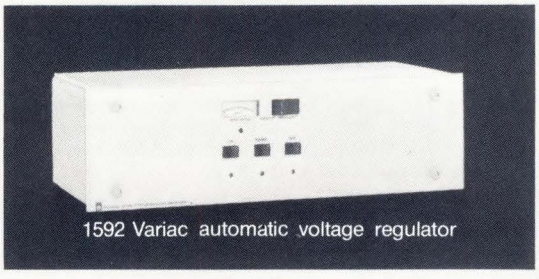
CIRCLE NO. 21



the beginning of a poor MTBF



1592 Variac automatic voltage regulator

...and the end.

Don't force 120 V into a system that will operate normally at a lower voltage! At the lower voltage, even internally regulated equipment will generate less heat—and less heat means fewer breakdowns and a longer life. The best way to select your input voltage, increase the MTBF, and decrease maintenance costs is to insert a 1592 VARIAC® AUTOMATIC VOLTAGE REGULATOR between your equipment and the public utility. The 1592 will maintain a constant and cool low-line input for you, even through the highs and lows sent your way by the utility. And you can forget about brownouts, too!

The 1592 vs any other kind of regulator

The 1592 is an electromechanical regulator that directly controls the rms characteristic of its output waveform. Since the 1592, unlike regulators of other designs, adds no distortion to the waveform, it also regulates the peak and average characteristics to which most power supplies respond. The clean waveform you get from a 1592 is essential to the precise operation of many devices. Heaters need the rms regulation of a 1592 to control exacting thermal processes; digital systems need a 1592 for regulation without the addition of potentially disruptive line transients and distortion.

The finer points of the 1592

The 1592 regulates 120- and 230/240-V, 50- and 60-Hz inputs with accuracy as tight as 0.25%, rated outputs up to 10 kVA, and transient-correction rates as high as 50 ms/V; it can also be used in many two- or three-phase configurations.

For $525 (U.S. price), it makes good sense to invest in a 1592 Variac automatic voltage regulator, instead of re-investing in the repair of equipment that has burned out before its time. The same $525 will keep your equipment on the air during times of low line voltage. Get complete specifications for the 1592 and the other GR voltage regulators from your nearest GR District Office or from 300 Baker Avenue, Concord, Mass. 01742. In Europe write to Postfach 124, CH 8034, Zurich, Switzerland.

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CIRCLE NO. 22

DESIGNING A RADIATION-STABLE VOLTAGE REFERENCE

Because radiation-resistant circuits are more widely used every day, assignments to design them are on the increase. Success in this field depends on several ingredients, as this design reveals.

ANTHONY J. SOFIA, Avco Corp.

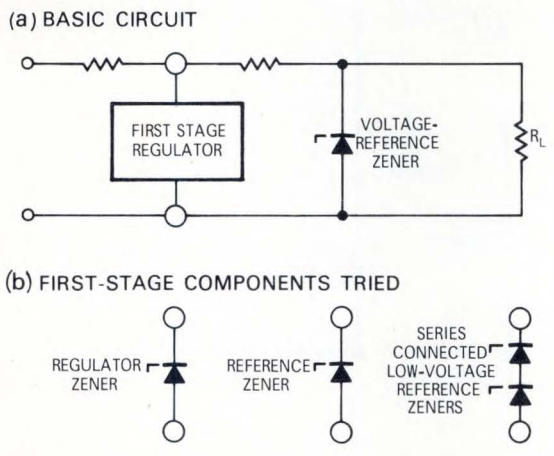


Fig. 1 – **Voltage reference** source: **(a)** basic circuit, **(b)** elements investigated for first-stage use.

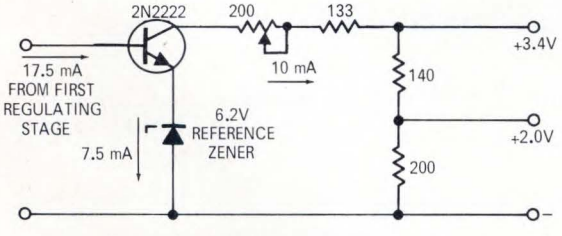


Fig. 2 – **Second stage regulator.**

Successful radiation hardened design demands both thorough analysis and comprehensive testing. This particular design required reference voltages of 2.0 and 3.4V with a three sigma (3σ) stability factor of $\pm 0.5\%$ for use as calibration standards in an instrumentation system. This stability had to be maintained with input of 29 $\pm$2V, over an ambient temperature range of -20 to $+80$°C and under stringent radiation conditions.

Because the load resistance exceeded 100 kΩ, and load variations were minor, regulation against input supply variation was the main requirement. Therefore two-stage (cascaded) zener regulation was tried, using a regulator zener in the first stage and a voltage reference zener in the output stage (**Fig. 1**). A regulator-type zener was chosen for the first stage because its low dynamic impedance would insure that the second stage received a highly-regulated input. As expected, this first-stage design delivered excellent regulation, but its temperature coefficient was excessive, so an 11.7V voltage reference zener was substituted.

This cleared up the TC problem, but brought on one of its own, for the 11.7V reference zener became very erratic when irradiated.

Fortunately a 6.2V reference was known to behave quite predictably under radiation. This suggested a satisfactory solution, which was to series connect two of these 6.2V units to serve in place of the 11.7V one. This design gave adequate first-stage regulation and good freedom from temperature influence.

Compensation for Irradiation Effects. Tests of the two-stage regulator just described showed that it still had one major drawback – namely a decrease of the output voltage as a result of irradiation.

(Continued)

Radiation-Stable Design (Cont'd)

This voltage shift can be nearly eliminated by counteracting it with the equal but opposite change in the saturation voltage of certain transistors when subjected to neutron flux. This change in saturation voltage is caused by a greater increase in the bulk resistivity of the base-emitter junction than that in the base-collector junction.

Second Stage Design. An output stage that includes the saturated-transistor compensation is shown in **Fig. 2**. A 200Ω potentiometer provides the 60Ω change needed to compensate for the ±5% voltage tolerance of the reference zener diode, and permits precise adjustment of the voltage fed to the output divider.

The transistor operates in saturation, and was selected for both its radiation performance and its very low saturation voltage ($V_{ce\ sat.}$). Tests showed that negligible output voltage error is attributable to the effect of changes in $V_{ce\ sat.}$.

Total current to the second stage is 17.5 mA, with 7.5 mA flowing from base to emitter and hence through the zener reference, and 10 mA flowing into the output circuit via the base-to-collector path. Calculated output impedance of the 3.4V branch is 146Ω, and that of the 2V branch is 132Ω.

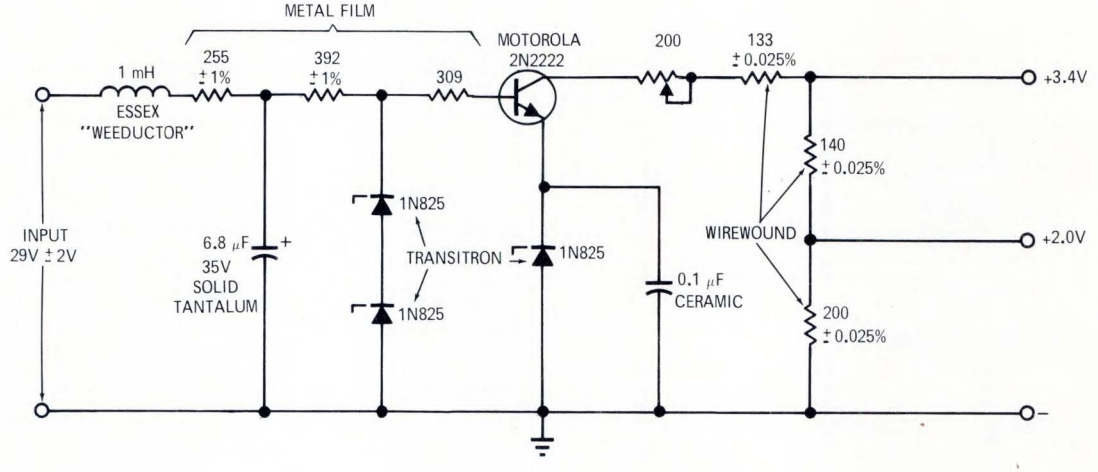


Fig. 3— **Radiation-stable** voltage reference

Specifications:

Input:	+29 ±2V dc
Load:	>100 kΩ. Essentially constant
Output:	2 and 3.4V with 3σ stability factor of ±0.5%
Temp. Range:	−20 to 80°C
Radiation:	Neutron fluence 2×10^{14} n/cm² E >10 keV
	Gamma dose 1×10^{6} rads (c)
	Steady-state gamma dose rate 2×10^{6} rads/s

Complete Design. The voltage reference supply that finally evolved is shown in **Fig. 3**. It includes the two-stage regulator previously described, as well as filter circuitry that helps keep the output voltage free of RFI and gamma-produced transients.

Input filtering was provided for both low- and high-frequencies. Initially an RF choke was connected in series with the input, and a large value capacitor was shunted across the first zener stage. This combination proved adequate for RFI purposes, but it caused large gamma-produced transients because of the RC time constant of the input circuit. Dividing the dropping resistor and connecting the capacitor to the junction, greatly reduced both the RFI and the gamma-produced transients.

Radiation testing was conducted at both the OMRR reactor in Watertown, Mass. and at the General Atomic (GA) facility in San Diego, Calif. Both piece parts and breadboard circuits were tested.

Meeting the Goal

When all testing had been completed, the final voltage reference circuit (**Fig. 3**) was found to meet the design objectives.

Temperature tests showed approximately 0.1% change in the nominally 3.4V and 2.0V output voltages with the input voltage held at 29V and the temperature varied from −20 to +85°C. Radiation caused about a 0.3% change in the output voltages. (For detailed data on radiation resistance see information in the boxed section "Radiation Test Data").

Results of the program clearly indicated that when designing circuits for operation in a radiation environment, both thorough analysis and comprehensive testing are essential. Subsequent large-lot testing of the piece parts chosen for use in the final circuit showed excellent agreement with the data that were obtained in the small-sample tests. □

Databank

The author cites the following references:

1. "Simplified Engineering Techniques for Predicting Diode TREE Responses", E. A. Carr and K. R. Walker, IEEE Transactions on Nuclear Science, December 1966.
2. "Nuclear Radiation Effects on Resistive Elements", REIC Memorandum 31, Radiation Effects Information Center, July 1966.
3. "Equivalent Circuits Estimate Damage From Nuclear Radiation", J. T. Finnell, Jr., D. B. Bertetti and F. W. Karpowich, Electronics, October 30, 1967.
4. D. J. Burkehart and D. E. Willis, "Statistical Test Program to Study Radiation Effects in Piece Parts for use in Project Sleigh Ride", General Atomic GACD 6794, November 1965.

Components versus Radiation

Final selection of components for the voltage reference was based on the acceptability of their performance in a neutron environment. Of prime importance was the selection of reliable zener diodes. Diodes were tested both prior to, and after, being irradiated at the Ordnance Materials Research Agency (OMRR) reactor in Watertown, Mass. Data were taken on their voltage breakdown, zener impedance, and temperature coefficient.

All 1N825 zener diodes except those made by Transitron failed under radiation. Data on the Transitron 1N825, on the average, showed a 55 mV decrease in zener voltage at 2×10^{14} n/cm². This amounts to a −0.64% change in output voltage.

A previous test program had been run to select a switching transistor for use in a radiation-hardened electronic commutator. During that testing the Motorola 2N2222 transistor showed saturation voltage changes of the type needed for this application. Accordingly some were tested further to determine if their saturation voltage change could, indeed, be used to counteract the zener voltage shift.

Radiation testing of resistors showed that next to wirewound, the metal-film types change the least. Therefore, all resistors, other than those in the output voltage divider (which are precision wirewound) were International Resistance Corp.'s metal film. For the potentiometer, Spectrol's Model 50 was selected because of its small physical size, high resolution and radiation "hardness". To make it radiation resistant, the vendor replaced some parts of the standard Model 50 with "acceptable" substitutes.

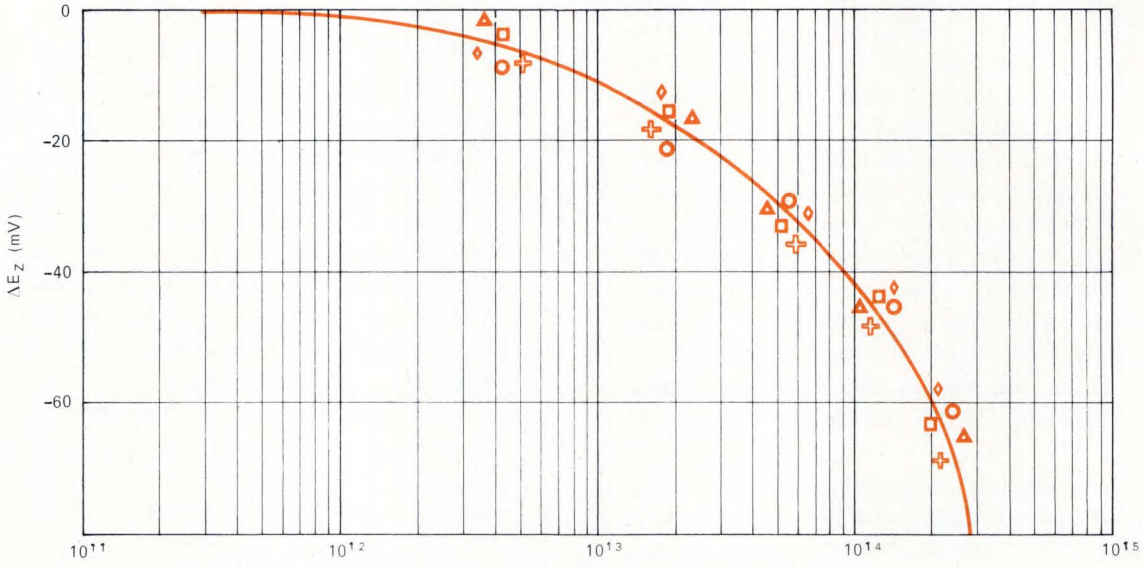
The 6.8 μF solid tantalum capacitor was chosen for its low leakage and small size.

Anthony J. Sofia is a senior engineer who specializes in circuit design relating to guidance control and avionics at Avco Corp.'s Advanced Technology Div., Lowell, Mass. Mr. Sofia received his B.S.E.E. from Northeastern University in 1959.

(Continued)

RADIATION TEST DATA—COMPONENTS

A. Transitron 1N825 Reference zener diode



Change in zener voltage (ΔE_z) as a function of integrated neutron dose (I_z = 7.5 mA).

T.C.

UNIT NO.	PRE-RADIATION T.C.	POST-RADIATION T.C.
1	-0.00268	+0.00527
2	-0.00188	+0.00498
3	-0.00144	+0.00511
4	-0.00071	+0.00528

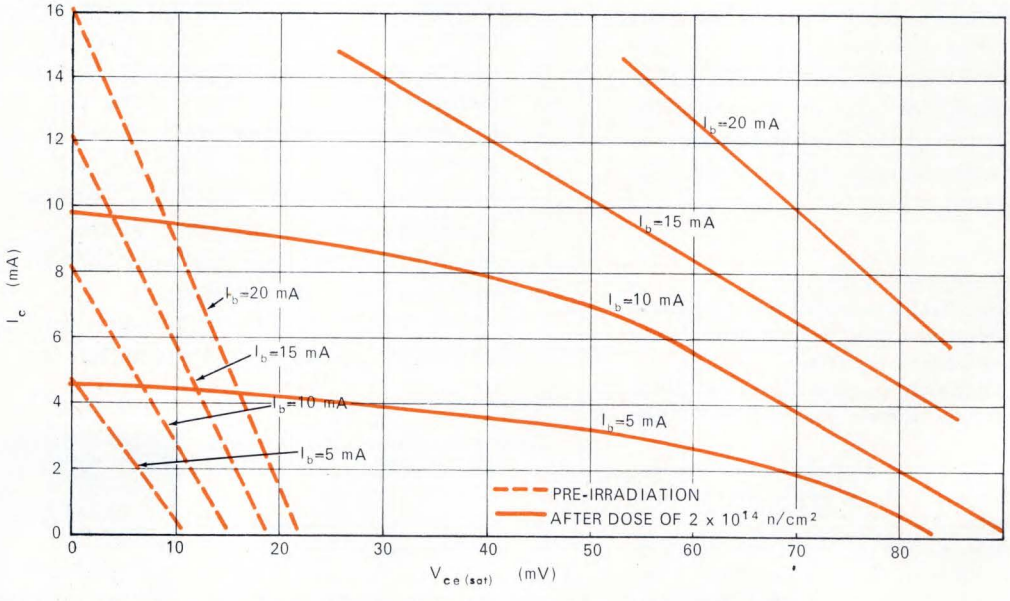
Temperature coefficient (%/°C) @ I_z = 7.5 mA.

Z_z

UNIT NO.	PRE-RADIATION	POST-RADIATION
1	6.80	8.27
2	9.46	11.46
3	11.33	13.60
4	8.53	10.04
5	8.26	10.00

Zener impedance (Ω) @ I_z = 7.5 mA.

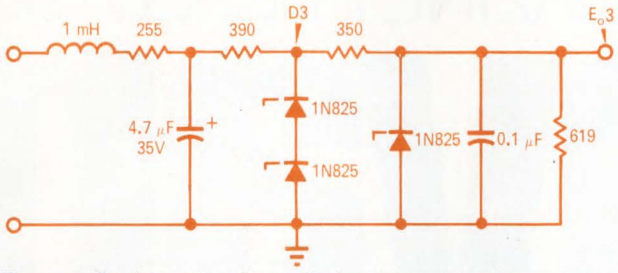
B. Motorola 2N2222 Transistor



Saturation voltage vs. collector current before and after a dose of 2 × 10^{14} n/cm².

RADIATION TEST DATA—BREADBOARD CIRCUITS

Test 1—Circuit A



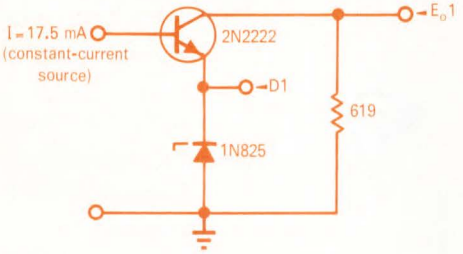
Purpose: To determine the radiation tolerance of an uncompensated two-stage reference voltage source.

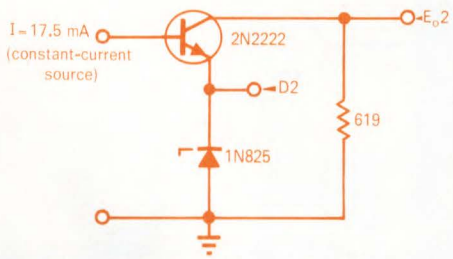
Test Data:

DOSE (n/cm²)	VOLTAGE AT D3	OUTPUT VOLTAGE AT E_o3
0	12.53	6.368
3×10^{12}	12.52	6.362
6×10^{12}	12.51	6.358
1×10^{13}	12.50	6.359
2.34×10^{13}	12.49	6.344
4×10^{13}	12.47	6.336
6×10^{13}	12.45	6.329
8×10^{13}	12.44	6.323
1×10^{14}	12.43	6.319
2×10^{14}	12.39	6.303

Conclusion: The output voltage dropped from 6.368 to 6.303V, a total decrease of 65 mV (−1.02%). Total drop at D3 was 0.14V, which averages to 70 mV per diode. The circuit does not meet the requirements.

Test 2—Circuits B and C





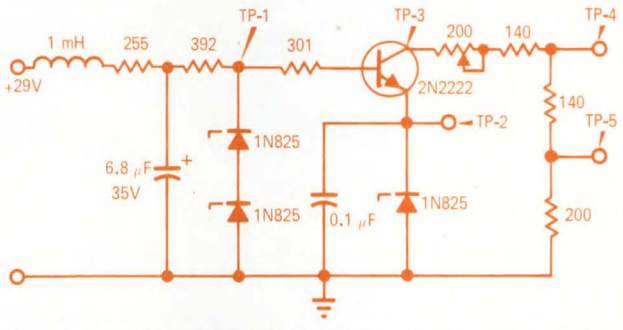
Purpose: To test the effectiveness of using a 2N2222, operated in saturation, for compensating the decrease in zener voltage with radiation.

Test Data:

	MEASURED VOLTAGES			
DOSE (n/cm²)	D1	E_o1	D2	E_o2
0	6.397	6.402	6.285	6.293
3×10^{12}	6.391	6.400	6.280	6.291
6×10^{12}	6.387	6.399	6.277	6.291
1×10^{13}	6.348	6.399	6.272	6.290
2.34×10^{13}	6.373	6.399	6.262	6.293
4×10^{13}	6.364	6.402	6.256	6.297
6×10^{13}	6.355	6.404	6.248	6.300
8×10^{13}	6.349	6.407	6.242	6.303
1×10^{14}	6.344	6.408	6.238	6.304
2×10^{14}	6.325	6.408	6.222	6.307

Conclusion: Diode voltages D1 and D2 decreased by 72 and 63 mV respectively. At the same time output voltages E_o1 and E_o2 increased by 6 and 14 mV (+0.094% and +0.22%) respectively. In the final circuit the base of the 2N2222 will not be driven by a constant current, so there will be a tendency for the overcompensation to decrease.

Test 3—Circuit D



Purpose: To verify that the combined circuitry will have the expected stability.

Test Data:

	MEASURED VOLTAGES				
DOSE (n/cm²)	TP-1	TP-2	TP-3	TP-4	TP-5
0	12.50	6.440	6.446	3.409	2.009
3×10^{12}	12.49	6.434	6.443	3.401	2.008
6×10^{12}	12.48	6.429	6.442	3.407	2.008
1×10^{13}	12.47	6.425	6.442	3.407	2.008
2×10^{13}	12.46	6.418	6.444	3.408	2.008
4×10^{13}	12.44	6.407	6.449	3.411	2.010
6×10^{13}	12.43	6.400	6.454	3.416	2.012
8×10^{13}	12.41	6.394	6.458	3.416	2.013
1×10^{14}	12.40	6.389	6.460	3.417	2.014
2×10^{14}	12.38	6.370	6.462	3.419	2.014

Conclusion: The desired compensation for the effects of radiation was achieved, for the measured voltage change at TP-4 was only 0.293% and that at TP-5, 0.25%.

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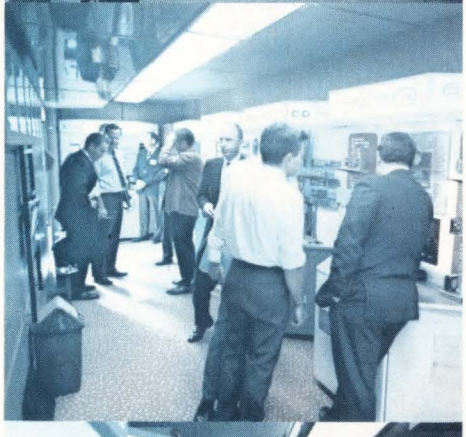

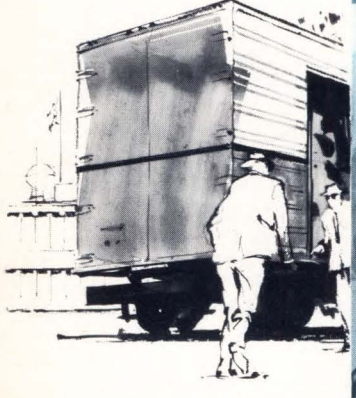

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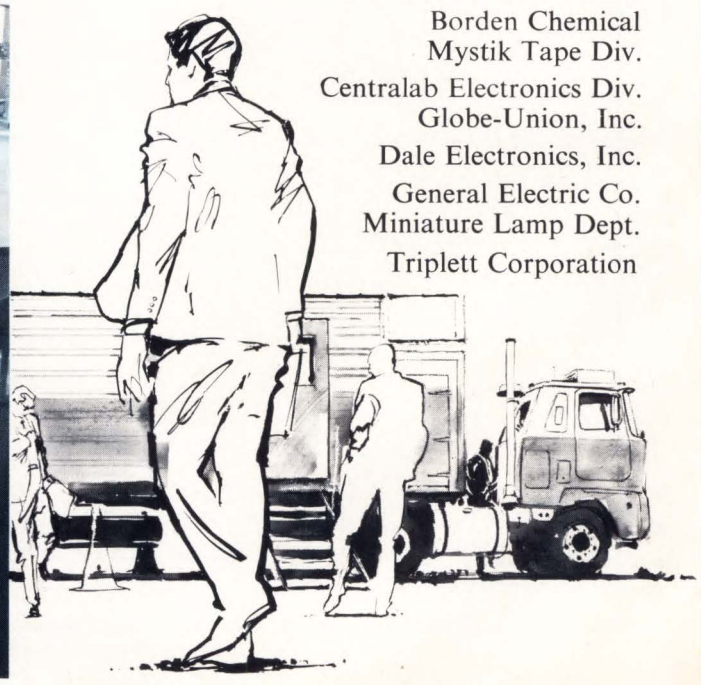

EDN CARAVAN ROUTING

September 14 - October 16, 1970

DATE / DAY / TIME	AREA	SITE
Monday, September 14		
9:00 - 12:00 noon	Hopkins, Minn.	Honeywell
1:30 - 4:30 p.m.	Minneapolis, Minn.	Control Data (Normandale)
Tuesday, September 15		
9:00 - 12:00 noon	Minneapolis, Minn.	Pako Corp.
1:30 - 4:30 p.m.	St. Paul, Minn.	3M Research Center
Wednesday, September 16		
9:00 - 11:00 a.m.	Roseville, Minn.	Univac
12:00 - 2:00 p.m.	St. Paul, Minn.	Univac—Plant 1
3:00 - 4:30 p.m.	St. Paul, Minn.	Univac—Plant 5
Thursday, September 17		
9:00 - 12:00 noon	St. Paul, Minn.	Control Data (Arden Hills)
Friday, September 18		
9:00 - 12:00 noon	Milwaukee, Wisc.	AC Electronics
1:30 - 4:00 p.m.	Milwaukee, Wisc.	G.E. Medical Systems
Monday, September 21		
9:00 - 12:00 noon	Schaumburg, Ill.	Motorola
1:30 - 4:30 p.m.	Skokie, Ill.	Teletype
Tuesday, September 22		
9:00 - 12:00 noon	Lincolnwood, Ill.	Bell & Howell
Wednesday, September 23		
9:00 - 12:00 noon	Ann Arbor, Mich.	Bendix
1:30 - 4:30 p.m.	Plymouth, Mich.	Burroughs
Thursday, September 24		
9:00 - 12:00 noon	Southfield, Mich.	Bendix
Friday, September 25		
9:00 - 11:00 a.m.	Ft. Wayne, Ind.	Magnavox (Corp. Hq.)
12:00 - 2:30 p.m.	Ft. Wayne, Ind.	Magnavox (Bueter Rd.)
3:30 - 4:30 p.m.	Ft. Wayne, Ind.	Magnavox (Industrial Park)
Monday, September 28		
9:00 - 12:00 noon	Indianapolis, Ind.	RCA
Tuesday, September 29		
9:00 - 12:00 noon	Dayton, Ohio	NCR
2:00 - 4:30 p.m.	Columbus, Ohio	Western Electric
Wednesday, September 30		
9:00 - 12:00 noon	Galion, Ohio	North Electric
3:00 - 4:30 p.m.	Cleveland, Ohio	Picker Corp. (X-Ray) (Highland Heights)
Thursday, October 1		
9:00 - 11:00 a.m.	Cleveland, Ohio	Addressograph-Multigraph
Friday, October 2		
9:00 - 12:00 noon	Webster, New York	Xerox
1:30 - 4:30 p.m.	Rochester, New York	Eastman Kodak
Monday, October 5		
9:00 - 12:00 noon	Owego, New York	IBM
1:30'-'4:00 p.m.	Endicott/Glendale, N.Y.	IBM
Tuesday, October 6		
9:00 - 12:00 noon	Binghamton, N.Y.	Link General Precision
Wednesday, October 7		
9:00 - 12:00 noon	Herkimer, N.Y.	Mohawk Data
Thursday, October 8		
9:00 - 12:00 noon	Nashua, N.H.	Sanders
1:30 - 4:30 p.m.	West Lynn, Mass.	General Electric
Friday, October 9		
9:00 - 12:00 noon	Foxboro, Mass.	Foxboro
2:00 - 4:00 p.m.	Maynard, Mass.	Digital Equipment
Monday, October 12		
9:00 - 12:00 noon	Sudbury, Mass.	Raytheon
1:30 - 4:30 p.m.	Wayland, Mass.	Raytheon
Tuesday, October 13		
9:00 - 12:00 noon	Bedford, Mass.	Raytheon
1:30 - 4:00 p.m.	Framingham, Mass.	Honeywell
Wednesday, October 14		
9:00 - 11:00 a.m.	Waltham, Mass.	Honeywell
12:30'- 2:00 p.m.	Billerica, Mass.	Honeywell
3:00'- 4:30 p.m.	Waltham, Mass.	Hewlett-Packard
Thursday, October 15		
9:00 - 11:00 a.m.	Windsor Locks, Conn.	Hamilton-Standard
2:00 - 4:30 p.m.	Norwalk, Conn.	Norden
Friday, October 16		
8:00 - 10:15 a.m.	Norwalk, Conn.	Perkin Elmer
11:00 - 12:30 p.m.	Wilton, Conn.	Perkin Elmer
1:30 - 3:30 p.m.	Stanford, Conn.	CBS Labs.

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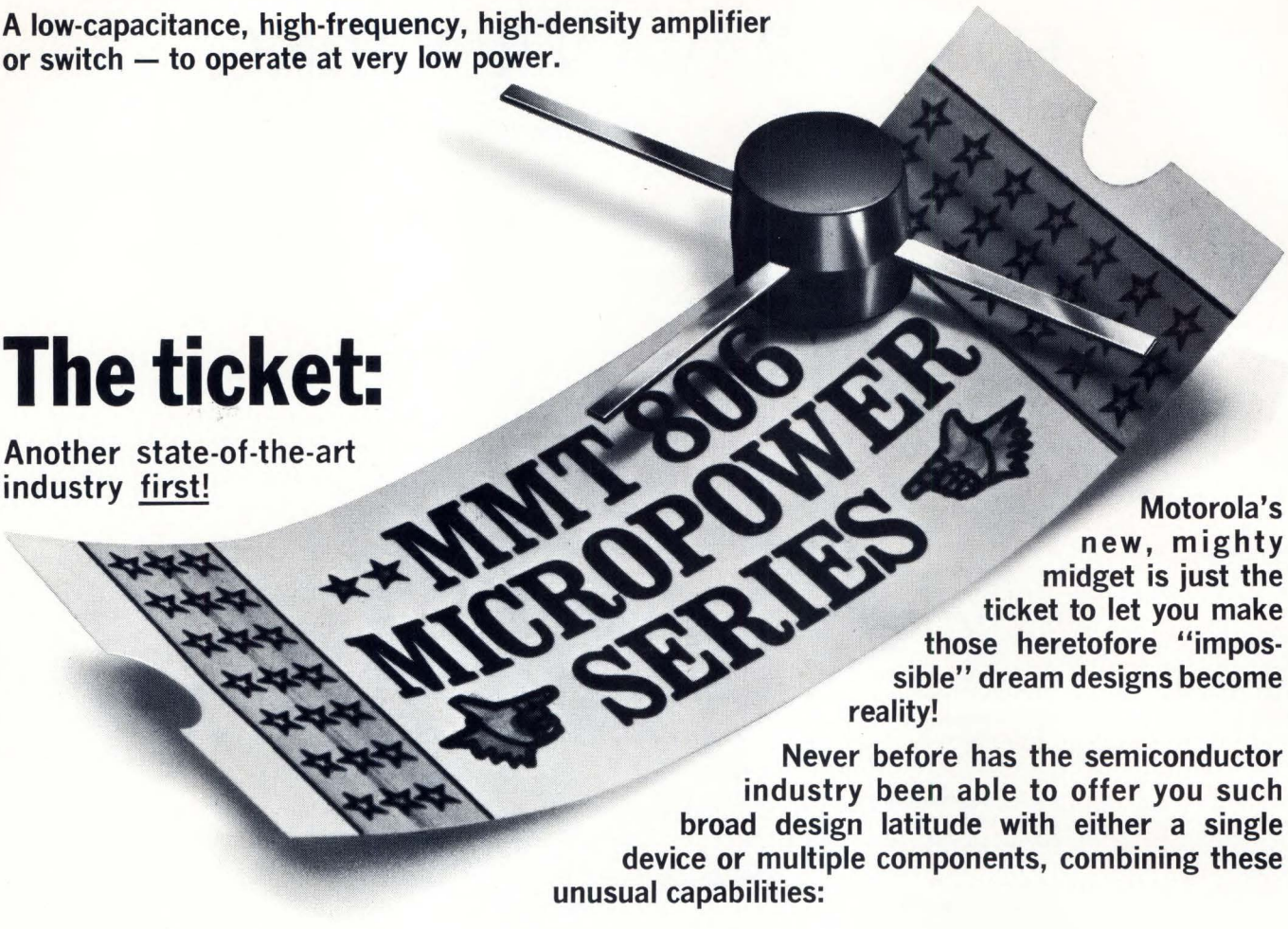

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Encapsulated in the rugged, voidless, Micro-T plastic package (case 28), the MMT806 silicon transistor series is comprised of two complementary pairs:

MMT806 (NPN) and MMT808 (PNP) Micropower Switches

MMT807 (NPN) and MMT809 (PNP) Micropower Amplifiers

AMPLIFIER CHARACTERISTICS	Symbol	Min.	Typ		Max		Unit
		NPN&PNP	NPN	PNP	NPN	PNP	
Power Gain (matched) ($f = 200$ MHz, $V_{CE} = 0.7V$, $I_C = 100\mu A$)	G_p	—	18	17	—	—	dB
Noise Figure (Opt. Source) ($f = 200$ MHz, $V_{CE} = 0.7V$, $I_C = 100\mu A$)	NF	—	2.0	2.6	—	—	dB
Input Capacitance ($f = 1$MHz, $V_{BE} = 0.0V$, $I_C = 0$, collector guarded)	C_{ib}	—	0.27	0.34	0.45	0.50	pF
Output Capacitance ($f = 1$MHz, $V_{CB} = 0.5V$, $I_E = 0$, emitter guarded)	C_{ob}	—	0.34	0.47	0.55	0.80	pF
Current Gain Bandwidth Product ($f = 200$ MHz, $I_C = 1$mA, $V_{CE} = 1V$)	f_T	1.2	2.1	2.5	—	—	GHz
DC Forward Current Gain ($I_C = 10\ \mu A$, $V_{CE} = 1V$)	h_{FE}	20	125	70	—	—	—

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CIRCLE NO. 23

REMEMBER THE MAGNET IN MAGNETIC REED SWITCHES

Overlook the word "magnet" in magnetic reed switches and you may be overlooking a versatile design component. Actuating reeds with a tiny permanent magnet opens up a fertile field for novel applications.

STUART E. WILSON, Hamlin Inc.

Magnetic reed switches have long been associated with electromagnetic circuits. In fact, this association is so strong that many engineers overlook a wide range of applications because they overlook the fact that these switches can be actuated by a simple permanent magnet.

The magnetic reed switch is essentially a pair of ferromagnetic contacts in a small, hermetically sealed glass enclosure (**Fig. 1**). These contacts are actuated by any magnetic field of sufficient strength – including the field of a permanent magnet. Using a permanent magnet can eliminate the circuitry and needless sophistication that adds to equipment cost.

Actuation of magnetic reed switches with permanent magnets not only offers cost savings, but also provides a wide range of actuation methods. Let's look at some of these methods after reviewing some characteristics of magnetic reed switches.

Characteristics

Normally, the switch reeds are cantilevered from the ends of the glass tube and overlap slightly at the approximate center of the tube with a small air gap between them (**Fig. 1**). In a magnetic field, the extreme ends of the reeds assume opposite magnetic polarities. As the magnetic flux between the two contacts increases, the attracting forces increase and overcome the stiffness of the reeds, bringing them into contact.

The speed with which this operation takes place is directly related to the strength and proximity of the actuating magnet. Because reed-gap flux is an exponential function of the magnetic flux, wide variations in closure time result from minor variations in magnet position or strength. However, kinetic energy of the reeds also increases with reed gap flux, which in turn produces greater contact bounce with sufficient current flow and the possibility of arcing and corrosion. The optimum strength for the actuating magnet is generally about 50% above the "just operate" value. The numeric values involved may usually be established through reference to reed-switch manufacturers' literature.

Contacts of currently available magnetic-reed switches are rated from dry circuit to 3A and form "A" or form "C" arrangements.

(Continued)

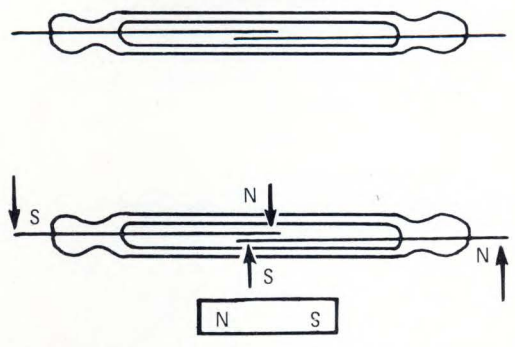

Fig. 1 – **Magnetic reed switch** consists of two ferromagnetic reeds sealed in a glass tube. Magnetic flux causes reeds to contact.

Actuation Methods

After establishing the basic switch parameters, the next problem is to establish the best type of actuation for the given application. Methods currently in use include proximity motion, rotation, shielding and biasing.

PROXIMITY – In all systems, magnet and switch must be brought to within a specific proximity of each other. This distance will vary according to the sensitivity of the switch and the strength of the magnet. When the magnet is close enough, the normally open contacts will close or pull in. When the magnet is removed, the contacts will open or drop out. The relative distance for pull-in is always less than that for drop-out. Examples of proximity motion switching:

Perpendicular motion **Fig. 2** – provides one switch closure with maximum magnet movement.

Parallel motion **Fig. 3** – provides up to three closures with maximum magnet travel or one closure with minimum travel.

Front-to-back-motion **Fig. 4** – somewhat similar to parallel motion, except magnet motion is at right angles to switch and provides one closure with maximum magnet travel.

Pivoted motion **Fig. 5** – pivoted motion actuation relies on angular movement of the magnet to actuate the switch. With this method, a large angular movement is necessary for one switch closure.

ROTATION – Revolving the magnet or switch nor-

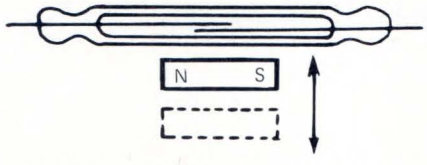

Fig. 2 – **Perpendicular motion** provides only one switch closure with maximum magnet travel.

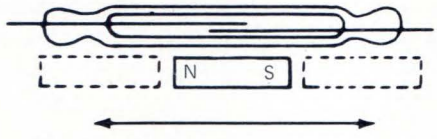

Fig. 3 – **Parallel motion** provides as many as three closures with maximum magnet travel, allows one closure with minimum magnet travel.

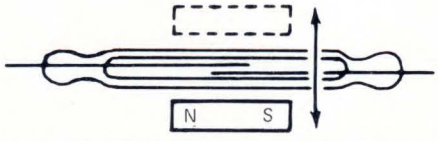

Fig. 4 – **Front-to-back motion** is similar to parallel motion except magnet motion is at right angles to switch to provide only one closure for maximum magnet travel.

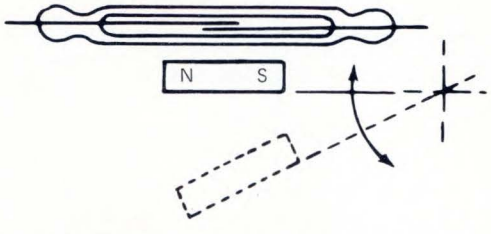

Fig. 5 – **Pivoted motion** requires large angular magnet travel to achieve one switch closure.

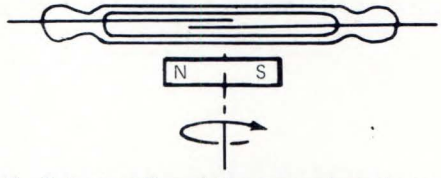

Fig. 6 – **Rotary motion** of the magnet produces two switch closures for each complete revolution.

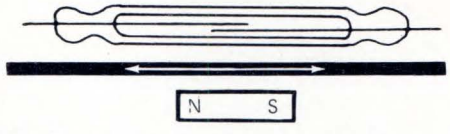

Fig. 7 – **Magnetic shield** short circuits flux. Removal of shield produces switch closure.

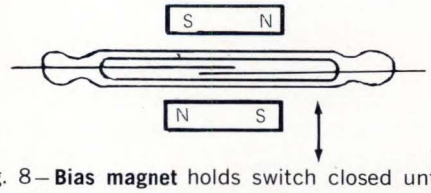

Fig. 8 – **Bias magnet** holds switch closed until actuating magnet cancels magnetic flux and opens switch.

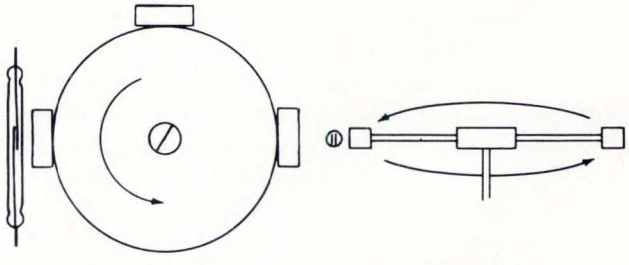

Fig. 9 – **Switch is stationary** while magnets rotate with cam.

mal to their axes will result in two switch closures per revolution. When their axes are parallel, the contacts close. When their axes are perpendicular, the contacts open. Although the magnet poles reverse, they still induce the opposite polarities necessary to close the switch (**Fig. 6**).

SHIELDING – In this type of actuation, magnet and switch positions are permanently fixed. A piece of ferromagnetic material is passed between the magnet and the switch to cause drop-out. This shunts the magnetic field, eliminating the attraction between the reeds. When the shield is removed, the contacts close (**Fig. 7**).

BIASING – A biasing effect is produced by placing a stationary magnet near the switch to keep it normally closed. The approach of another magnet with reversed polarity will cancel the effect of the first magnet and the switch will open (**Fig. 8**).

Applications

Once basic actuation is established, the number of potential applications becomes almost unlimited. For example, magnetic reed switches and magnets can be applied as a revolution counter (**Fig. 9**). With each revolution of the cam the magnet attached to the cam's outer edge actuates the switch. The pulsating output of this switch can be connected directly to a meter for quick readout of rotation speed.

One extension of this method employs a fixed position magnet shielded from a reed switch by ferrous metal attached to the outer edge of a rotating cam (**Fig. 10**). Each time the shielding comes between the magnet and the switch, the switch is deactivated. When a cutout comes between the magnet and switch, the switch is activated and permits the passage of an electrical pulse. Pulse duration may be varied by simply changing the size of the cutout, making this approach especially useful in controlling production processes where cycles of different pulse lengths control a complex machine operation. A related method of actuation is shown (**Fig. 11**) in which the cam is formed so as to provide the shielding and cutout action.

Another possible method of applying reed switches and permanent magnets uses several stationary reed switches and a permanent magnet mounted on the edge of a cam to produce an inexpensive, yet highly accurate position indicator (**Fig. 12**).

Figures 13-15 show three other potential applica-

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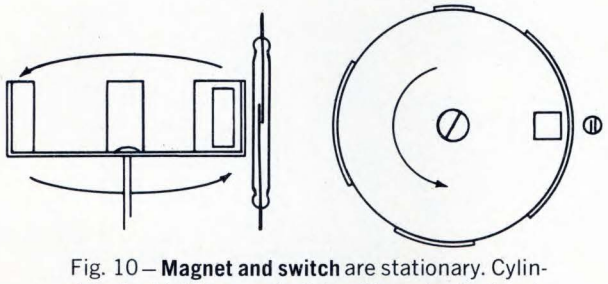


Fig. 10 – **Magnet and switch** are stationary. Cylindrical shielding material with cutouts is attached to edge of rotating cam. Switch actuates whenever cutout permits flux to reach the switch.

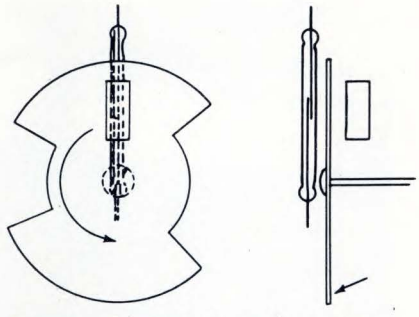


Fig. 11 – **Magnet and switch** are stationary. Disk-type cam with cutouts rotates. Switch is actuated whenever cutout permits magnet flux to reach switch.

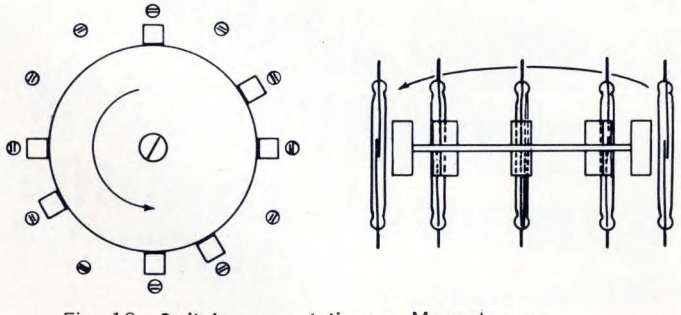


Fig. 12 – **Switches are stationary**. Magnets are attached to edge of rotating cam.

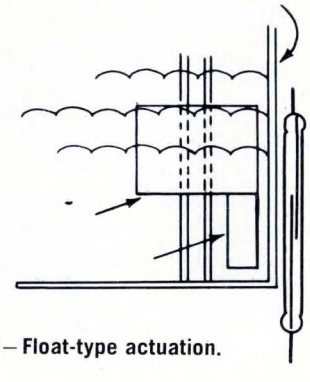


Fig. 13 – **Float-type actuation.**

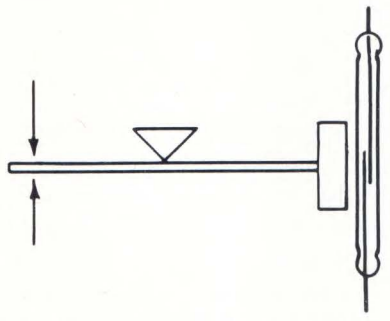


Fig. 14—**Beam-balance** or scale-type actuation.

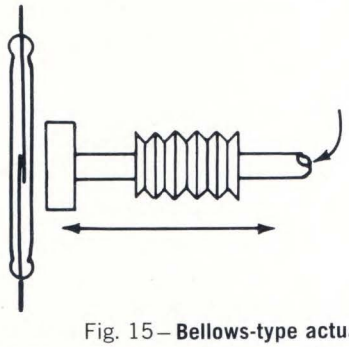
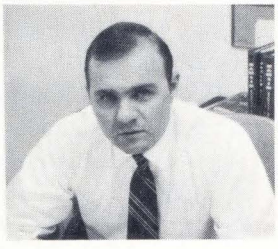


Fig. 15—**Bellows-type actuation.**

tions in the areas of remote sensing and limit controls. For example, the approach shown in **Fig. 13** could be used to automatically cut off the flow of liquid into a storage tank or to provide a readout of liquid level at a remote station. The method shown in **Fig. 14** could be used to sense virtually any form of linear motion, while **Fig. 15** shows a method for remotely sensing and controlling fluid pressures in hydraulic systems.

As is apparent from these illustrations, the magnetic-reed switch provides extreme versatility in design application. The next time you encounter a particularly tacky monitoring or control problem consider the reed switch and a magnet. It may save time, money and possibly some headaches. □

Stuart E. Wilson has been with Hamlin, Inc. for 8 years. For the past year he has held the title of Sales Manager. Wilson received his M.B.A. in 1960 from the University of Michigan. He has given papers both in the U.S. and France on the subject of magnetic reed switches.



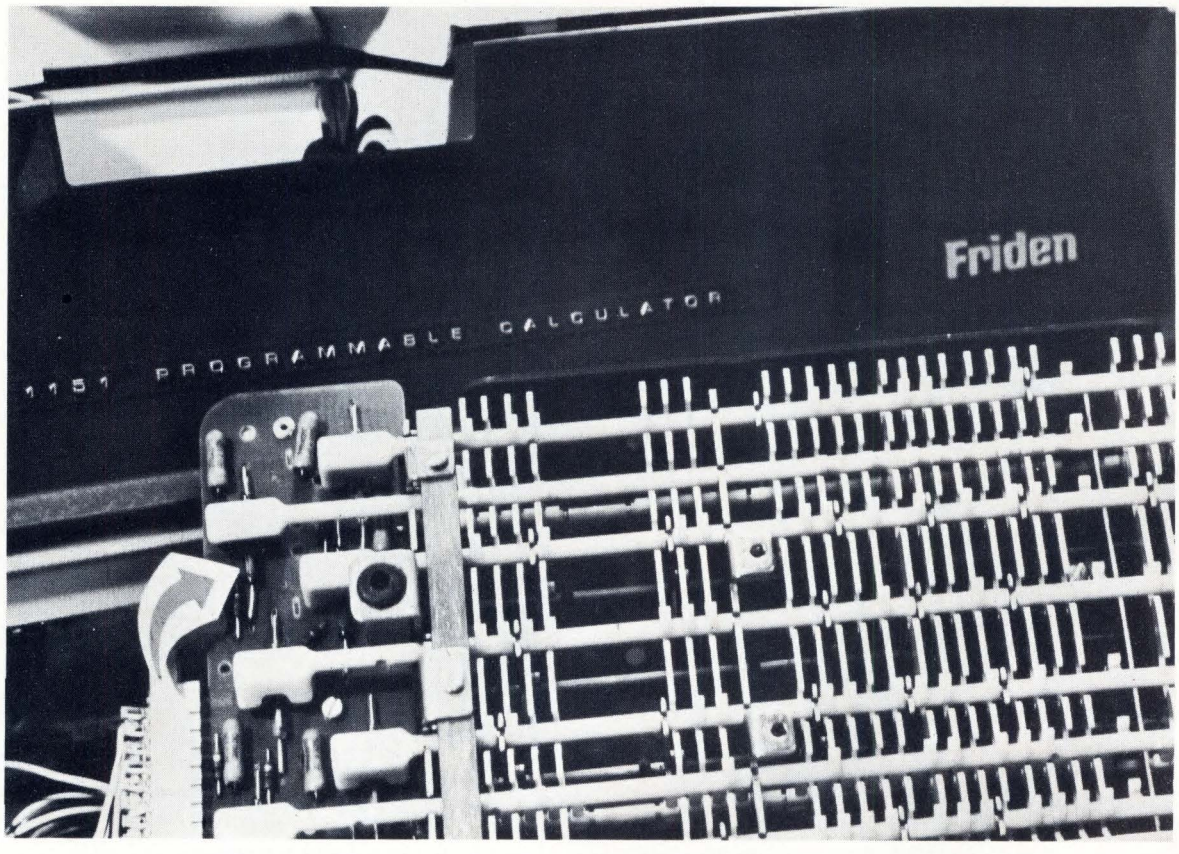


Fig. 16—**Typical application** of magnetic reed switches is in a calculator keyboard. Rotary motion of magnet actuates reed switch (arrow).

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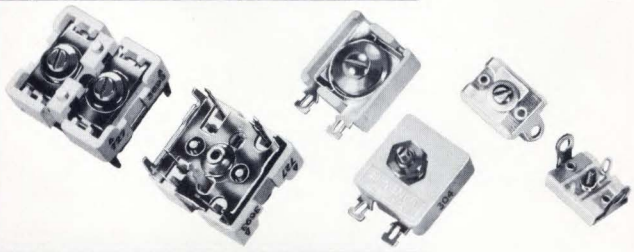

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Only 1 Failure in 7,168,000 Unit-Hours!

- Life tests at 100°C with rated voltage applied have yielding only 1 FAILURE PER 716,800 UNIT-HOURS for 1 MFD. Since the number of unit-hours of these capacitors is inversely proportional to the capacitance, 0.1 MFD Mylar-Paper Dipped capacitors will yield only 1 FAILURE PER 7,168,000 UNIT-HOURS!
- Working volts DC: 200, 400, 600, 1000 and 1600.
- Durez phenolic resin impregnated.
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- Dielectric strength: 2 or 2½ times rated voltage, depending upon working voltage.
- Exceed all electrical requirements of E.I.A. specification RS-164 and military specifications MIL-C-91A and MIL-C-25A.

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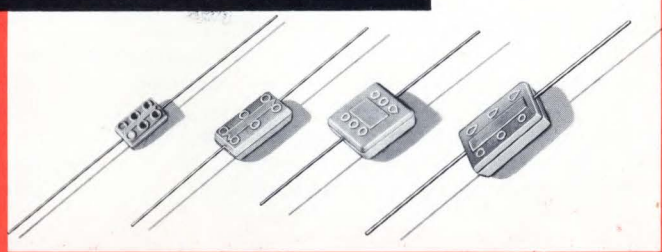

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CIRCLE NO. 24

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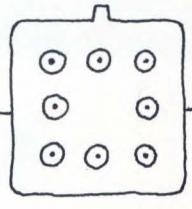

Packaging and Production Engineers please note: CENTIGRID* Series 112 Relay's 8 leads, spaced on 0.100 centers — all on the periphery of the header — permit direct plug-in convenience on all PC boards. This relay won't be the highest component on the board. It's only .225 high, thereby minimizing board spacing. It's only .370 per side.

Design and Circuit Engineers please note: The CENTIGRID* has the same performance as our TO-5 relays. Coil voltages, in 6 choices, range from 5 to 26.5 VDC.

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CIRCLE NO. 25

IC Comparator Separates Sync Pulses

Only one transistor and a 710 IC combine to form a low-cost yet versatile sync separator.

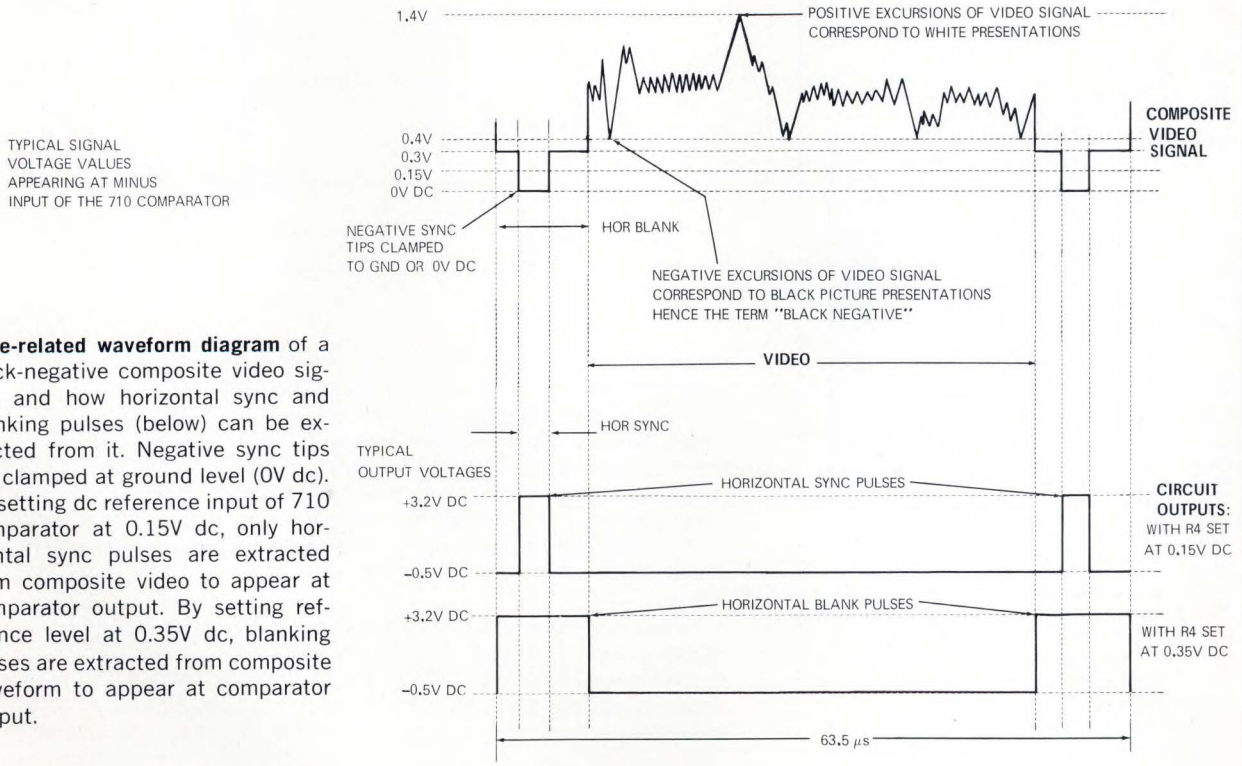
RICHARD G. GROOM, MTI

Separating video sync pulses from a composite signal is simple and easy with only one transistor and an IC comparator. The transistor, along with a couple of resistors and a coupling capacitor, forms a combination clamp and emitter follower.[1]

In its static state, the transistor is in saturation. When a black-negative composite video signal is applied to the base, the negative sync tips are clamped firmly at ground level.

The ground clamped composite video signal is then applied to one input of a high-speed comparator.[2] The other input is dc biased to one half the sync amplitude. Since the comparator output is either a logic "1" or "0", clean sharp positive-going sync pulses are derived from the composite video waveform.

By reversing the comparator inputs, negative-going sync pulses can be derived. A 710 high-speed comparator automatically gives fast, sharp edges to the pulses and is compatible with all IC logic forms. By adjusting



Time-related waveform diagram of a black-negative composite video signal, and how horizontal sync and blanking pulses (below) can be extracted from it. Negative sync tips are clamped at ground level (0V dc). By setting dc reference input of 710 comparator at 0.15V dc, only horizontal sync pulses are extracted from composite video to appear at comparator output. By setting reference level at 0.35V dc, blanking pulses are extracted from composite waveform to appear at comparator output.

(Continued)

IC Comparator (Cont'd)

the dc level at one input of the comparator equal to the pedestal level, blanking pulses can be extracted from the composite video signal, provided the pedestal level is constant and distinct. Since only 2 mV change in input signal flips the comparator, noise rejection is extremely good because the 2 mV can be chosen from the most noiseless portion of the input sync pulse.

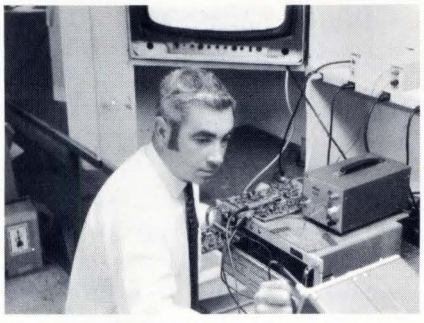
Still another advantage is the comparator's ability to drive a discrete output transistor to raise the sync output to a higher amplitude. Comparator output is a few tenths of a volt below ground, enabling an npn output transistor to be driven OFF.

In addition to its versatility, the single-quantity parts cost of all components is approximately $3.00, making it a very economical sync separator. □

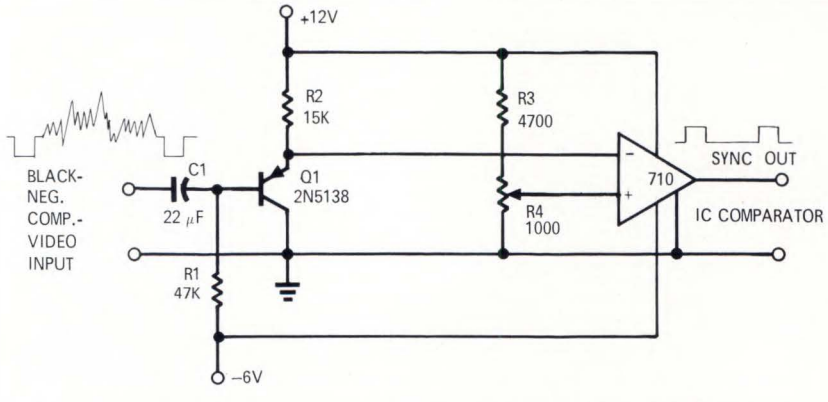
Databank

The author recommends the following references:

1. "An Improved Transistorized DC Restorer" by Walter G. Jung.
2. "The Operation and Use of a Fast Integrated Circuit Comparator" by R. J. Widlar, Fairchild Application Bulletin APP-116.



Richard G. Groom designs video instrumentation equipment and CCTV systems at MTI, a Div. of KMS Industries, Cockeysville, Md. He has worked at MTI for 5 years.



Sync separator consists primarily of transistor Q1 and a high-speed IC comparator. Transistor Q1 and associated components R1, R2 and C1 form combination clamp and emitter follower. In its static state, R1 keeps Q1 saturated. When a black-negative, composite video signal is applied, negative sync tips forward-bias the collector-base junction, clamping sync tips one diode drop below ground. With all other portions of waveform more positive than sync tips, Q1 is driven out of saturation and performs as an emitter follower. Emitter-base and collector-base junction drops then cancel both in temperature drift and static voltage, thus placing sync tips firmly at ground level.

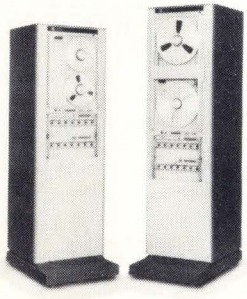
Ground-clamped video signal at output of Q1 then is applied to minus input of 710 comparator. Divider R3, R4 feeds plus input with dc voltage equal to one-half sync-pulse amplitude. If minus input is more negative than plus input, output will be in the high, or logic "1", state. Conversely, output will be in low, or logic "0", state when blanking or video signals are present at minus input making it more positive than plus input. Comparator output then will be clean, sharp, positive-going sync pulses. Maximum of only 2 mV change in comparator input causes 710 to flip states.

HP instrumentation recorders work with hours less downtime. How much is your time worth?

When you're putting instrumentation measurements on tape, the last role you want to play is maintenance man. And who can afford all those time-wasting adjustments? Hewlett-Packard's instrumentation recorders are so reliable they require up to five times less routine maintenance than most machines. Both the HP 3950/3955 Series Systems for lab use and the lightweight HP 3960 portable for the field have what it takes to make you more researcher and less caretaker.

You won't be plagued by misalignments that cause you slowdowns on other recorders. Tape transport components on all HP machines are mounted to a single, rugged cast-aluminum frame that's precision machined to assure permanent alignment. So you'll never have to make shimming or other adjustments in the field. You can use the time you gain for more rewarding work.

Both the IRIG-compatible lab models and 50-pound portable feature a simple, uncluttered tape path that lets you clean head assemblies in just seconds. Even mounting of tape reels and tape threading goes easier and faster with a snap-on reel hub assembly.



Whether you choose the interchangeable 7 or 14-track lab models or the economy 4-track portable, you'll have high-performance recorders that will sharply reduce your operating costs.

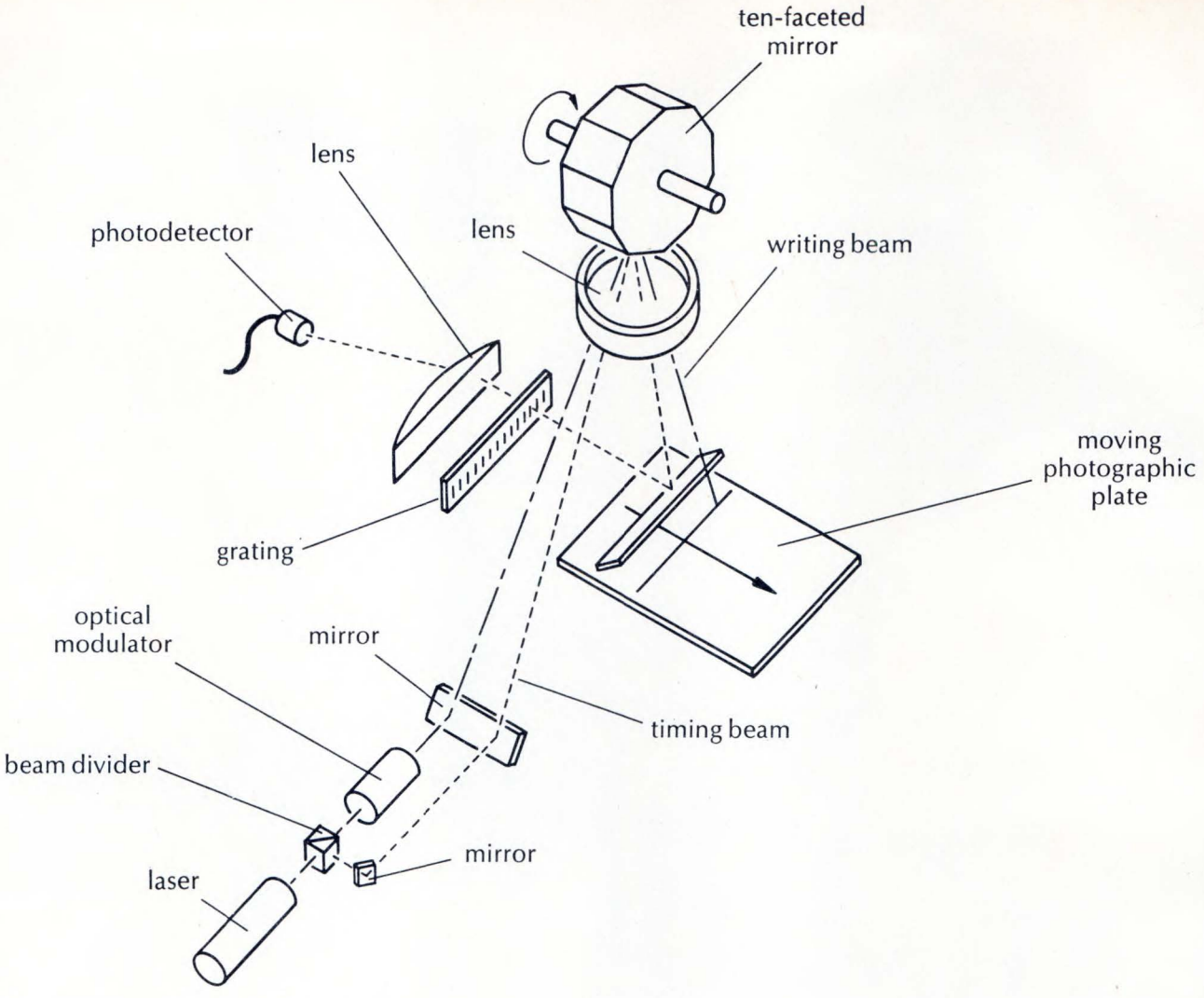
To that, add the initial low price that comes with HP quality electronics. If you want to see what these recorders can do, it's easy to set up. Your local HP field engineer will be happy to demonstrate the wide uses of these recorders in the medical, scientific and industrial fields. Call him. Or write Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

HEWLETT hp PACKARD

MAGNETIC RECORDERS

42004

CIRCLE NO. 27



Better circuit masks exposed

Making integrated semiconductor and thin-film circuits requires a set of photographic masks to outline the application or removal of materials during processing. The demand for these masks has increased as integrated electronics has come of age and it will continue to grow with the technology.

Mask-making has long been automated. The engineer feeds a geometric description into a standard program and a computer generates a tape. The tape controls a machine which moves a light beam or a knife along coordinate axes to draw the mask. This takes many hours.

Now, Bell Labs has developed a machine which can produce complex masks in under 10 minutes. The machine contains an argon-ion laser. The laser beam is scanned across an 8 by 10 inch photographic plate and switched on and off to expose the emulsion on the plate according to the mask pattern. As each scan is completed, the plate is shifted one linewidth. Scanning time—20 milliseconds per line—is independent of the number of times the beam is switched on and off.

Each facet of a ten-faceted rotating mirror (above) sweeps the beam once across the plate. At the same time, each facet sweeps an auxiliary laser beam across a grating, generating 26,000 timing pulses for each scan. A digital computer processes the pulses to determine the position of the scanning beam and to generate control signals for an acousto-optic modulator which switches the beam on and off.

The laser beam can be directed with an accuracy better than 2 arc-seconds, the equivalent of a mile-long straight line with less than $^{5}/_{8}$ inch deviation. For such precision, the machine is operated in a special controlled-environment chamber where temperature is maintained within 1/7°C and a cubic meter of air contains fewer than 3500 dust particles larger than one micron.

These high-speed, precise machines will supply the Bell System's mask needs for several years. As integrated circuits gain wider telephone use, this will keep costs down.

From the Research and Development Unit of the Bell System:

Bell Labs

Sweep Generator Boasts only Three Parts

Amid the welter of ICs, MSI and LSI, it's hard to find simple, reliable discrete component designs. Here's one for a sweep generator with excellent (0.07 percent) linearity and stability.

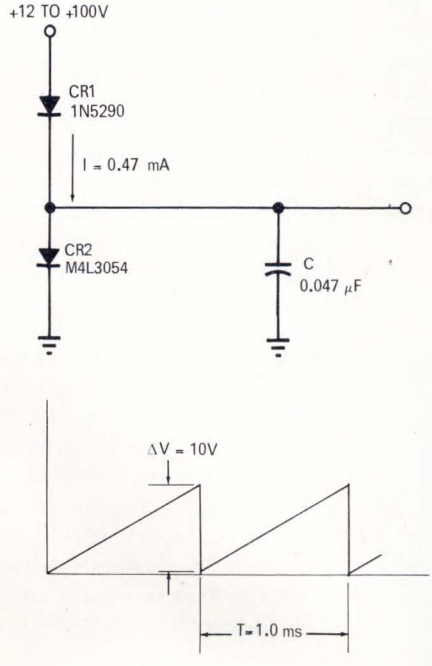
DENNIS R. MORGAN, General Electric Co.

In our enthusiasm to aspire to the state of the art, many times we overlook the simple alternatives. The judicious choice of a few components, rather than the indiscriminate choice of many, achieves high performance. One example is this extremely simple and reliable sweep generator consisting of a constant-current generator, a capacitor and a Schottky diode.

Sweep rates as high as 100 kHz can be achieved by the simple expedient of varying the value of the capacitor. Constant current generator CR1 charges the capacitor. When the breakdown voltage of the Schottky diode CR2 is exceeded, the capacitor discharges, and another cycle is initiated. The current range of CR1 is such that its nominal temperature coefficient equals the breakdown voltage temperature coefficient of the Schottky diode. For the series of current generators used, the optimum current is far enough below the holding current of the Schottky diode to assure reliable operation up to 75°C. For low-impedance output, just add an emitter follower.

Sweep rates up to about 100 kHz are attained by varying the capacitor value. If the capacitance exceeds 25 μF, a small series resistor is recommended. This resistor limits the discharge rate in order to stay within the secondary breakdown limit of the Schottky diode. □

Dennis R. Morgan is an engineer at General Electric's electronic laboratory in Syracuse, N.Y. He is presently involved with research and development of signal processing systems. He is a member of IEEE and is working toward his Ph.D.E.E. at Syracuse University.



Excellent linearity (0.07 percent) and stability over a wide range of supply voltage (12 to 100V) and temperature (−55 to 75°C) highlight design. Period is defined by

$$T = ZC \log_e \frac{1}{1 - \Delta V/ZI} = \frac{\Delta VC}{I}$$

where Z = CR1 dynamic impedence (ohms)
I = CR1 nominal regulator current (amps)
ΔV = Difference between CR2 forward-breakdown voltage and CR2 forward-on voltage. ($V_{BRF} - V_F$)
C = Capacitance in farads

Peak-to-peak percentage error between output and linearity is given by:

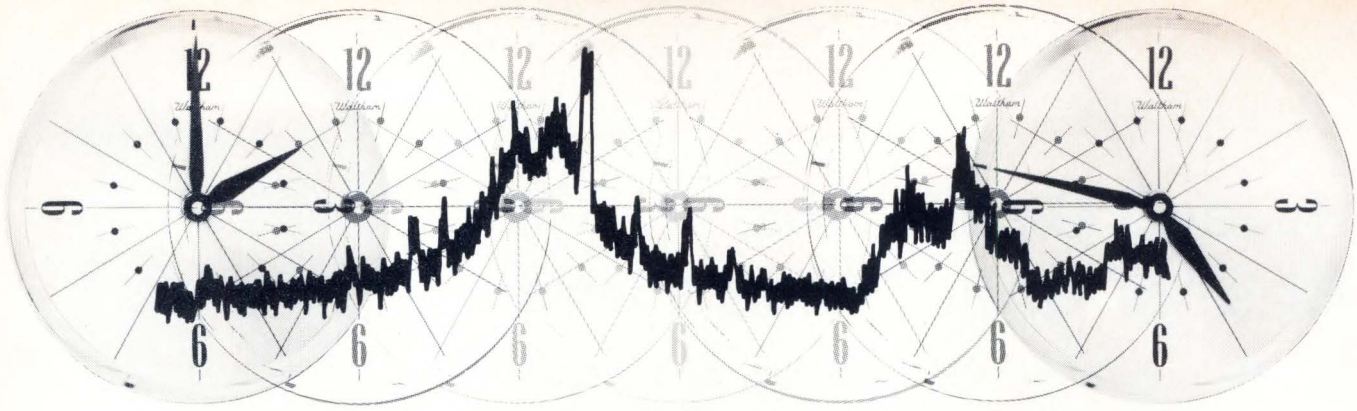
$$\epsilon = \frac{(\sqrt{2} - 1)^2}{2} \frac{\Delta V}{ZI} = 0.086 \frac{\Delta V}{ZI}$$

Calculated design parameters are

Z = 2.7 MΩ min at 25V
I = 0.47 mA
V_{BRF} = 11V
V_F = 1V

$$T = \frac{C}{0.047} \times 10^3 \text{ s}$$

ϵ = 0.07 percent max at 25V supply



A wave analyzer with a 10,000-second sweep time? Why?

090/6

...because, in low-frequency spectrum analysis work, you need to use a narrow-bandwidth window. The narrower the window you use, the slower you must sweep it across the frequency range to be analyzed. And the slower you sweep, the smaller a frequency range you can cover in any given time. Thus, until now, your choice has been either accuracy or range but not both.

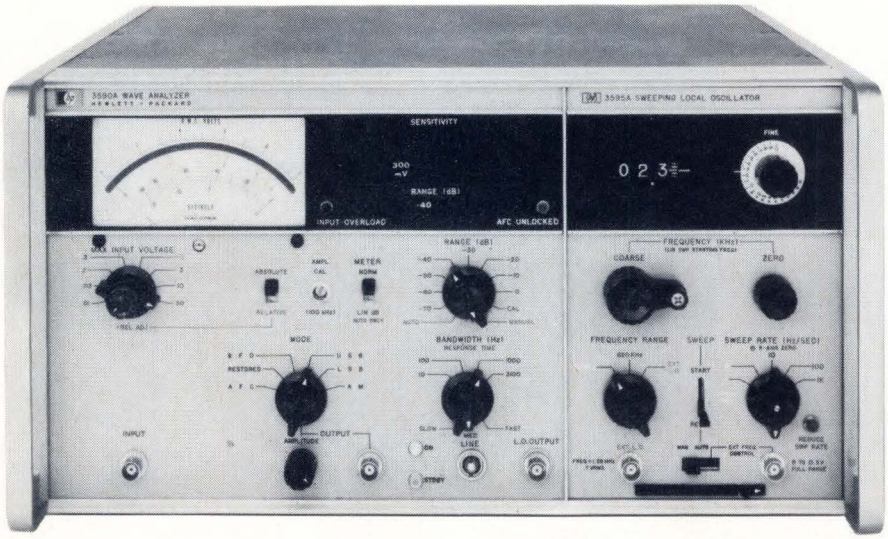
The new HP 3590A/3595A system solves that dilemma. The HP 3595A plug-in is a sweeping local oscillator with 10,000 seconds of sweep time available. By using it with the HP 3590A Wave Analyzer mainframe, you can scan the entire three-decade audio frequency range at 2 Hz per second, in one sweep. And, by adding an HP X-Y recorder, you can see the results on a single 11 x 17-inch graph.

In addition to extended sweep time, the 3590A/3595A combination also gives you a choice of five sweep rates (from 1 Hz to 1,000 Hz per second) and four filter bandwidths (from 10 Hz to 3,100 Hz), an 85 dB dynamic range over either of two frequency ranges (20 Hz to 62 kHz and 200 Hz to 620 kHz), 3 μV to 30 V sensitivity, and built-in autoranging for ease of operation.

The result is a systems-analysis tool ideally suited for work in the lower frequency ranges, with the capability to work in higher frequency ranges as well!

The 3590A Wave Analyzer mainframe is $3200; the new 3595A plug-in with the 10,000-second sweep time is $1250. Other plug-ins available for the 3590A are: the 3592A slave and program unit, for use with a second mainframe, $80; the 3593A with 3-digit mechanical display and 620-second maximum sweep time, $1100; and the 3594A with 5-digit electronic counter frequency display and 620-second maximum sweep time, $1600.

To get complete information on the HP 3590A and the various plug-ins, contact your local HP field engineer. Or, write to Hewlett-Packard, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

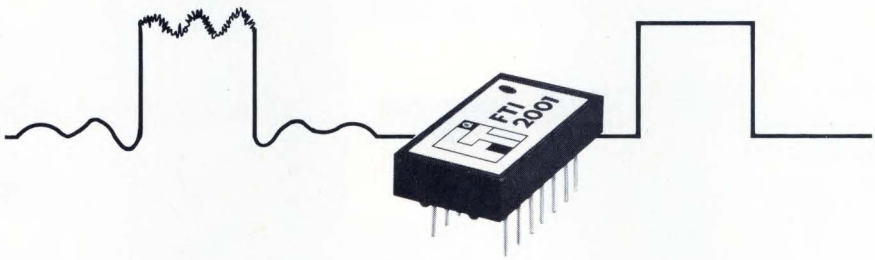


CIRCLE NO. 28

HEWLETT hp PACKARD

SIGNAL ANALYZERS

THE NOISE-ELIMINATING DATA FILTER.



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FABRI-TEK
MICRO-SYSTEMS, INC.

... where Hybritronics® got its name.

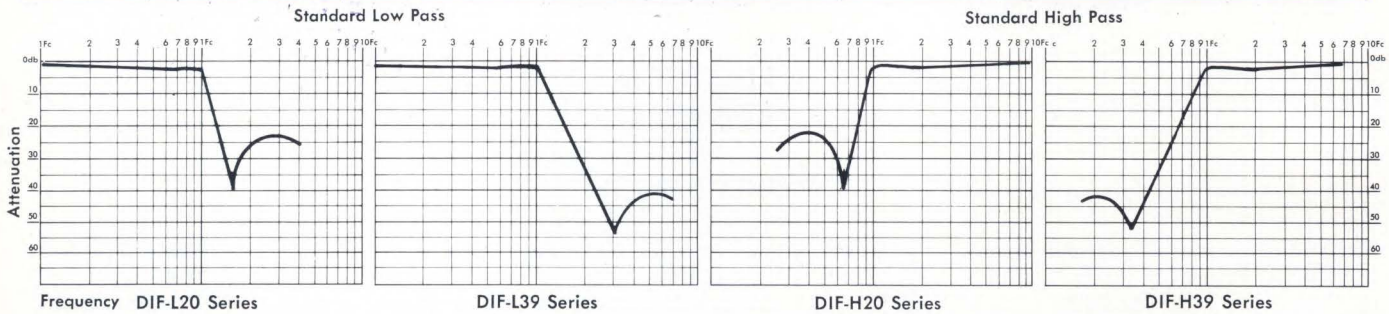
CIRCLE NO. 29

ESC Introduces ... The Dual In-line LC Filter Series – compatible with integrated circuit boards

To meet the demand for a standard miniature filter, ESC has designed and developed the DIF® (Dual In-line Filter) series. DIF filters are passive, stable networks that fit any commercial dual in-line connector or hole spacing. They meet the requirements of MIL-F-18327C, grade 5, class R operating temperature range of −55°C to +105°C.

In addition to the standard DIF filters shown here, other characteristics can be custom designed to your specifications in this case size e.g. linear phase, band pass, telemetering filters.

.76"L x .46"W x .25"H



Type	DIF-L20 Series	DIF-L39 Series	DIF-H20 Series	DIF-H39 Series
Insertion Loss	.5 db maximum at .1Fc		.5 db maximum at 10Fc	
Ripple	Less than ±1 db in passband			
Attenuation in stopband	20 db minimum at 1.4 Fc & higher	39 db minimum at 2.5 Fc & higher	20 db minimum at .715 Fc & lower	39 db minimum at .4Fc & lower

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Write today for your copy of ESC's DIF Filter brochure.

ESC Electronics

CIRCLE NO. 30

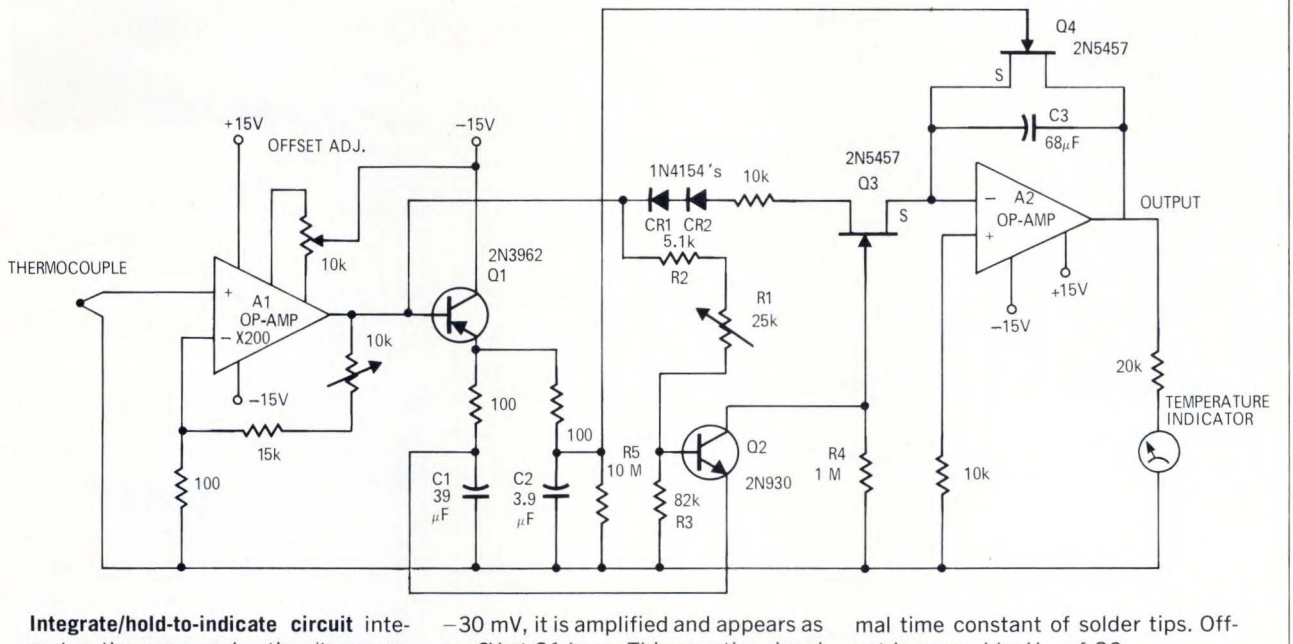
Heat-Energy Pulse Measured and Displayed

CARL BROGADO, Univ. of Colo. Medical Center

Heat developed in the tips of a pulse soldering machine must be adjusted for various size solder preforms. An integrate/hold-to-indicate circuit provides temperature readout on an analog meter.

Pulses of heat energy applied to solder preforms are metered by an integrate/hold-to-indicate circuit. Heat energy is applied in short, 1 to 3s pulses through the soldering tips of a pulse soldering machine. The heat energy is measured by integrating time versus temperature. Thermocouples located in the tips of the pulse soldering machine provide a millivolt output that is amplified and integrated. FET analog switches control the integrating and hold-to-indicate periods. Temperature readout is on an analog meter. Soldering-tip temperature (equivalent to heat energy in the tips) is adjusted for various size solder preforms. Temperature proportional to the energy in the solder pulse is indicated on a meter which allows an operator to adjust the soldering-tip temperature up or down as required. Because input pulses occur at intervals of 3 min or more, the operator has adequate time.

A circuit designed to provide the operator with such a meter indication uses an op amp integrator with a FET analog switch across the inte-



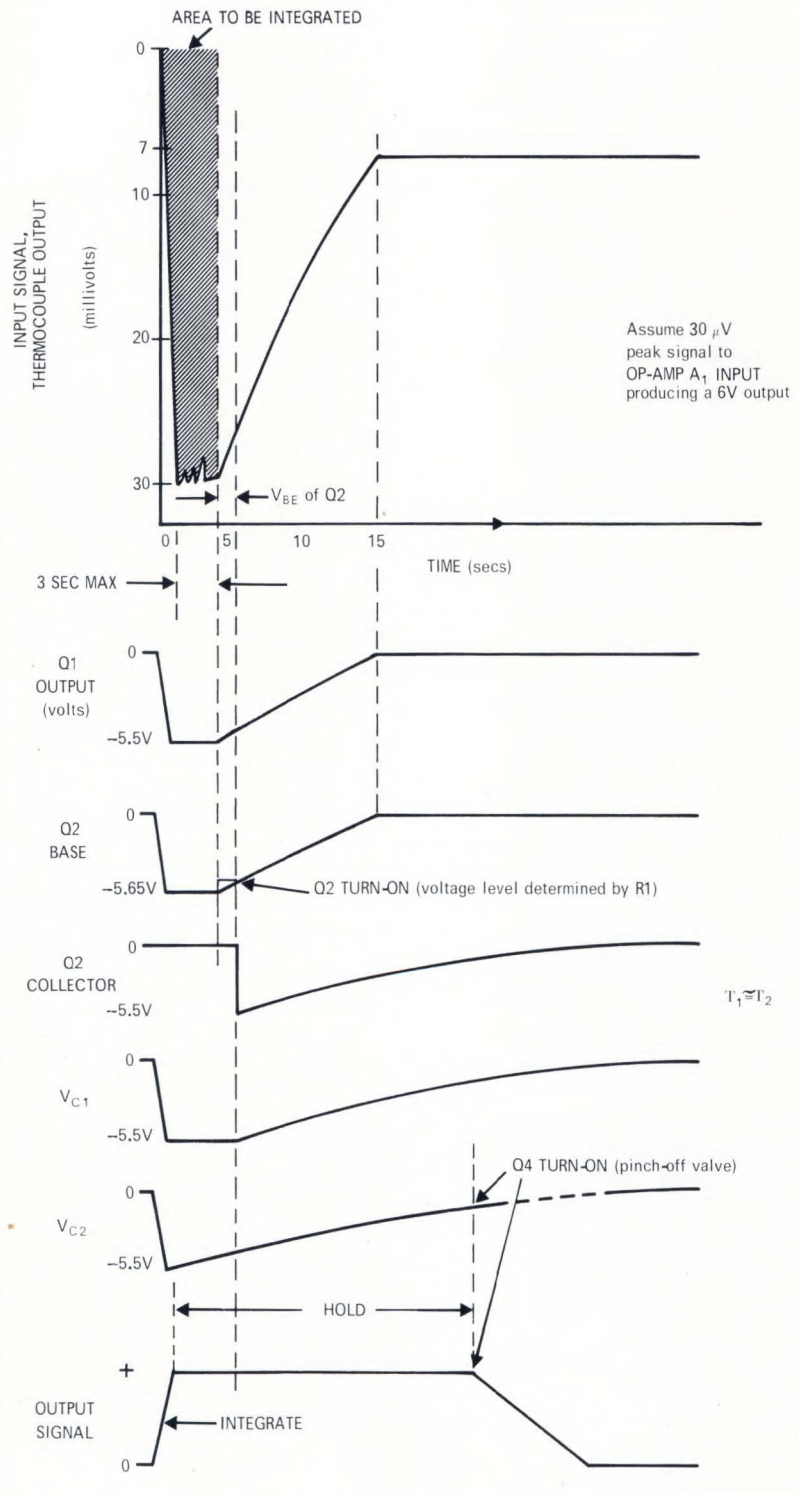
Integrate/hold-to-indicate circuit integrates the area under time/temperature curve (heat energy) measured at the soldering tips of a pulse-soldering machine. Temperature is indicated momentarily on a meter for adjustment by operator.

Noninverting input of op amp A1 presents a high input impedance to the thermocouple and amplifies the −7 to −35 mV thermocouple signal approximately 200 times. Op amp output normally is at ground potential, assuming −7 mV input and proper offset adjustment. A1 and Q2 then are OFF; analog gates Q3 and Q4 are ON because their gates and source terminals are at ground potential. As negative thermocouple output increases to −30 mV, it is amplified and appears as a −6V at Q1 base. This negative signal turns Q1 on to charge C1 and C2. Voltage divider R1, R2 and R3 is adjusted to keep Q2 OFF and Q3 ON. R1, when adjusted properly, places base and emitter of Q2 at same potential. As C2 charges negatively, Q4 turns off and unclamps integrator to initiate integration of the 3s maximum soldering pulse. At end of soldering pulse, C1 slowly discharges through Q2 and R4 to ground. Base of Q1 and Q2 fall off more rapidly (positive going) than emitter to turn on Q2 and thereby turn off analog gate Q3. Adjustment of R1 provides for Q2 turn-on slightly after end of pulse and on upward (positive going) slope of slowly decaying thermal time constant of solder tips. Offset is caused by V_{BE} of Q2.

Integrator then goes into a "hold" condition during which C2 discharges through R5 (time constant, $\tau 2$). As C1 discharges, the Q2 emitter reaches the same potential as the base and turns off Q2 causing Q3 to turn on, thereby ending the "hold" period. CR1 and CR2 keep Q3 from conducting on downward (positive going) slope of input signal. Without these diodes, a positive-going signal would be conducted through Q3 to be integrated in A2, and would result in a slowly rising effect on the meter. After C2 discharges (≈40s), Q4 turns on discharging integrating capacitor C3. Q3 and Q4 should have a V_p of 2V.

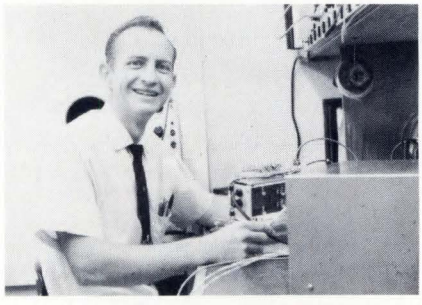
(Continued)

Energy Measurement (Cont'd)

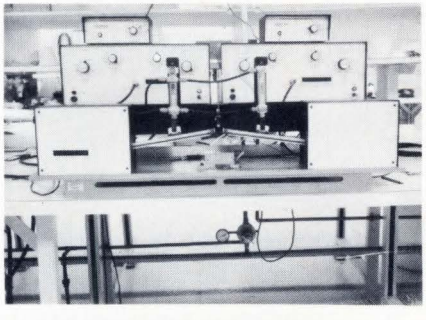


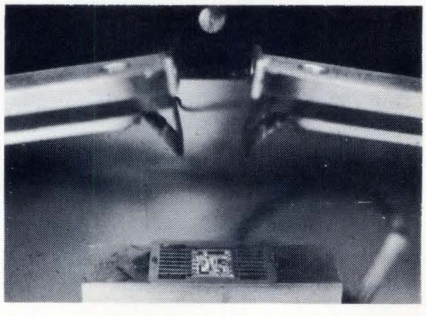
Timing diagram of input/output signals for integrate/hold-to-indicate circuit.

grating capacitor to clamp it to zero except while integrating. Another FET analog switch cuts off the input signal at the end of the integrating period to hold the reading. An input op amp amplifies the input signal from the thermocouple before it is integrated. A pair of bipolar transistors and associated circuitry control the switching and timing. □



Carl Brogado, formerly test equipment designer at Tecnetics, is now engineering technician in the Bioengineering Dept. of the University of Colorado Medical Center, Denver, Colo. Author of four previous EDN articles, Brogado developed this measurement technique for soldering Tecnetics' hybrid circuits.





Pulse soldering machine applies heat via tips (bottom) to hybrid-circuit leadframe solder preforms.

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CIRCLE NO. 31

CUSTOMER ENGINEERING CLINIC

Simple Scheme Isolates System Grounds Optically

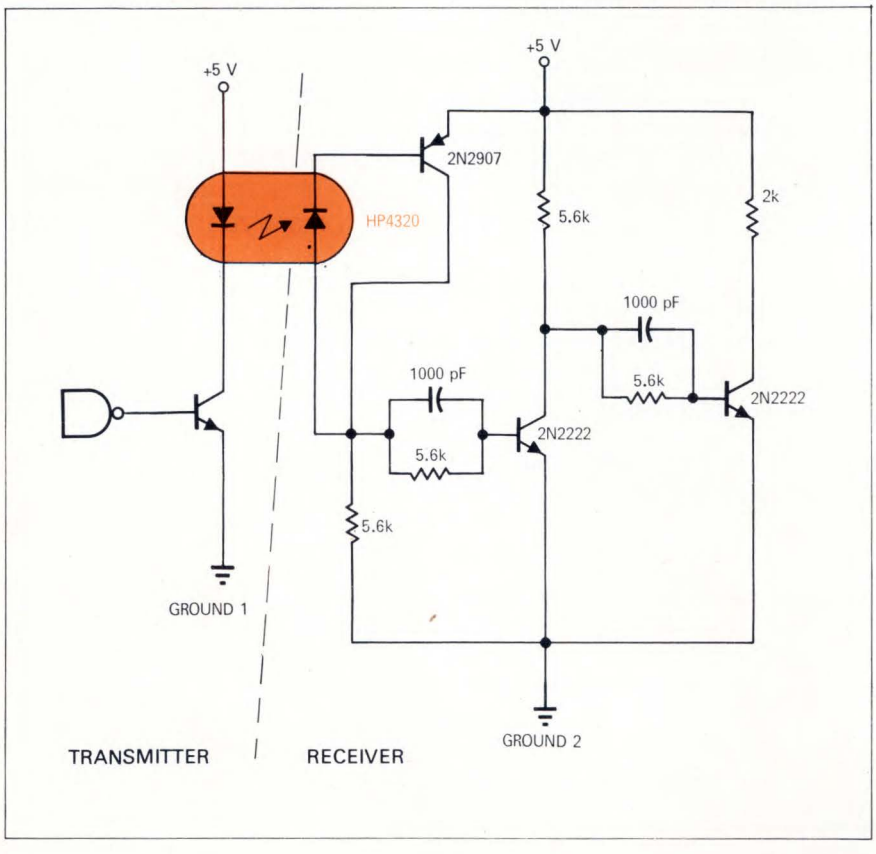
W. C. MILO, Autonetics

Problem: A DTL- or TTL-driven circuit with a bandwidth of dc-to-1-MHz must provide ground isolation up to 200V between systems.

Discussion: In aerospace design, one critical factor is the isolation of system grounds. For example, the isolation requirement between a spacecraft and the automatic ground equipment (AGE) is at least 10 MΩ up to 200V dc.

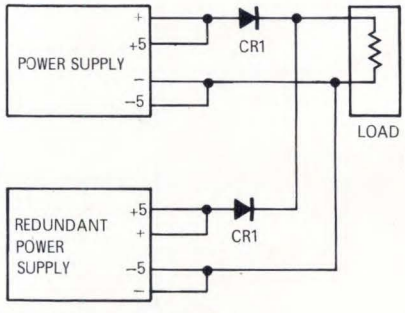
Solution: The heart of the illustrated circuit is the photon-coupled isolator HP 4320 (Hewlett-Packard HP 5082-4300 Series). Photon-coupled isolators are wide-bandwidth signal coupling devices, each comprised of a gallium arsenide electroluminescent diode infrared source and a silicon pin photodetector. A thin, optically transparent insulator separates the source and the detector.

The input, which may be in a separate and electrically isolated circuit, controls the signal applied to the photodiode. Insulation resistance between input and output is typically 10^{11} Ω shunted by 2 pF. The HP 4320 can withstand up to 200V between input and output. □



EDN will pay $50 for any problem-solution article accepted for publication.

NEXT ISSUE'S PROBLEM:



Resistors Restore Regulation and Redundancy

Load regulation is lost when power supplies are hooked up as shown to provide redundant operation. When the redundant supply doesn't come up to full output fast enough, redundancy also can be lost.

FOR A FREE REPRINT OF THIS ARTICLE, **CIRCLE NO. L66**

Executive Life

FIRST IN PERSONAL SERVICE TO BUSINESSMEN

SEPTEMBER 1970

Inside:

Why More Wives Are Going to Conventions

Is Your Desk Obsolete?

A CAHNERS PUBLICATION

HOW TO MANUFACTURE A MILLIONAIRE

ROBERT G. WOOLF, who turns struggling athletes into rich businessmen, has some tips to help you.

Boston attorney Robert G. Woolf is a rich man because he advises others how to become rich, too.

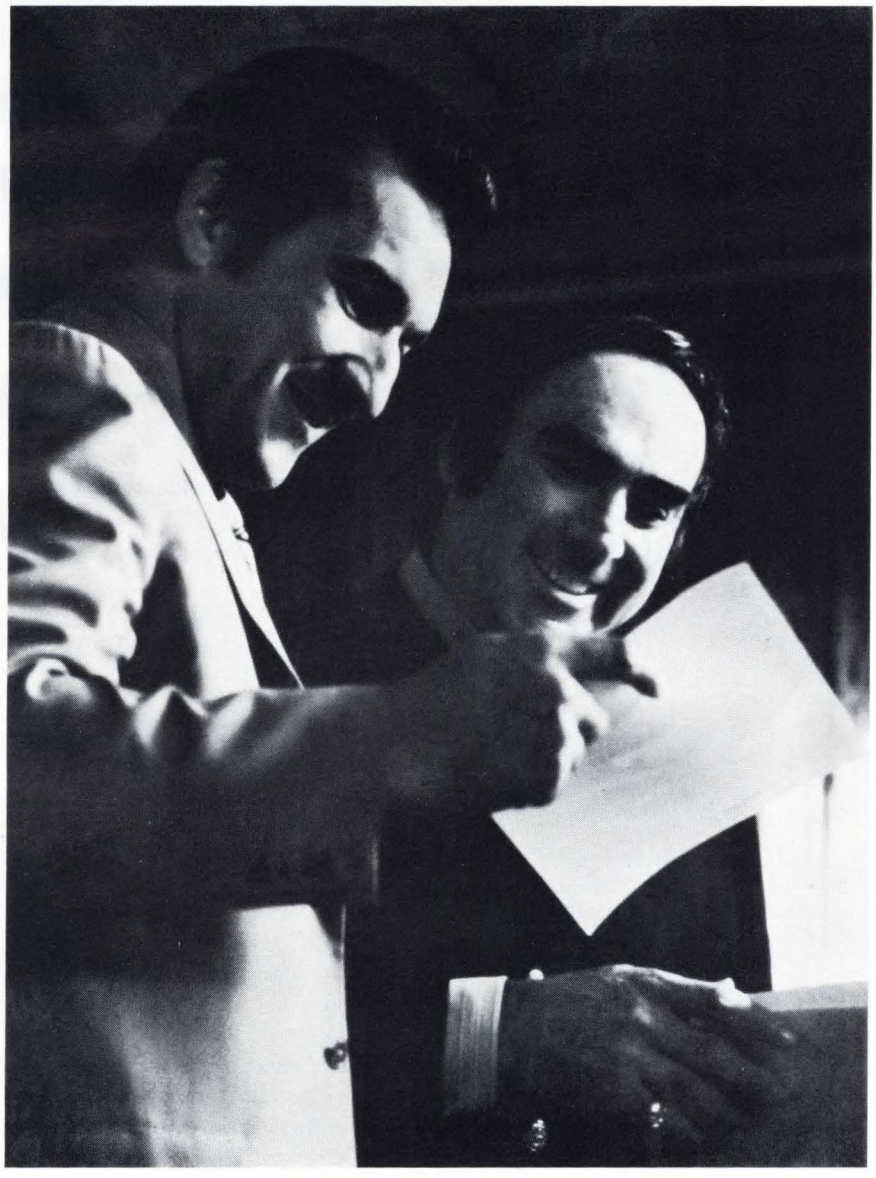
"But if you want to get rich quick, I can't help you."

That's what Woolf tells the 150 athletes he represents. He has made his fortune protecting and carefully building the incomes of the world's most prodigal sports personalities.

And he is convinced that his methods are equally applicable to businessmen, adapted to their advantage. His credo: "Every executive should be making more money."

Many of Woolf's clients, thanks to him, are the highest paid players in professional sports — including Ken "The Hawk" Harrelson of the Cleveland Indians; Teddy Green of the Boston Bruins; Neal Walk of the Phoenix Suns; and John Havlicek of the Boston Celtics.

Conversation about Bob Woolf has spread through the locker rooms of professional sports like fire through a wheat field. The reason is not only that Woolf has produced more money for more athletes than anyone else,



Attorney Woolf (right) and satisfied client, football pro Gino Cappeletti of the Boston Patriots.

but he has protected their incomes, and promoted their off-field images with more dash than "Colonel" Tom Parker, who made singer Elvis Presley a household name.

Bob Woolf is a combination of Clarence Darrow and P. T. Barnum. His legal expertise and attendant persuasive powers enable him to extract astronomical salaries from club owners (see box); and his highly creative knack for player publicity ensures that few of his athletes are ever out of the income-producing limelight.

Woolf's legal and publicity maneuverings for his players are as varied and colorful as the player-images he creates. He is, for example, now prodding the owners of the Dallas Cowboys to allow place kicker Zenon Andrusyshyn to wear a golden shoe. He helped transform Boston Bruin's Derek Sanderson from a lackluster off-ice hockey player into the "mod," long-haired swinger he is today. The results of Sanderson's rebirth: appearances on the national T.V. nighttime talk shows, scores of product testimonials, participation in Joe Namath's chain of Bachelors III clubs, and a possible movie contract or two.

At best, managing one's personal income is a time-consuming and risky business. All executives are subject to individual and often persuasive advice from an ever-increasing array of specialists — mutual fund salesmen, insurance salesmen, stock brokers, real estate salesmen, etc. How best should a businessman view the vital questions of personal money management? *Executive Life* asked Bob Woolf to tell his secrets.

Q. It sounds as though an important part of your service is protecting an athlete's income.

A. Yes. I conduct my business as a sports attorney the way a coach would direct his team. I have an offense and a defense. Each has seven key plays with slight variations. My defense is applicable to businessmen, or anyone else who is making substantial money. My defensive set-up is this:

1. Defensive measures and protection in a player's contract.
2. Corporate structures.
3. Tax shelters.
4. Insurance program and estate planning.
5. Protection against exploitation.
6. Protection of client's reputation and integrity.
7. Protection against bad investments.

Q. What would be the first piece of advice you would give a businessman about protecting and maximizing his income?

A. Basically we're all murdered by taxes, so it would be to assist in reducing them. Unlike professional sports, which is also a business, I think industry is far behind in using imaginative deferred compensation plans as incentives to attract and keep good men.

BRINGING HOME THE BACON

These are the five biggest contracts enjoyed by Woolf's clients:

John Havlicek, Boston Celtics	$600,000
Calvin Murphy, San Diego Rockets	300,000
Neal Walk, Phoenix Suns	300,000
Ted Green, Boston Bruins	250,000
Ken Harrelson, Cleveland Indians	200,000
	$1,700,000

When I negotiate an athlete's contract with management, I aim toward paying the least amount of taxes allowable under the law. Frequently I cooperate with management in splitting a contract into two parts — current compensation and deferred compensation.

Q. Not too many businessmen would be able to relate to the enormous salaries you produce for your athletes.

A. True, but I'm talking about a principle — a way of reducing heavy tax burdens. It amazes me that really valuable executives don't ask management for more creative ways of doing this, such as deferred income for retirement, restricted stock arrangements, and security trusts. Let's face it, companies should want to keep good men.

Unlike an athlete who has a much shorter career span, executives become more valuable as time goes on. Any deferred compensation plan for a businessman should take this into consideration. The valuable man's earning power will increase over the years; so he and management can project a step-by-step deferred compensation program much better than an athlete can, who at best has only ten good years and during that time will be slowly losing his overall ability.

Q. Well, of course, many individuals in business have these programs now.

A. Yes, but usually only after a man has reached the top. I'm saying that there should be more of it on the middle management level — long-term programs for people management wants to keep. A good man should insist on a contract, just like an athlete. Stock options should be requested. Business is business. As Bob Townsend said in *Up the Organization* . . . you can't beat an employee who has an equity in the company; he made sure all of his employees did.

In a sense, profit-sharing plans and imaginative deferred compensation plans are just this — they benefit the executive immediately by lessening his tax burden and in the long-run with interest growth. And they should be attractive to management since they help keep good men — which I'm told is a real problem these days.

Q. So you think a company should take as much interest in an executive's personal finances as you do in your athletes?

A. Absolutely. Help an executive succeed and he'll help your company succeed. The first thing I do with an athlete is find out how much he'll have to pay in taxes and then with various plans, try to reduce them. After that, I help the athlete split up his income into basics: living expenses, insurance, savings programs, mutual funds, etc. I help him create an estate and protect his future. Immediately, I insist that he execute a will, no matter what his age. This may sound obvious, but you'd be surprised how often it is neglected. And this helps solidify the creation of an estate.

I cannot emphasize this too greatly, especially for an executive. It seems to me that if all this were done, a secure executive would become a better executive.

Q. Many businessmen have little money left over after living expenses.

A. All the more reason to use wise-

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Johnnie Walker Black Label Six-Pack, about $60. Sold separately, about $10 a fifth.

ly whatever is left. With little to invest, it is critical not to get "conned" by the next door neighbor who is selling a "hot" mutual fund. The guy next door might be a terrific person, but is he an expert? I make it a point to get the best possible investment advice for my clients. It costs no more, and in the long run probably costs less.

Q. Over the years, what investments have proved best for your athletes?

A. It's hard to define "best." Remember, I tell my ballplayers, "If they are looking to get rich quick, find someone else." My position is to preserve, protect, and insure. I tell them that they have to work as hard at keeping their money as they do at making it.

So I have found over the years that the safest and most successful investments have been the purchase of common stocks in commercial banks; conservative mutual funds; municipal bonds and treasury bills which have great tax benefits; the formation of limited partnerships and trusts, and in many instances, the acquisition of real estate.

The important thing is to keep the money you make. Too many people get greedy and lose it. That's when the real trouble sets in. I believe that almost every athlete should have a lawyer to handle his affairs. I feel that successful executives should too.

Q. Are you proud of any particular investments you have made for your clients?

A. In many instances, the best investments I've made for my athletes are the ones I've kept them out of. We double-check everything. And so should businessmen. If I were a businessman contemplating taking a position with a new company, I'd want to know — to the letter — all the basics, and more.

For instance, what exactly are the long-term disability benefits in case you are unable to work? I mean aside from a hospital plan. How long will the company pay me if I am disabled? Is it a part of my contract?

This, of course, is critical to athletes and I really focus on this aspect when negotiating contracts. A case in point is Teddy Green of the Boston Bruins. Last year, I negotiated a contract for him that reportedly made him one of the highest paid players on the Bruins. This was before he was hit on the head by Wayne Maki of St. Louis during an exhibition game in Canada. Green was disabled for the year.

In his contract was a vital disability clause that stated that Green would be paid should serious injury disable him. He was paid, and I'm sure that management would have seen to it anyway; but it is wise to have it in writing. I have required this guarantee for all my athletes, and executives should make it a bargaining point too.

Q. Do you believe business management would sit still for the kind of contracts you are advocating?

A. If they really want a man. And I'm told that good talent is getting hard to find in industry. Frankly, I believe really talented business managers are going to get scarce in the years ahead. I think good men are going to be in an excellent bargaining position.

Q. Why are you so successful in getting big salaries for your clients?

A. Mostly because I have been fortunate enough to represent athletes who have great talent. They are in demand, and the burden is on management to present an attractive proposal. The same should be true for businessmen. Give me a top marketing man and a few interested companies and you have the same situation I have with my athletes.

Q. What is your fee?

A. My fee is based purely on my performance. It's based on what I accomplish and not on any percentage of income or anything of that nature. People always think I get ten percent. I don't. I charge a mutually agreed-upon fee at the end of a certain period of time.

Q. Will you ever represent a businessman?

A. Why not? If he is a good one: talented, ambitious, aggressive, and wants to advance. If he's in demand and has real potential. I think we could work something out.

Better Incentives in Store for Executives

by R. J. Wytmar, President Wytmar & Co., Inc. Management Consultants

Thirty years ago about 75 percent of an executive's compensation package was derived from salary and bonus, the balance from pension benefits. During the past twenty years, various forms of stock distribution have become highly popular. Today roughly 45 percent of an executive's compensation package comes from salary and bonus, about 30 percent from stock distribution, the balance from insurance and pension plans.

Recent compensation studies demonstrate that top management pay *has not* kept pace with industry growth and economic inflation. Management excellence continues in short supply and companies are faced with the fact that new compensation plans must be devised to attract and hold top calibre executives.

Executive earnings (salary and bonus) have increased an average of only 4.8 percent per year over the five year period 1964 to 1969. It is predicted that executive earnings will rise dramatically during the next five years with an average annual increase of 10 percent (which includes a 3 percent annual inflation factor). More corporations will predicate or relate executive compensation to corporate size and periodically adjust executive pay directly to corporate growth.

Look For Unique Plans

New and imaginative compensation plans which tailor the total pay package to the needs of the individual executive will become more prevalent. Financial and legal expertise will be utilized by companies to assist their key executives in estate planning and maximization of take-home pay.

Incentive compensation (bonus and profit sharing) and stock distribution plans based on corporate achievement and individual performance will be extended to more executive and managerial personnel. New types of stock distribution will be devised to minimize the impact of a gyrating stock market.

Insurance programs will become more sophisticated. Insurance for key managers will see a large growth, and many companies will adopt a "loss of job" insurance for top people.

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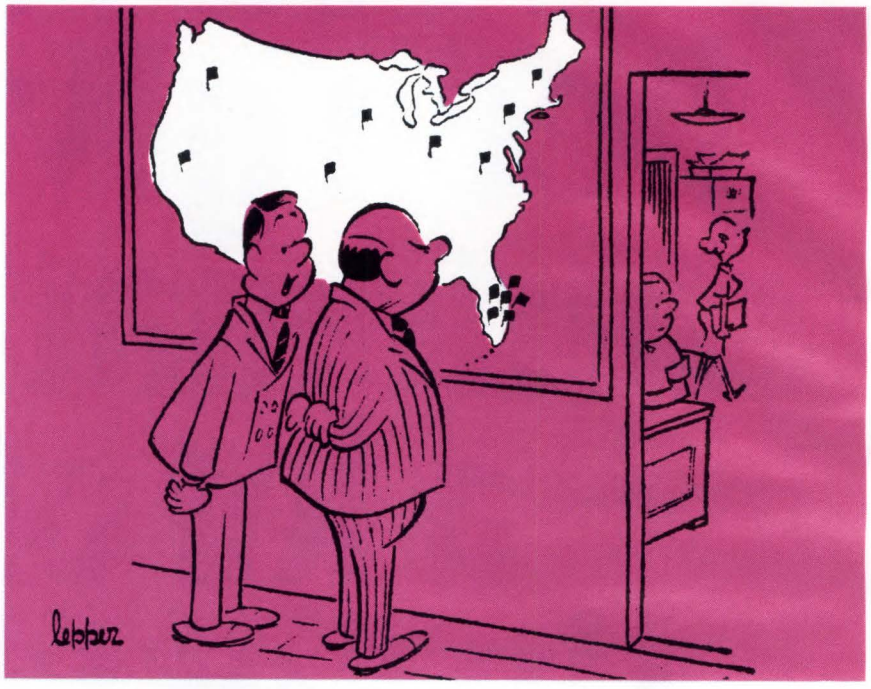
WIVES ARE A CONVENTION "PLUS"

It's more fun and, very often, good business to take your wife along. And she's deductible.



"That's Stebbens. He's got his wife and kids with him this trip."

Convention managers have finally realized that wives have minds and want to do something with them. Businessmen are learning that wives can be a help at conventions. The result: attendance of wives at conventions has soared — one of the most significant developments in the $5 billion convention industry.

"There are definitely more wives in attendance today," says James P. Low, executive vice president of the American Society of Association Executives, whose 3,400 members are responsible for most of the big conventions held in the United States. "It's a trend that started after World War II and accelerated in the 1960's."

Confirmation comes from the New York Convention and Visitors Bureau, which reports that more than 60% of its 1969 convention delegates were accompanied by their wives, as against a mere 15% in 1953 and 35% in 1963.

Not all convention sponsors keep separate records, but the National Association of Home Builders does. NAHB convention executive Dick Newman tells what the records show: "From 1956 through 1960, wives' attendance averaged 2,302 per year. From 1966 through 1970, it more than doubled, to 4,997."

The trend holds true for state and regional associations, too. From 1966 to 1969, wives' attendance at the California Life Underwriters Association annual meeting zoomed from about 20% to 62%, according to Donald Burns, who manages the association.

"We used to offer wives nothing but fashion shows, zoo tours, social events. Then in 1967 we decided to give them a couple of things they could sink their teeth into. We brought in a doctor to speak on executive health ("How to Let Your Husband Live"), and also had a panel of top insurance men tell their wives exactly what their husbands were doing all day to earn a living. The audience participation was so enthusiastic that the session ran an hour longer than we had planned. Right then we knew we were onto something important."

Just as the convention can do a lot for wives, Burns believes, their presence does a lot for a convention.

"Wives make for a helluva lot better convention," he says. "The atmosphere is more dignified and business-like. There's less drinking and staying up all night, which was inevitably a problem at all-male conventions, and attendance by delegates at work sessions is better. And of course, the wives get a better appreciation of what their husbands are doing and why, and that makes both sides happy."

The all-male convention, in point of fact, seems to be on the way out. According to several surveys, some 80% of all conventions have special programs for women. Another 15% make wives welcome but have no specific women's program, while a die-hard 5% hang out the "Men Only" sign.

"Women's liberation has come to the convention field," sums up Philip Harrison, publisher of *Sales Meetings* magazine, "And it's about time."

Wife's Expenses Deductible, If . . .

If the trend is easy enough to recognize, the reasons behind it are somewhat more complex. "There's always been a basic resentment on the wife's part when her husband goes off and leaves her alone," says Harrison. Now many companies are realizing how important the executive's or salesman's wife can be to his job performance, and they're paying her way to conventions. She meets the people he works and does business with, helps him entertain, and gets to understand him a lot better. It's just plain good business. For a little extra cost, they get an extra member on the team."

The Internal Revenue Service, which in 1963 adopted a hard line on expense deductions for wives, has apparently decided it *is* good business. Tax experts say a recent IRS policy change will allow full deductions for a wife's expenses if she attends as little as one hour of business sessions per day.

Although the average ladies' pro-

gram is still more likely to include a fashion show than a panel of psychologists explaining the business pressures on husbands, a recent but rapidly growing trend toward more serious women's programs has undoubtedly lured many a "new" wife over the convention threshold, just as it did for Don Burns' group.

Says ASAE's James Low, "Convention programs in general have become more educational and more sophisticated in the last ten years, and so have women's programs. Wives aren't just housekeepers and cooks anymore. They're important partners in a businessman's life. Associations which treat them with the importance they deserve are rewarded with higher attendance, and with better conventions."

Ideas on how to treat delegates' wives importantly vary widely from convention to convention. A lot depends on the nature of the convention, and on the kind of woman involved.

In fields where wives are likely to be active partners in the business — real estate, retailing, home building — a high proportion of wives attend all or most of the business sessions, and social and business aspects tend to overlap (translation: *everybody* talks shop all the time).

"We run a family-oriented convention with an emphasis on education, says Washington-based Dr. Walter Kardy of the Mechanical Contractors Association of America, who enjoys an 80-85% wives' turnout. "Along with educational sessions for the men, we offer them for the women, too, and their attendance is high. Of course, many of the wives are helping run the business, so they attend as equals. And for the wife as a person, we'll have a variety of things: sessions on understanding the husband's business, the stock market and Agnes de Mille on the theatre."

Where the Wives Go, and Why

Convention consultant Charles Louis Schafer, who attends scores of meetings every year, emphasizes the importance of the vacation aspect as a motivator of wives. "Conventions in cities with high tourist interest always draw the highest percentage of wives," he says. Statistics back him up: San Francisco and Miami Beach lead in average proportion of wives attending at about 75%.

But generally the overall trend is toward more genuine wifely involvement in the convention itself. Mrs. Ruth Buck, whose husband is a hospital administrator, has attended more than 50 conventions of the American Hospital Association and its state and regional affiliates since 1940. She says, "Women who used to attend for the socializing have become more and more interested in the true subject of the convention. At first, I went along because it was the only time George could get away from his job — so it was a vacation for both of us. Then I started attending some of the sessions and the exhibits. After all, we had hospital for breakfast, lunch and dinner at home, so naturally I got interested. I found that really attending the conventions was the best way to keep up with what was going on in my husband's business. It helped me help him."

Generally speaking the higher the business or professional rank of a man attending a meeting, the more likely he is to bring along his wife, and the more likely she is to be treated as an equal.

The NTL Institute's week-long Presidents' Conference on Human Behavior, which costs $1,600 to attend and draws top men like Thomas Carroll, president of Lever Brothers, Vernon Stauffer of the restaurant chain and Carl Gerstacker, Chairman of Dow Chemical, runs a parallel program for presidents' wives which costs an additional $1,000.

"It's tremendously important to have wives there, too," says Leland Bradford of NTL. "More than half our conferees bring their wives, and the ones who don't usually regret it before the conference is over.

"When you're the top man you're a pretty lonely guy. You never can be sure if your subordinates are leveling with you. But putting the wife through the same course as her husband, we give her a new understanding of what he's up against. We have two long separate group meetings for husbands and wives per day, but sometimes I think the most fruitful time is after the evening sessions when husband and wife talk over what's happened during the day. We call it 'The Bedroom Group.'

"After one recent conference a wife told me, 'It's changed my whole life, and his. I've really gotten involved in what he does — and we both love the change.' "

They Come to Learn

Pierre duPont of the Young Presidents' Organization is another believer in attendance by top executives' wives. "All our members bring their wives," says duPont, "unless they're pregnant or getting a divorce. Over 90% of our sessions are open to wives, and they attend them almost as well as the men. They come for the same reason their husbands do: to learn. They want to grow with their husbands."

— *James O. Dunaway*

Why Take Your Wife?

Is it worthwhile to bring your wife with you to a convention? By and large, the answer is "yes."

From a business point of view, a wife can be a big help. She can make socializing, both formal and informal, more relaxed and more rewarding, especially if you're selling or trying to make important contacts. She can also cover some of the meetings you have to miss, and help you shop the exhibits more efficiently. Given a chance, she may turn out to be a pretty good businessman.

Just as important, if you make attendance a working partnership — as more and more conventiongoers are doing — she'll have a much better idea of what your job is all about. This kind of understanding can go a long way toward easing the tensions of married life, tensions which seem to keep increasing as life gets busier and more complicated.

If there's a woman's program with serious subjects, whether oriented toward culture, family life, contemporary problems or business, she'll come back mentally refreshed and maybe a little wiser.

Even if she just goes along for a vacation, and spends all her time loafing or shopping, she'll still probably make contacts which can help you in your work. And she's bound to appreciate a few days away from housework

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Petroleum Production Engineering Technology
Petroleum Refinery Oper.

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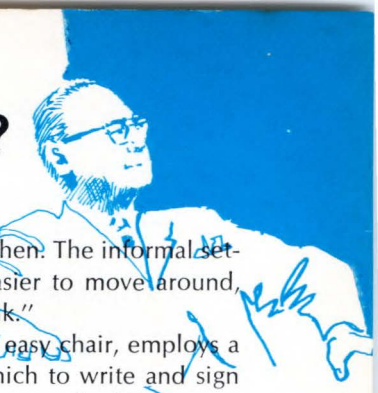

Desks as we know them may be going the way of the quill pen.

"My desk used to be a place to bury unmade decisions," says Lauriston Crockett, a Chicago insurance man. "Essentially it was nothing more than a filing cabinet filled with 'someday' items that took up space."

Crockett is one of many executives taking a hard look at the purpose a desk should serve. They are trading furniture for function, and the results are deskless offices.

Crockett works from a round glass coffee table. "If you don't have anywhere to hide your paper work you'll get through it more quickly," he says.

So he keeps no files or papers himself; relies on assistants to bring him items needing attention. He acts quickly on new matters or, if they can't be settled, jots down thoughts, routes them to those who can add ideas or material, or has them tickled for a second look. He simply refuses to be buried in a paper grave of his own making.

Crockett believes that many executives use conventional desks as symbols of office — for prestige. "They feel more important; the man in front less important," he says. "Neither is relaxed. Eliminating the traditional desk brings about an informality which encourages easier conversation and faster moving conferences."

Peter Flynn, a Boston executive, also works from a round glass table.

"I asked myself what I needed a desk for," Flynn said. "The answer was nothing. Specifically, an executive's job involves signing mail, making notes on reports and correspondence, running meetings, dictating and telephoning — none requires a desk. Take paper work; three or four times a day my secretary brings a folder of correspondence, memos, and reports. Since the only place I can put it down is on my coffee table, I do the job right there and then. The informal setting makes it easier to move around, dictate, and think."

Flynn uses an easy chair, employs a clipboard on which to write and sign letters. His out-going basket is in a sideboard. Paper clips, pencils, and similar items are in a little drawer built into an adjoining bookcase. So is his dictating machine. A single personal file holds all necessary current reference material.

"The point is, "Curtail clutter," Flynn said. "But you probably shouldn't go as far as one friend of mine who kept his telephone inside his desk drawer."

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Songs of the Humpback Whale

It has recently been discovered, by Dr. Roger S. Payne of the Institute for Research in Animal Behavior, that Humpback whales sing — wonderful, complex, moving songs. Many scientists and musicians have called these songs the most beautiful sounds of any in the wild world.

The songs of the Humpback whale—which you now have a chance to hear on a remarkable record—are surely one of the most startling and beautiful of the ocean's mysteries. Who would have expected that, even now, we could discover an entirely new point of contact with the wild animal world? Yet with the discovery of the Humpback songs this has happened. They add an entirely new dimension to our experience of the natural environment.

Who would have supposed that the enormous whale—the world's largest animal, one of its most intelligent and most mysterious, the graceful giant of the ocean depths —sings songs that can overwhelm humans who hear them? Yet this happens. People who hear the record—and read the accompanying book—never fail to be deeply impressed, often profoundly moved, by the experience.

A major scientific discovery now on a unique record

Until now these songs have been heard by only a small number of people: Dr. Payne, his colleagues at The Rockefeller University and the New York Zoological Society, and the fortunate few for whom Dr. Payne has played the songs during his lectures. But now our Executive Life readers can also have this experience. This record has been made as part of an effort to alert ecologically responsible people here and abroad to the fact that whales are now being rapidly hunted toward extinction. Dr. Payne has selected from his many hundreds of hours of recorded songs the outstanding examples, which are presented on the 12-inch stereo record we are offering you here. With the record comes an important book about the songs and the present fate of whales. In cooperation with the New York Zoological Society, we are offering you through this unique record and its accompanying book not only an incomparable listening experience, but also a chance to participate in a fast growing international movement to save whales.

The majority of the profits from the sale of these books and records goes to the New York Zoological Society's Whale Fund, a non-profit organization devoted solely to the study and preservation of whales.

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How were the whale songs discovered? The large, fully illustrated book that accompanies the songs tells this story and much more. For instance, it explains why the Humpback's sounds are in fact songs, and it shows you with spectrographic charts the phrases and themes that compose the songs you will hear on the record. More fascinating still, it explores the possibility that the lowest notes of the Humpback's song may travel tens, even hundreds, of miles through the ocean's "deep sound channel," perhaps carrying an intelligible message to other whales vast distances away. And it also explains, with scientific accuracy, just how severely threatened the world's whales now are. If the slaughter is allowed to continue only a short while longer, we may never be able to pursue the fascinating discoveries that are only now being explored; we may never learn what these magnificent whale songs mean.

The whale's world is our world

Every day more people wake up to the fact that our survival depends on maintaining the natural balance of the whole earth—a balance in which whales are as important as we are. And yet, if we don't get involved right now, the whaling industry will soon have slaughtered every species of whale out of significant existence. There's still time. The world has not yet lost its whales. Like us, you can get involved now and help swing the weight needed to get whales protected. You *can* do something, right now, to help save the world's whales.

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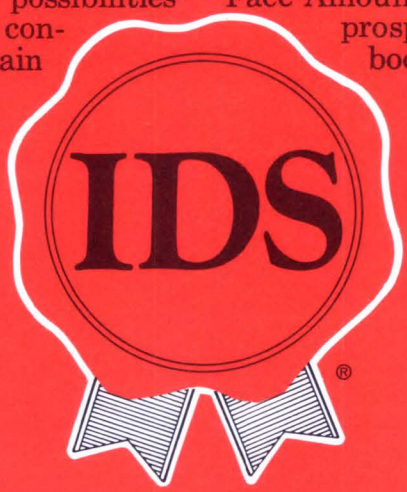

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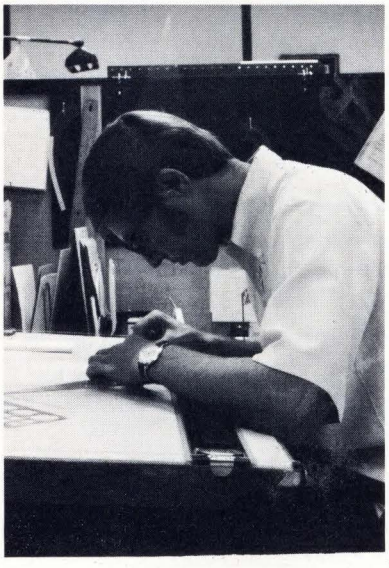
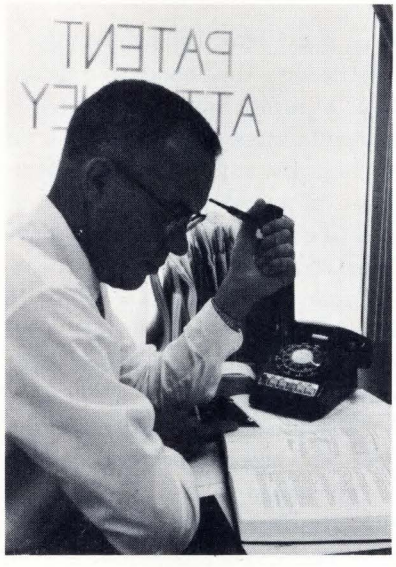




Patents—Why Bother?

Patent procedures and language mystify the average engineer, and they cost companies time and money. But trying to operate without patent knowledge in today's competitive world can be a blunder.

ROY W. FORSBERG, Boston Regional Editor

Engineers who understand patents possess a powerful, two-edged tool. On the personal side, patents can result in career advancement and monetary rewards. On the professional side, they can be a reference source that reflects past development and portends future engineering trends.

Companies also can benefit from full understanding of patents. Not only do patents protect a company's rights to its own processes for a set time period, but they also help the company steer clear of areas staked out by previous inventions. Unexpired patents are valuable property, and the company that unwittingly trespasses on this property may create both legal and public relations problems for itself.

From the viewpoint of an industry as a whole, patents provide stepping stones to new advancements in the state of the art by creating stimulus and incentive for inventive minds to come up with newer techniques, variations, and, in the end, competitive items.

What's in It for You?

For you, as a designer, the benefits depend on where you are employed. The principal benefit, and the im-

(Continued)

mediate one, is the patent incentive or award program. To get a handle on the answer, EDN conducted a limited survey among the country's major electronics firms. Of those surveyed, roughly 50% had a patent incentive or award program, 43% had none, and 7% said "it's a secret".

What is an incentive plan? Most companies take a posture similar to Raytheon's—that honoraria should be considered as tokens of recognition rather than as full compensation related to sales. In fact, none of the plans reported is tied to market value of the invention, although a few had special awards for significant inventions. Unusual creative or inventive ability is rewarded by advancement and readjustment of salary. Before you say "Aha! Exploitation!", it's only fair to point out one pertinent, although little-known fact: only a very small percentage of the more than three million patents issued during the history of the U.S. Patent Office have earned any money at all. So, in the long run, the engineer who accepts an award in the $100-200 range comes out ahead.

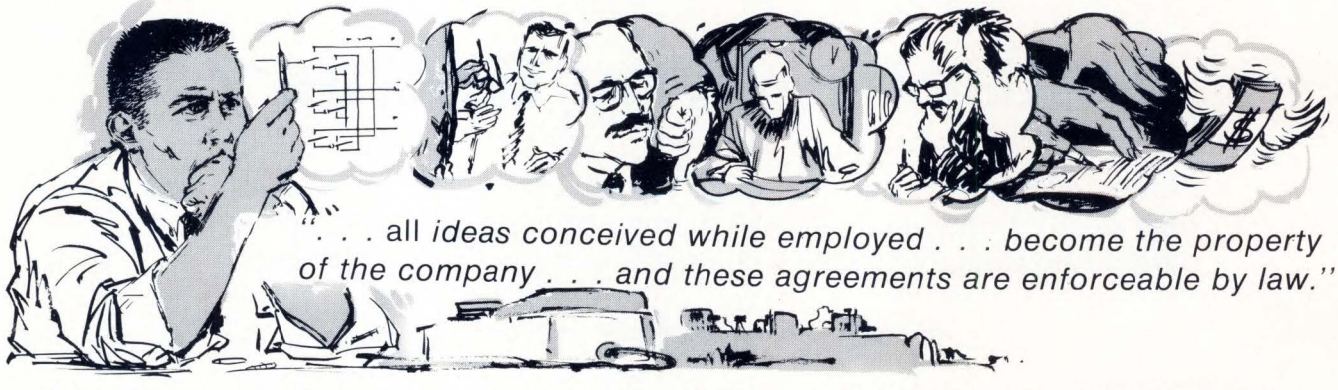
There are some valid arguments on the side of those companies that have no incentive plans. A few of those surveyed expressed views similar to North American Philips' statement that cash payments create individual competition and thus less cooperation among engineers who don't want to share awards. Because some individuals are in a position to invent, while others who are equally talented are not, North American Philips felt that an unfair situation exists. This might be questioned, however, since most of those who are not in a position to invent are eligible for participation in employee suggestion plans—often at higher award rates than patent incentive plans.

Among other arguments that companies present to justify their positions are: inventive persons are rewarded by promotion and salary increases (may be true in small or rapidly growing firms); the engineer's acceptance of salaried security implies that invention is a normal part of his work (try *that* one on your unemployed friends!); and finally, from Bell Telephone Lab's. excellent book "An Introduction to Patents", the citation that professional prestige and freedom to publish outside are reward enough.

Carrot on a Stick

The ingenuity that has gone into some of the more elaborate incentive plans is notable. One of the first to come to mind is IBM's "Individual Achievement Award Plan", which operates on a "point" system. Each patent is worth three points and each technical article published in the company's scientific bulletin is worth one point. When the inventor collects 12 points, he is awarded $1600.

Another part of IBM's program, the "Outstanding Invention", starts at $1000 for inventions of outstanding significance to IBM. So far, the highest award, $180,000 (that's right!), was split by three inventors for the development of the basic computer communication channel. IBM also maintains a "Fellow Program"—a 5-year fellowship allows an individual to work on projects of his choice at any IBM location. Since 1963, about 40 of these fellowships have been awarded.



VARO's incentive plan takes another tack—a progressive one. Twenty-five dollars is awarded for each disclosure accepted; $25 when patent search is completed and application is ready to be made; and $75 when patent application is filed at the U.S. Patent Office. All valid patent disclosures become eligible for "Inventor of the Year" awards at the annual Inventor

Awards Banquet, with the top three worth $1000, $750, and $500. An additional award of cash or company stock is called the "Business Success Award".

General Dynamics Electric Boat Div. has some unique aspects to its plan. Besides a $100 award for each disclosure accepted, the employee receives 15% of the proceeds of inventions sold or licensed to others (less expenses) and 15% of recoveries for infringements (less expenses). Payments do not depend on the inventor's continued employment with General Dynamics, and in case of death, the proceeds go to his estate.

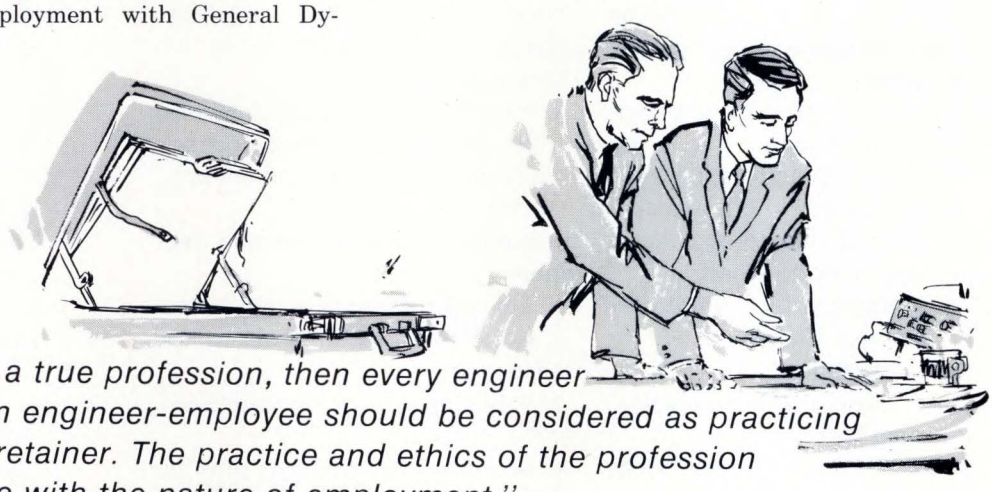
Other companies had special awards of cash for patents that are business successes, for publication of technical notes, or for worthwhile disclosures that must be kept secret or are not patentable.

Most companies make their patent awards when the application is filed at the Patent Office, although some make the award at time of disclosure and others when the patent is actually granted. The trend is definitely away from partial payment systems like VARO's. A few companies make their awards once a year at a special dinner, and it is "tough luck" to the engineer who is no longer with the company at award time.

Sign Your Life Away

Fully 95% of companies responding required engineers to sign patent agreements as a condition of employment. Most of these agreements essentially say that *all* ideas conceived while employed shall be disclosed to the company and become the property of the company . . . and these agreements are enforceable by law. Only 17% would release a patent to its inventor even if it was outside the company's line of business or would not be used by the company. Even then, the company retains right of royalty-free license.

The employment agreement policies appear to be a bigger bone of contention between engineers and employers than lack of an award system, but both have resulted in Bill No. HR15512 filed by Rep. John E. Moss (Calif.) on Jan. 22, 1970.



"If engineering is a true profession, then every engineer is a consultant. An engineer-employee should be considered as practicing on the basis of a retainer. The practice and ethics of the profession should not change with the nature of employment."

Moss Bill Seeks Equity

When filing his bill, Rep. Moss also included in the Congressional Record an article by Robert J. Kuntz, P.E., first vice-president of the California Society of Professional Engineers. Mr. Kuntz quotes the Canons of Ethics, Creed, and Rules of Professional Conduct, which states: "A customer, in designing apparatus, does not acquire any right in its design, but only the use of the apparatus purchased. A client does not acquire any right to the ideas developed and plans made by a consulting engineer, except in the specific case for which they were made."

Interpreting this, he notes that "the rule specifically mentions 'consulting engineers', however this is the only reference made to the rights of inventors in the code. If engineering is a true profession, then every engineer is a consultant. An engineer-employee should be considered as practicing on the basis of a retainer. The practice and ethics of the profession should not change with the nature of employment."

While this is all well and good, Mr. Kuntz does not

(Continued)

Basics of Moss Bill HR15512

A. Applies to all inventions and proposals for technical improvement made by:

1. Employees of private persons or organizations.
2. Military personnel and employees of Federal, State, territorial, and local governments.
3. Other persons who consent by contract to be treated as employees.

B. Definitions

1. Proposal for technical improvement is an innovation.
    a. Not patentable because of inclusion in prior patent
    b. Application of secret process or trade secret
    c. Uses products which cannot be analyzed
2. Service invention
    a. Made during employment period.
    b. Grown out of employees type of work
    c. Based on experiences gained during employment
3. Free inventions—any invention not a service invention

C. Invention Procedures—Service Invention

1. Employee makes complete disclosure to employer
2. Employer, without undue delay, acknowledges in writing exact time of receipt
3. Employer must make written claim within 4 months of receipt
4. Employee then assigns all rights to the employer
5. Employer makes adequate compensation within 3 months after granting of patent or declaring invention as trade secret.

D. Compensation for Service Inventions

1. Shall represent fair market value adjusted to:
    a. Employees position and duties
    b. Degree of employer's operations assistance
2. Kind and amount of compensation determined by agreement between employer and employee based on regulations issued by Secretary of Labor
3. Patentable trade secrets not patented require additional compensation because of lack of patent protection

E. Service Inventions become free when:

1. Employer releases it in writing
2. Not claimed by employer within 4 months
3. Patent application not filed within 6 months
4. Abandoned by employer prior to making compensation to employee

F. Free inventions requirements:

1. Employee must promptly give written notice to employer unless *employee judges* invention is obviously of no use to employer
2. Employer must make written claim within 3 months to contest invention as a free one
3. Free inventions within scope of employers operations cannot be used by employee during his employment without first offering it to his employer in exchange for adequate compensation
    a. If not accepted within 2 months invention is free without restrictions
    b. If accepted but disagreement arises over compensation, an Arbitration Board shall fix the terms

G. Proposals For Technical Improvement

1. Payment for accepted proposals based on increased profits or decreased costs
2. Payments must be made within 3 months

H. Arbitration Board

1. Composed of:
    a. Chairman appointed from Patent Office examiners in chief by Commissioner of Patents to serve for 1 year
    b. Two associates appointed for each case by the Commissioner or assistant commissioner from Patent Office officers and employees with expertise in the general field in question
    c. Two additional members when petitioned by either party, each selecting a member
2. Shall reach decision by majority vote
3. Shall terminate proceedings when:
    a. Either party fails to comply with procedures
    b. Either party refuses to enter proceedings
    c. Either party files written objection to a proposal for conciliation

I. Judicial Review

1. Suits may be brought into U.S. District Court only after proceedings before Arbitration Board except:
    a. 6 months have passed since petition was filed with the Board
    b. Suit is for attachment or injunction

note that a very small percentage of practicing engineers belongs to SPE and are thus subject to the code. The code also presumes a nonexistent contract to which the employer is not bound.

Mr. Kuntz further points out:

(1) that U.S. patent law clearly states that financial assistance in developing a patent in no way grants the provider a position of co-inventor. The patent must be filed in the inventor's name even though the inventor is required to assign all his rights to the employer;

(2) that the report from an in-depth Congressional investigation during the 87th Congress stated "the Corporations themselves in pressing for the policy of the Government, leaving with the research contractor the patents that stem from Government-financed research, vigorously contend that money compensation alone is *not* sufficient to bring forth the best efforts of the researcher and that they (the corporations) should receive patent rewards as well. Assuming, without conceding, that this be true in the case of Government research contracts, corporations have not made it clear why it should be any less true in the case of their own employee contracts";

(3) that many engineers place ideas in an "idea file" to use at some later date when they are on their own;

(4) that because of lack of incentive for adequate rewards these ideas do not get disclosed to employers, and hence fortunes are lost to employers through lost inventions;

(5) that most employers have "suggestion plans" which give substantial awards to nonprofessionals, technicians, etc., while excluding engineers;

(6) and that many companies delay processing disclosures for years, or when releasing them to the inventors, retain license-free right, thus denying the inventor any useful marketability.

Mr. Kuntz concludes that, "Employees feel that there is a need for a complete re-evaluation of the present unilateral preassignment of patent rights as a condition of employment. Most feel that these agreements should be supplanted with bilateral agreements *that recognize the rights of both the employee and employer.*"

While one would find it difficult to argue with Mr. Kuntz's conclusion, the need for such a bill as HR15512, as it is written, is open to question. Only a very small percentage of patents granted earn any money directly —many are simply "paper" patents obtained for protection. Thus, in the long run, the inventor's financial rewards would be fewer if they were tied to marketability. With an industry trend toward incentive systems not tied to invention marketability, and with more companies seemingly inclined to make extra awards for extremely successful patents, need for such legislation is questionable. While the intent of this bill is laudable, there are areas of more pressing concern to the engineer—portable pension plans, health and life insurance, and employment security.

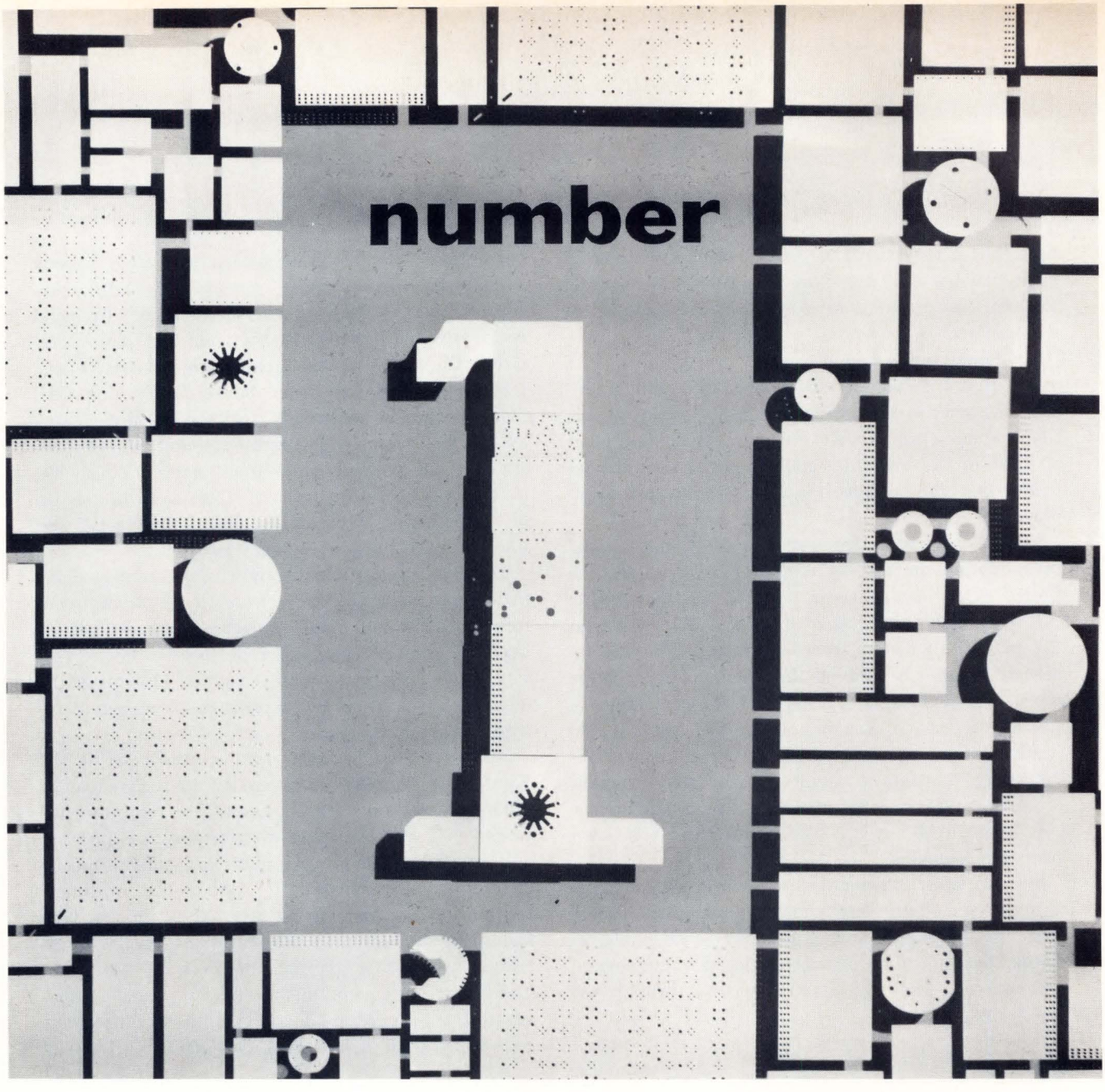
The existence of different and varied incentive plans throughout the industry indicates a healthy spirit of free enterprise and gives companies a broader base of benefits when competing for prospective employees. This wide variety of incentive plans also gives the engineer-inventor who is concerned about patent rewards a wider selection.

However, there is a real need, as concluded by Mr. Kuntz, for changes in preassignment agreements. HR15512, without the set compensation requirements, would go a long way toward rectifying this problem and would free many inventions for exploitation by energetic entrepreneurs. It does define workable boundaries and does clarify inventor's rights. In this form, without legislated compensations, without arbitration boards and the like, the Moss bill would not be cumbersome to administer. (The bill is now in committee, and Rep. Moss's aides do not expect it to come before the house in this session of Congress.) ▭

This is the first of a two-part article on patents. The concluding part will appear in EDN Oct. 15, 1970, and cover patents themselves, including what's involved, descriptions, what is patentable, what patents really protect, and what you must do to protect yourself and your company's rights.

Databank

1) HR15512—A bill to create a comprehensive federal system for determining the ownership of, and amount of compensation to be paid for inventions and proposals for technical improvement made by employed persons. Congressional Record - House, Jan. 22, 1970, pp. H 191-H 194. (Contains full text of Robert J. Kuntz statement and HR15512.)



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Coors can produce substrates to your specifications from either glazed or unglazed 96% alumina ceramic or unglazed 99.5% alumina ceramic. Both of these ceramics are dense, impervious, resistant to high temperatures, easily metallized, and have excellent electrical-insulation characteristics and good heat-transfer properties.

For details on Coors ceramic substrates, send for Bulletin 1400. Coors Porcelain Company, 600 Ninth Street, Golden, Colorado 80401.

Coors/CERAMICS

CIRCLE NO. 33

Systems Programmer Complements Computing Counter

Just a few months ago, Hewlett-Packard Co. announced the establishment of an "applications library" for their 5360A Computing Counter. With its keyboard and plug-ins, the 5360A was finding profuse application – hence the "applications library" to keep current and potential users informed. The HP librarian will no doubt be dusting off a new shelf with the latest addition to the 5360A repertoire, namely the **5376A Systems Programmer** (see photo). Like the earlier 5375A keyboard, the 5376A can control and program the computing counter – however, it does so with features that complement the keyboard. The rack-mountable 5376A can retain program storage after power loss. Because of modular construction, it gives the user more flexibility and program power than its keyboard counterpart.

The 5360A/5376A combination is, in effect, a computerized instrumentation system that can perform such tasks as data reduction, statistical analysis, and process control. Simpler to program than using BASIC, the 5376A offers the user two methods of program entry: a reprogrammable ROM or an IBM card reader.

ROM programming, intended for dedicated applications such as process control, is accomplished with a mechanically-alterable program board. With its modular construction, the 5376A can house up to five program boards, each of which can hold 40 plug-in diode packages. Specific OP codes are created by snipping off the appropriate leads on each diode package – thus giving the instrument a 40-step program capacity that can be optionally expanded to 200 steps. This provides a capacity for ten independent programs.

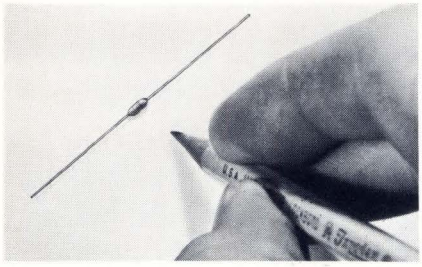
For less-dedicated applications, as might be found in the laboratory, the user is likely to prefer the IBM card reader for program entry. Each IBM card can hold a 160-step program, providing capacity for eight independent programs. When handling multiple programs, the 5376A permits program selection via the front panel START ADDRESS switch. Once programmed, the 5376A can be handled easily by unskilled operators.

Owing to its modular assembly, the 5376A allows the user to buy only the program capacity that he needs. Beside the aforementioned ROM program boards and IBM card reader, the user may add the following options: up to six storage registers (for intermediate program storage), up to three front panel thumbwheel switches (for numerical constant entry), up to two D/A converters (to provide analog output for plotter or stimulus) and a parallel BCD input/output.

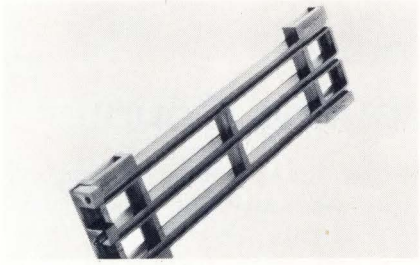
This last option, the BCD I/O, is probably the most powerful feature from a systems standpoint. With it, the 5376A can digitally control peripheral devices – as well as accept inputs from a host of digital instruments. Apart from affording the user an economical option mix, all options can easily be installed in the field.

HP also offers the 5380A integrated systems package, which includes the 5360A Computing Counter, the 5376A Systems Programmer and other required peripheral instruments. Price for the package varies, depending on complexity and amount of hardware involved.

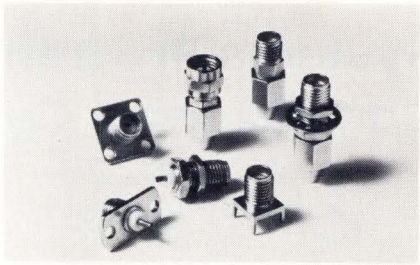
Price for the 5376A Systems Programmer mainframe, including one ROM program board and two storage registers, is tentatively $1650. Hewlett-Packard, Santa Clara Div., 5301 Stevens Creek Blvd., Santa Clara, CA 95050. **325**



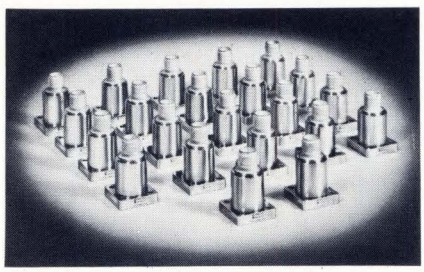
Standard line of epoxy roll-coated chokes fulfills the requirements of MIL-C-15305-D. There are 13 models within the inductange range of 0.1 to 1 μH (±10% tolerance). Self-resonant frequencies range from 680 to 240 MHz. Maximum standard dimensions of the choke body are 0.35 in length and 0.135 in diam. Minimum overall length including tinned copper leads is 2.955 in. Dale Electronics, Inc., Dept. 860, Box 609, Columbus, NE 68601. **326**



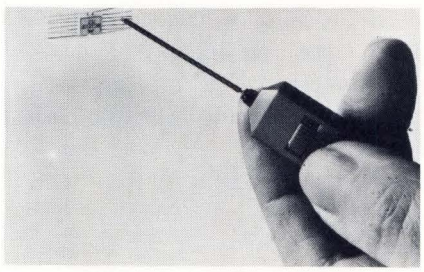
Multiple card guides are one-piece moldings combining many card guides (3 to 19) into one integral piece. These guides feature back-panel frame keying to assure alignment and connector plus an environmental seal. Guides are available in 12 different colors or with hot stamped markings for card identification. Price varies from $0.39 to $0.08 depending on size and quantity. Scanbe Mfg. Corp., 3445 Fletcher Ave., El Monte, CA 91731. **329**



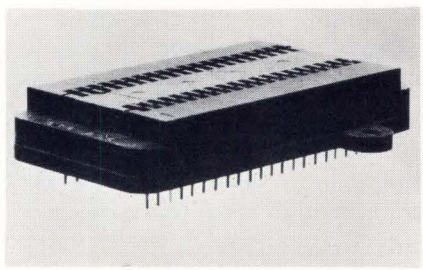
Miniature RF coaxial connectors are qualified for applications up to 3 GHz. Seven types are available for panel and printed-circuit mounting and for flexible cable assemblies. All types are interchangeable and intermateable with standard SMA connectors. These connectors will accept a broad range of cable sizes, eliminating the necessity of stocking many sizes. E. F. Johnson Co., Waseca, MN 56093. **333**



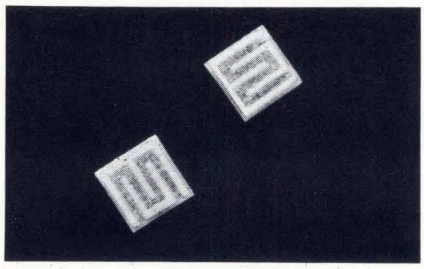
Inexpensive vibration sensors, Series IV-400, detect and measure vibrations from 0.01 to 100,000g either dynamically or over an indefinite time period. Units measure approximately 0.75 in diam by 1.5 in high. In quantities of 10 to 10,000, the prices are as low as $25 for the OEM manufacturer. Columbia Research Laboratories, Inc., MacDade Blvd. & Bullens Ln., Woodlyn, PA 19094. **327**



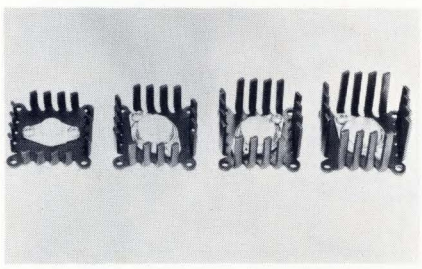
Eight models have been added to a family of general testing probes designed specifically for ICs. Designated the "Mini-Grip" family, the probes are small, light and strong. All models have a hooked tip and its gripping force is controlled by a thumbwheel in the probe handle. Prices range from $9.50 to $11.50 each. Data Display Systems, Inc., 139 Terwood Rd., Willow Grove, PA 19090. **330**



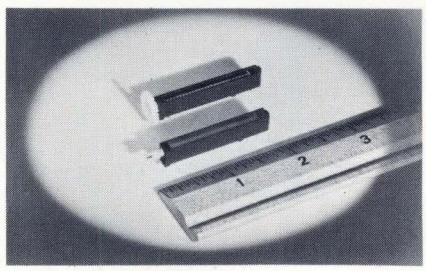
Sockets, 121-10 series, accommodate up to 40-lead DIPs and accept all standard MSI and LSI devices. These units come standard with tab terminals for wave or hand soldering. Solder tab terminals are 0.007 by 0.025 by 0.185 in long. Also, the 121-10 sockets assure positive contact and device retention but do not cause lead deformation. Barnes Corp., 24 N. Lansdowne Ave., Lansdowne, PA 19050. **332**



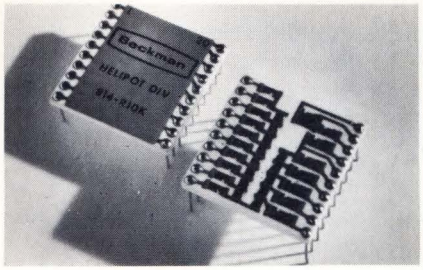
Low-ohm chip-resistor series range in values from <1 to 10Ω. These 0.05- by 0.05- by 0.01-in miniature thin-film chips are leadless with gold terminations suitable for various semiconductor bonding techniques. Reverse side is metallized for attachment to substrate. Temperature coefficient is ±100 ppm/°C for high resistance values and ±300 ppm/°C for lower resistance values. IGE, Box 63, Watertown, MA 02172. **328**



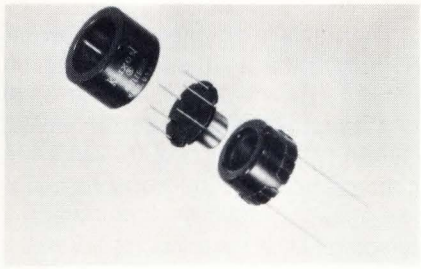
High-performance circuit-board coolers, 6001 Series, feature unique slanted vane fins that provide optimum cooling/unit volume occupied. Four standard models are available. Each model is 1.81-in^2 with height variations of 0.5 through 1.25 in. Typical performance of Model 6004 (1.25 in high) is 5°C/W rise above the ambient at the 15W power level. Thermalloy Co., 8717 Diplomacy Row, Dallas, TX 75247. **331**



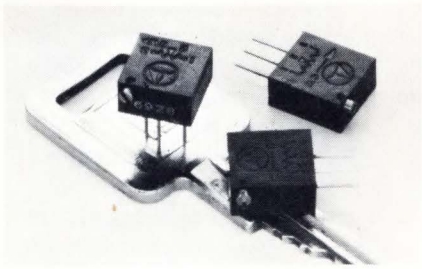
Multi-turn preset carbon potentiometers dissipate up to 1/8W at 70°C and sell for $0.33 each in lots of 25,000. Nominal resistances for these 20-turn trimmers is from 1 KΩ to 2.2 MΩ. Tolerance is ±20%, and repeatability is 0.1%. Two styles are available: hand adjustment by means of toothed wheel on the spindle or screwdriver adjustment by means of slotted spindle. Amperex Electronic Corp., 280 Northern Blvd., Great Neck, NY 11021. **334**



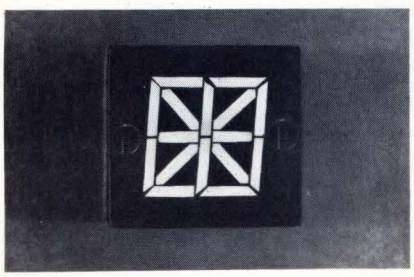
Fourteen-bit ladder network, Model 814, features tracking up to 1 ppm/°C, 100 ns settling time and maximum output voltage ratio errors as low as 33 ppm. These cermet thick-film units are available in two standard models with standard resistance values of 10 kΩ. The networks are <0.14 in high and occupy only 1 in² of board space. Helipot Div., Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, CA 92634. **335**



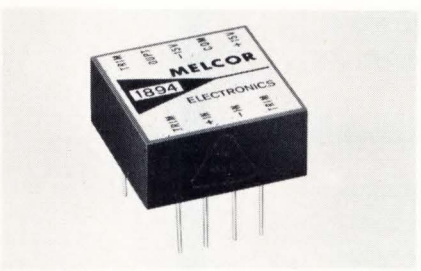
Solid-state component stabilizer operates without thermostatic controls, stabilizes itself and contains TO-5 compenent at 65°C in <1 min. Drawing <1W in steady state at room temperature, this tiny stabilizer operates over ambients from −55 to 15°C below its control temperature. Operating voltage is 24V ac or dc. Texas Instruments Incorporated, Control Products Div., 34 Forest St., Attleboro, MA 02703. **338**



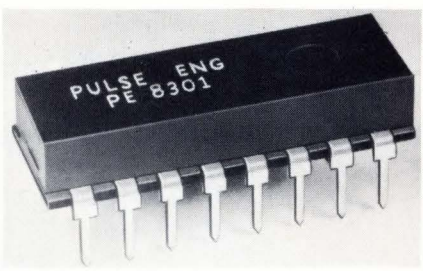
Multiturn cermet trimming potentiometer, Series 2305, is available in three terminal styles—printed circuit card mounting, side adjust or top adjust. Measuring 3/8 in square, the Series 2305 offers infinite resolution from 20Ω to 1 MΩ with ±10% tolerance. Contact resistance variation is 3% or 20Ω, whichever is greater. Amphenol Controls Div., The Bunker-Ramo Corp., 120 S. Main St., Janesville, WI 53545. **341**



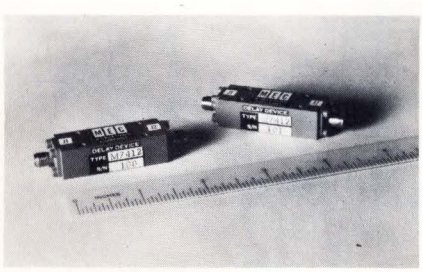
Alphanumeric readout features miniature size (0.4- by 0.4-in character), readability in sunlight (500 fL) and front relamping with a choice of colors and filters. This economical unit provides a 16-bar segment display. Mating solid-state circuitry is optional. Individual units mount side by side on 0.675-in centers. Oppenheimer, Inc., Wyandotte Rd., Willow Grove, PA 19090. **336**



Operational amplifer, Model 1894, is a low-cost unit with a common-mode rejection ratio of 50,000 over an input range of ±10V. Output is 10V at 50 mA with a unity-gain bandwidth product of 10 MHz. Encapsulated in a 1.125- by 1.125- by 0.5-in epoxy case, unit price is less than $20 in production quantities. Melcor Electronics Corp., 1750 New Highway, Farmingdale, L.I., NY 11735. **339**

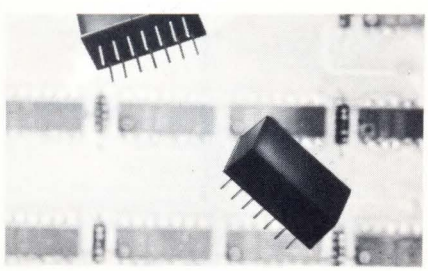


A line of ten modules, each containing four transformers in a 16-lead dual-in-line package, are ideal for computer and peripheral equipment. Inductance values from 20 to 500 μH and turns ratio of 1:1 and 2:1 are available. Peak pulse voltage rating is 50V, and insulation resistance exceeds 10^4 MΩ. Price for 1 to 9 units is $18.50 each. Pulse Engineering Corp., Box 12235, San Diego, CA 92112. **342**



One cubic inch acoustic delay line replaces 750 lbs of coaxial cable in an altimeter calibration application. Model M7307C with 30 dB insertion loss over 4.2 to 4.4 GHz radar altimeter band comes in a miniature ultra-rugged package designed for MIL-E-5400 environments. This is one of a series of low-loss delay lines available in the frequency range from 200 MHz to 14 GHz. Teledyne, 815 Stewart Dr., Sunnyvale, CA 94086. **337**

A 50Ω programmable step attenuator, Series 33300, attenuates wideband signals in 10 dB steps from 0 to 70 dB. These 7- by 1.5- by 1.25-in units are flat from dc to 18 GHz, and the attenuation accuracy over the 70 dB range is typically better than ±2.5 dB. In quantities from 1 to 9, unit price is $665, including a choice of RF connector types. Hewlett-Packard, Inquiries Manager, 1501 Page Mill Rd., Palo Alto, CA 94304. **340**



Multiple capacitors for ICs, 14-pin dual in-line encasements, offer minimum space and assembly costs. Available in values from 0.001 through 0.047 μF with any combination of values up to seven units, they carry tolerances to ±1%. Operating temperature range is −55° to 105°C. Capacitor elements are metallized mylar or polycarbonate dielectrics. S&EI Mfg., 18800 Parthenia St., Northridge, CA 91324. **343**

Introducing RCA's new superswitch: light sensor and power amplifier on one IC chip!

Choose a medium-speed application that uses a light sensor. You'll find the circuitry easier to design when you use the RCA-CA3062—because there's less to design.

The CA3062 consists of two parallel-connected photosensitive Darlington pairs which drive a differential power amplifier to provide a normally-off and normally-on output in response to a light input.

Available in a compact, window-ended TO-5 style package, the CA3062 has 100 mA output current capability, and can be operated at supply voltages in the range of 5 to 15 volts dc. It is compatible with RCA's 40736R infrared emitter. Use it for counter and position sensors, optical tachometers, limit detectors, level scanners, paper web sensors, wheel balancers, and similar devices.

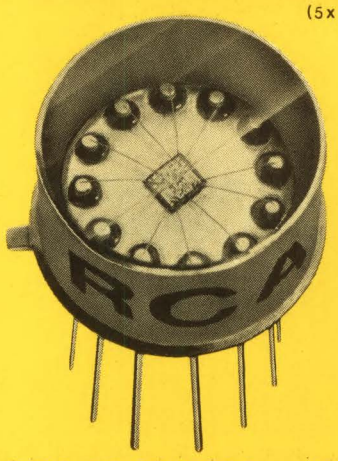
For further details, see your local RCA Representative or your RCA Distributor. For technical bulletin, File No. 421, write: RCA, Commercial Engineering, Section 50I-15/CA41, Harrison, New Jersey 07029. International: RCA, 2-4 rue du Lièvre, 1227 Geneva, Switzerland, or P. O. Box 112, Hong Kong.

CA3062 Photo Detector and Power Amplifier

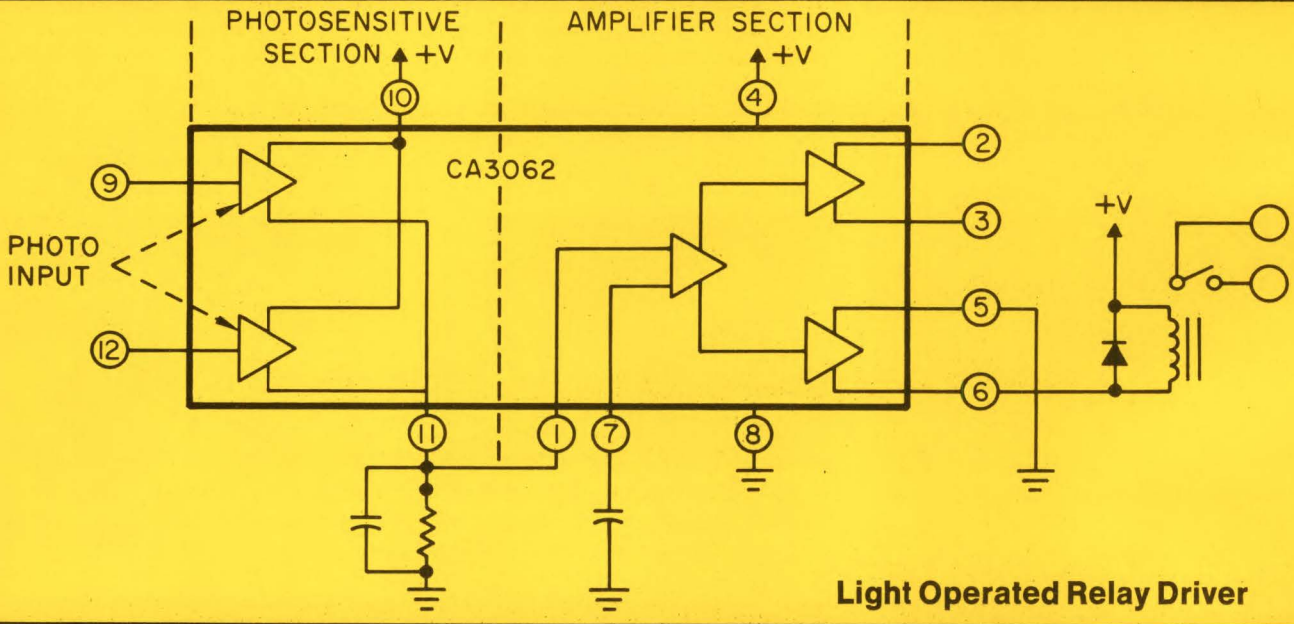
FOR:
- ☐ counters
- ☐ sorters
- ☐ level controls
- ☐ intrusion alarms
- ☐ edge monitoring
- ☐ position sensor
- ☐ isolators
- ☐ inspection

FEATURES:
- ☐ Darlington-connected photosensitive pairs
- ☐ 100 mA output current capability (drives a relay or thyristor directly)
- ☐ 5 to 15 Vdc supply voltage range
- ☐ compatible with RCA=40736R IR emitter

(5x actual size)



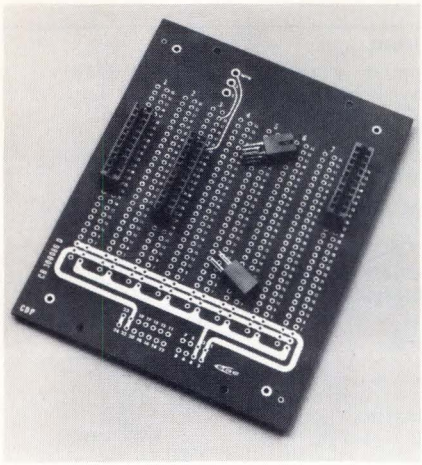
CA3062 $2.95 (1000-unit level)



Light Operated Relay Driver

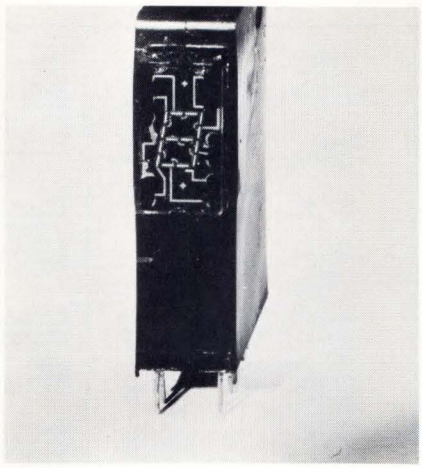
RCA
Integrated Circuits

CIRCLE NO. 32



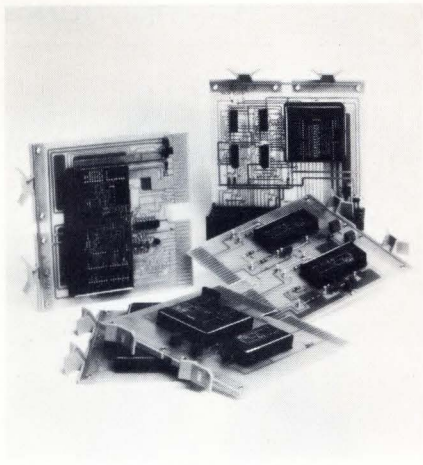
Printed-circuit card edge connectors, called "MOD-CON", are four- or six-contact modules with which to build card-edge receptacles for double-sided 1/16-in circuit cards. Two four-contact end sections combine with "n" midsections for 8 + 6n terminal connectors. Expanded pin just below insulator body ensures tight, solderless press-fit into mother boards. SAE Advanced Packaging, Inc., 2203 S. Grand Ave., Santa Ana, CA 92705. **344**

"Sensor Bolt" measures pressure changes anywhere and can be threaded or press-fit into pipes, tanks or any other rigid or semirigid material. Handling pressures to 25,000 psi and over, they will withstand shock to 1000g. Operating temperature range is −150° to 400°F. With temperature compensation, accuracy is ±1% over the temperature range and repeatability and hysteresis are ±0.5%. ITI, 4631 Scotts Valley Dr., Santa Cruz, CA 95060. **345**



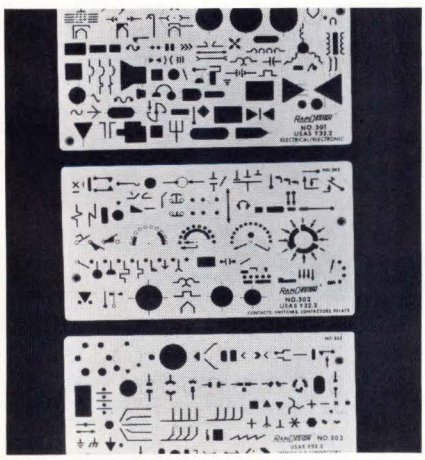
Alphanumeric readout assemblies feature MAN-1, a seven-segment solid-state display. These display modules, MDA Series, offer users a predesigned and assembled plug-in digital display package that saves time and money. The MDA Series includes two single digit readouts (MDA 100 and MDA 101) and one multiple-digit module (MDA 301). Monsanto Electronic Special Products, 10131 Bubb Rd., Cupertino, CA 95014. **347**

Termed Series 90K, this series of two-lamp lighted pushbutton switches and word indicators features an adapter that accepts crimp-type wire terminals plus five optional front lens configurations. Housed in rugged stainless steel packages, the Series 90K two-pole and four-pole switches are obtainable in either alternate or momentary action, as well as holding coil versions. Master Specialties Co., 1640 Monrovia, Costa Mesa, CA 92627. **348**



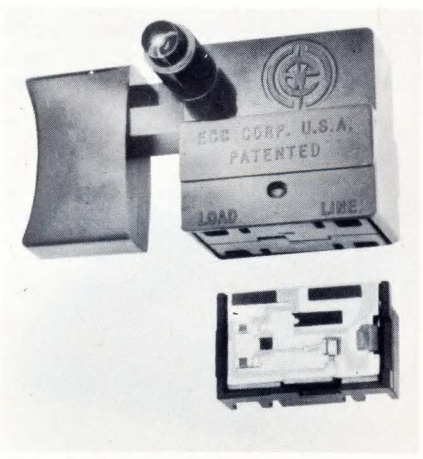
Fifteen analog module additions to the line include high and constant impedance multiplexers, dual amplifiers, sample-and-hold modules, and D/A or A/D converters. All have 12-bit accuracy and are compatible with DTL and TTL circuitry The modules are highly stable and feature advanced shielding techniques. Prices vary from less than $250 to more than $500. Digital Equipment Corp., 146 Main St., Maynard, MA 01754. **350**

Eight-bit D/A converter, Model MN302, features low power consumption (400 mW), TTL compatibility and packaging for use with standard 300 mil dual-in-line sockets and common PC board layouts. Other features of the 0.45- by 0.75- by 0.14-in unit include 0.5 V/μs maximum slewing rate and a ±10 ppm/°C temperature coefficient. Unit price for quantities of 100 is $53. Micro Networks Corp., 5 Barbara Lane, Worcester, MA 01604. **351**

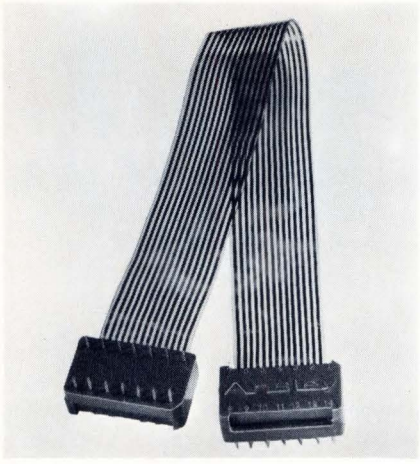


Comprehensive set of electrical/electronic drafting templates, No. 300, is comprised of three templates. Symbols have been grouped into sections for ease of use. All symbols are in correct relative size so that any size grid can be obtained through photographic reduction. All templates are precision milled for professional quality. RapiDesign, Inc., Box 6039, Burbank, CA 91505. **346**

Submicro disc trimmer, 7S-Triko-16, is of military quality but commercially priced. Available ranges are within 2 to 35 pF, and the working voltage is 160V dc. Rotor diameter is 0.267 in, and the unit is designed for printed-circuit mounting. A beryllium alloy spring with wiper action is used in place of silicone rubber. Stettner-Trush Inc., 67 Albany St., Cazenovia, NY 13035. **349**



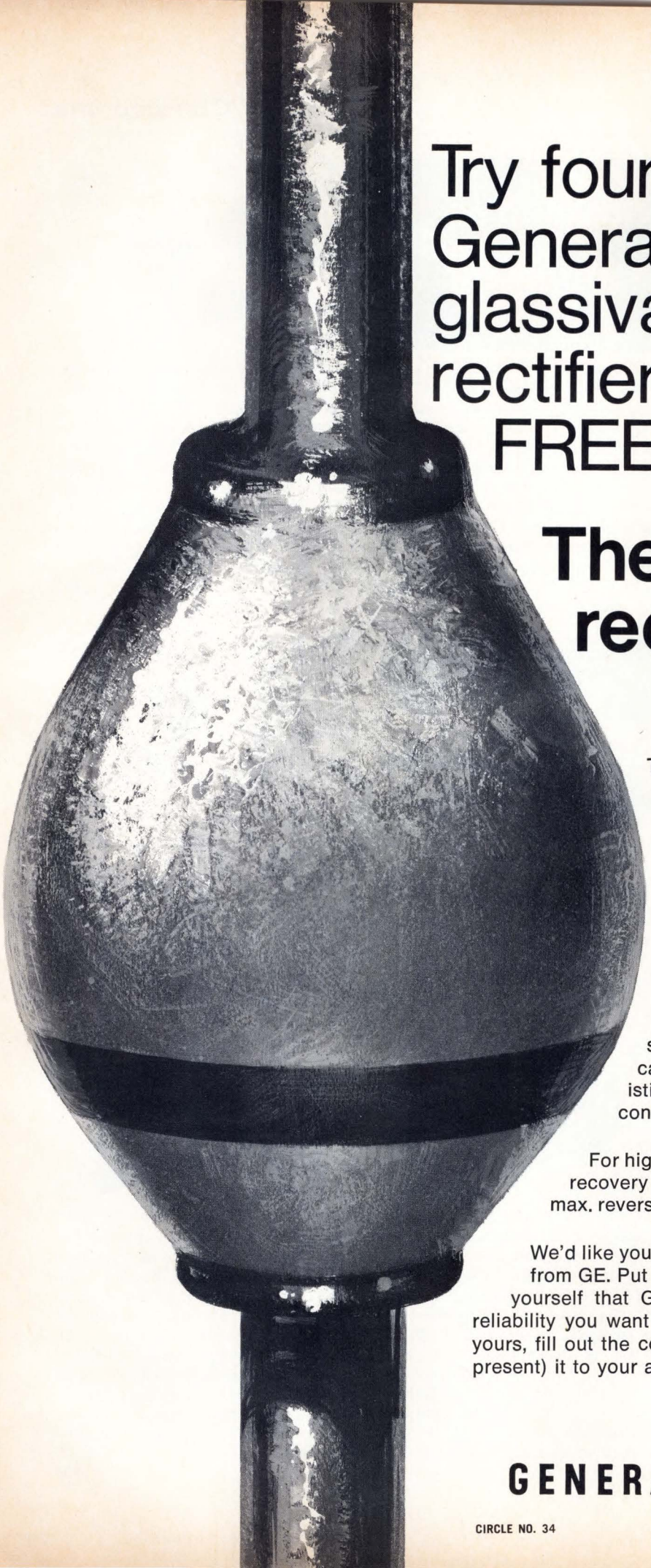
Solid-state speed-control device offers convenience, reliability and low cost. This device incorporates an alumina substrate as the mounting surface and thermal conductor for the glass-passivated QUADRAC semiconductor chip. Maximum steady-state current rating is 4.5A. Complete assembly mounts in an all plastic housing. ECC Corp., Box 669, 1011 Pamela Dr., Euless, TX 76039. **352**



Low-profile flat-cable jumpers for 14-pin DIP sockets improve packaging density by reducing bulk and weight. An extremely wide range of flat cable is available to meet any electrical requirements. Cables can be ordered to any length with a dielectric such as vinyl, polyester, Teflon and Kapton. All jumpers come completely assembled, tested and ready to plug in. Ansley West Corp., 4100 N. Figueroa St., Los Angeles, CA 90065. **353**

Miniature precision resistors find use in special computer circuits and military applications. Called the NC3, this resistor's temperature coefficient is 50 ppm, and it is rated 1/10W at 70°C or 1/20W at 125°C. Resistance range is from 49.9Ω to 100 kΩ at a 1% tolerance and a 200V rating. Body length is 0.145 in and diameter is 0.062 in. Price is from $2.05 (10-24 pieces) to $0.32 (1000 or more pieces). Corning Glass Works, Corning, NY 14830. **354**

Encapsulated FET amplifier, MMA 105, fulfills the need for a wide band (10 MHz) high-current output (200 mA). Other specifications for the 2- by 2- by 0.43-in module include 30 V/μs slewing rate, 1 μs settling time to 0.01% and 20 pA input bias current. Unit price is $55. Monitor Systems, 401 Commerce Dr., Fort Washington, PA 19034. **355**



Try four General Electric glassivated rectifiers FREE

The reliable rectifier

The best way to assure reliability in a low-current rectifier pellet is to put it in a package that really protects it. Protects it from shock, humidity, vibration and temperature.

And that's just what we do with General Electric's glassivated 1-amp (A14) and 3-amp (A15) rectifiers. Solid glass provides passivation and protection of the silicon pellet's P-N junction—no organic material is present within the hermetically sealed package. In addition, rigid mechanical support and excellent thermal characteristics are provided by the dual heat sink construction.

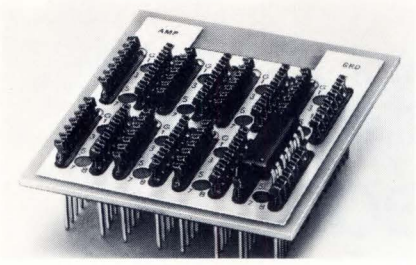
For high-frequency applications, GE offers a fast-recovery rectifier, the 1-amp A114, with a 200 nsec. max. reverse recovery.

We'd like you to try up to four free glassivated rectifiers from GE. Put them to any test you can think of. See for yourself that GE's A14/A15/A114 rectifiers deliver the reliability you want for your low current application. To get yours, fill out the coupon on the opposite page and mail (or present) it to your authorized GE semiconductor distributor.

220-85

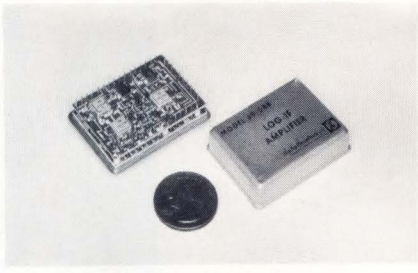
GENERAL ELECTRIC

CIRCLE NO. 34

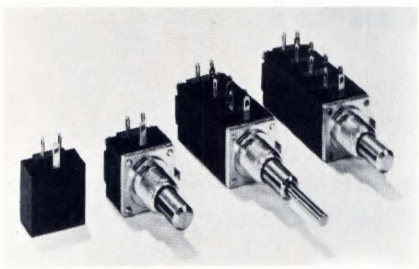


IC packaging receptacles mount directly on the PC laminate without the use of a plastic housing, and the contact design accepts either round or rectangular leads. Consequently, these receptacles can be located on virtually any grid pattern, and they will accept a wide variety of IC package types. An anti-overstress feature assures the proper insertion and withdrawal forces, regardless of lead size or IC configuration. AMP Inc., Harrisburg, PA 17105. **356**

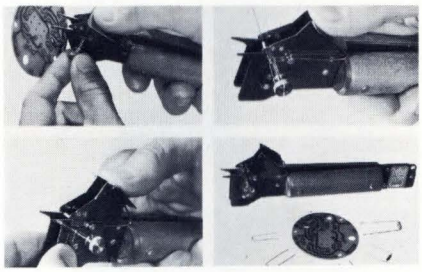
Cermet thick-film A/D (Model 871) and D/A (Model 847) converters offer MOS system compatibility and ±0.05% accuracy over the −20 to 85°C temperature range. Model 871 offers 8-, 9-, 10- or 12-bit resolution with a maximum power consumption of 950 mW. Model 847 is a 10-bit converter with 350 mW maximum power consumption. Both models are hermetically sealed in metal packages. Helipot Div., Beckman Instruments Inc., 2500 Harbor Blvd., Fullerton, CA 92634. **359**



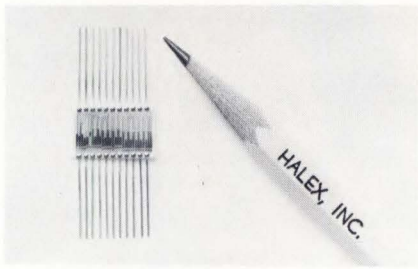
Thick-film LOG-IF amplifier, Model 58-588, provides linear to log conversion over a 60 dB signal range at 4.5 MHz. Sensitivity is 80 dBm. This component operates from a +12V and a ±5V supply. Gain and logarithmic characteristics are extremely stable over the −55° to 100°C temperature range. Hermetically sealed in a 1.4- by 1.9- by 0.4-in shielded case, the unit meets MIL-STD 883. The Hallicrafters Co., 600 Hicks Rd., Rolling Meadows, IL 60008. **362**



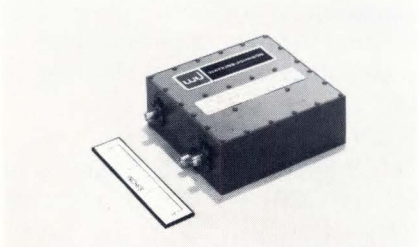
Family of versatile 5/8-in square modular potentiometers, Series 70, are supplied as single or multiple-section units. They are available in cermet, carbon or combination of cermet and carbon. Resistance ranges are 100Ω to 2.5 MΩ for cermet and 50Ω to 10 MΩ for composition. Allen-Bradley Co., 1201 South 2nd St., Milwaukee, WI 53204. **357**



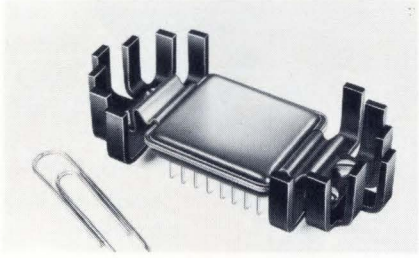
Lead bender, N-400, eliminates trial-and-error bending of component leads, providing a fast and continuous adjustment for space between bends. Designed for micro-size components, the tool reduces the space between the bent lead and the body of the component to a minimum of 0.025 in. Price is $19.50. Henry Mann, Inc., Box 65, Feasterville, PA 19047. **360**



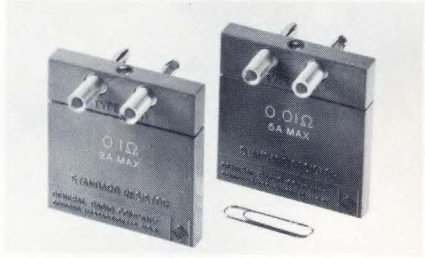
Microminiature 12-bit ladder network, Model HX510, has output accuracy of ±125 ppm, (±1/2 LSB) over temperature range of −55 to 125°C. In a 3/8- by 5/8-in flatpack, the resistors are vacuum-deposited nichrome thin-film with gold thin-film conductors. Price is $58.50 each, in lots of 100. Halex, Inc., 3500 W. Torrance Blvd., Torrance, CA 90509. **363**



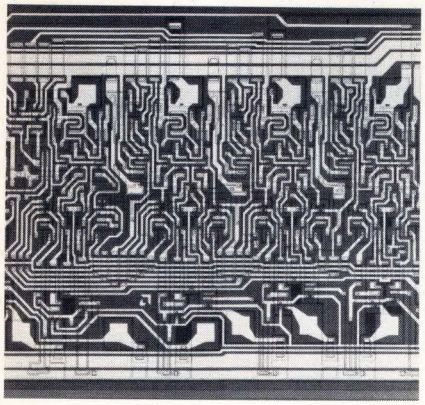
Solid-state amplifier WJ-5004-13 provides high-dynamic-range performance in the 2.1 to 4.2 GHz range. The 9-oz unit measures 1.3 by 3.5 by 3.5 in. This amplifier exhibits 10 dBm minimum power output at 1 dB compression, 30 to 33 dB small signal gain and 10 dB maximum noise figure. Inside the WJ-5004-13 is a microstripline circuit employing thick-film biasing circuits and chip components. Watkins-Johnson Co., 3333 Hillview Ave., Stanford Industrial Park, Palo Alto, CA 94304. **358**



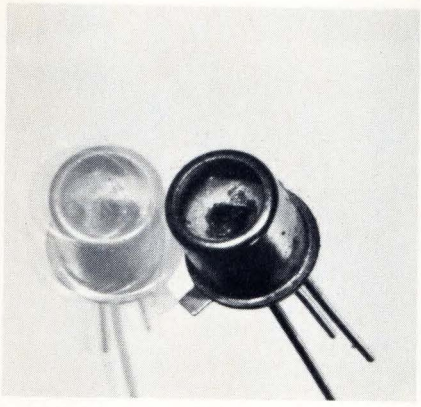
Heat dissipator (LBOC1-72-CB) and retainer (DCV-1B) combination allows a hybrid circuit to operate at 18W dissipation with a 70°C case rise in forced air (1000 FPM). This assembly was designed for metal packaged circuits from 0.125- to 0.187-inch in flange height and 0.6-in center-to-center pin line separation. Price (dissipator plus two retainer clips) is $0.54 in quantities of 1000 or more. International Electronic Research Corp., 135 W. Magnolia Blvd., Burbank, CA 91502. **361**



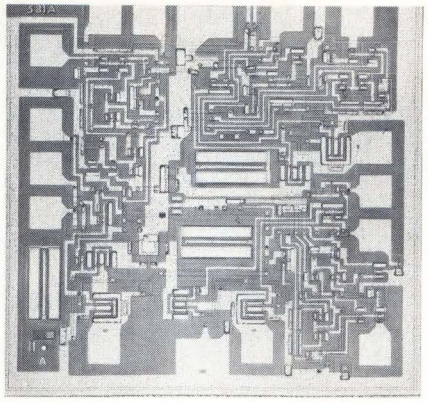
Two resistor models, 0.1 and 0.01Ω versions, are new additions to the Type 1440 standard resistors. Made of sheet "Manganin" punched in a random pattern to reduce inductance, these resistors are initially calibrated to a precision of ±20 ppm, with a long-term stability of ±10 ppm/year. Temperature coefficient is 20 ppm/°C. Both are encased in sealed, oil-filled diallylphthalate boxes to provide mechanical protection. General Radio Co., 300 Baker Ave., West Concord, MA 01742. **364**



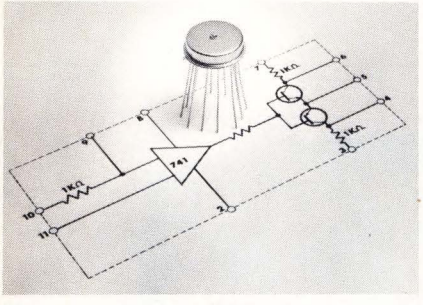
Synchronously presettable binary hexidecimal up/down counter AM2501 features 25 MHz clock frequency operating speeds and input clamp diodes. It features a carry look-ahead and allows multistage counting with no loss of speed. In lots of 100 items, prices are $7.70 (0 to 70°C) and $11.55 (−55 to 125°C). Advanced Micro Devices, Inc., 901 Thompson Pl., Sunnyvale, CA 94086. **365**



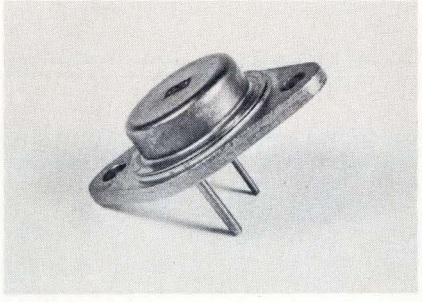
Silicon npn planar epitaxial phototransistors include three devices that cover a light sensitivity range from 0.2 mA to 3 mA at 5 mW/cm² and maximum collector to emitter voltages from 15 to 50. Designated CLT 2010, 2020 and 2030, these units operate to 150°C and have a power dissipation rating at 25°C of 250 mW. Clairex Electronics, 560 S. Third Ave., Mount Vernon, NY 10550. **368**



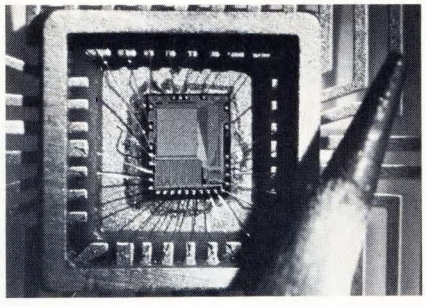
Digital dual-line driver 8T13 and triple-line receiver 8T14 operate with 50 and 75Ω coaxial transmission lines. The 8T13 driver offers 75 mA at 2.8V and a speed of 20 ns driving a 1000 pF load. In lots of 100 to 999 a 0 to 75°C silicone packaged driver is priced at $2.88 and the receiver is priced at $5.33 each. Signetics Corp., 811 E. Arques Ave., Sunnyvale, CA 94086. **371**



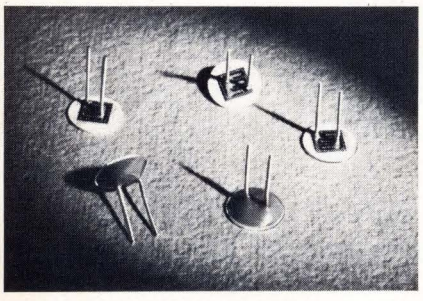
Hybrid power op amp DPA500 features a 2W power output, internal frequency compensation, wide output voltage range and a price of $14.50 in lots of 100 to 999. Dickson Electronics Corp., Box 1390, Scottsdale, AZ 85252. **366**



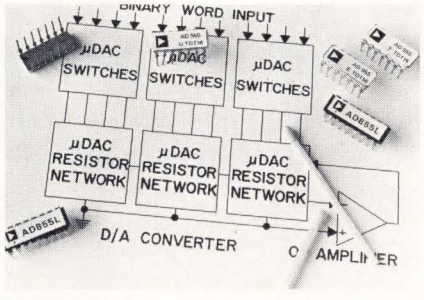
Germanium pnp power transistors feature I_C capability of 50A max with high gain, V_{CE} sat of 0.4V, V_{CBO} from 60 to 140V and a V_{CEO} from 60 to 120V. Solitron Devices, Inc., 1177 Blue Heron Blvd., Riviera Beach, FL 33404. **369**



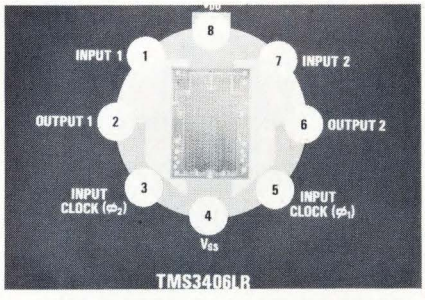
MOS read-only memory UA2572/UA3572 is a static 3072-bit unit with 256 by 12-bit memory organization. Access time is 750 ns, and units operate either from −55 to 125°C or from −25 to 70°C. UNISEM Corp., Trevose, PA 19047. **372**



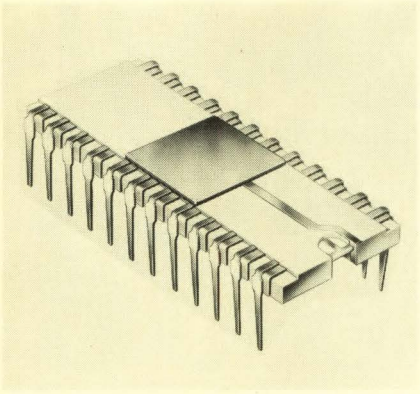
Power npn transistor chips for use with hybrid circuits include three new devices capable of dissipating 117W. V_{CEO} is 60 or 35V at an I_C of 200 mA and h_{FE} is 20 or 12 at a V_{CE} of 4V and I_C of 4A. In lots of 100 to 999, prices range from $0.89 to $0.99 each. Power Physics Corp., Industrial Way West, Box 626, Eatontown, N J 07724. **367**



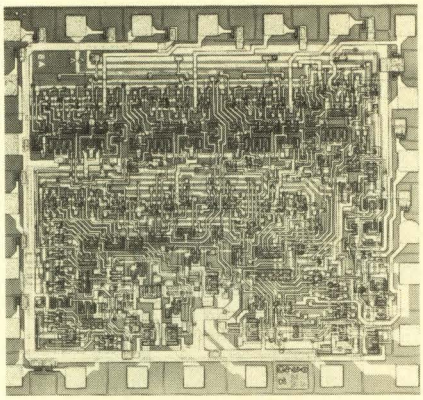
Monolithic IC quad voltage switch μDAC AD555 and its companion AD850 thin film R-2R resistor ladder are used to build miniature D/A and A/D converters. Because the AD555 unit includes two independent variable analog references, complete four-quadrant multiplication can be performed. Analog Devices, Inc., Pastoriza Div., 221 Fifth St., Cambridge, MA 02142. **370**



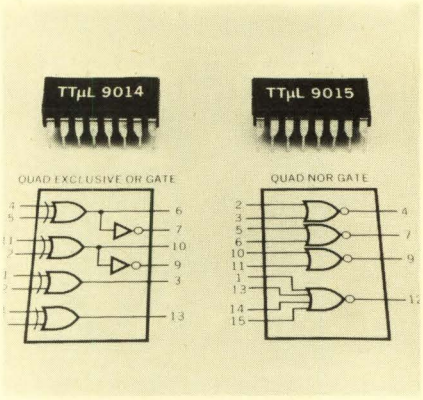
Dual 100-bit shift register TMS3406LR is an MOS dynamic low-threshold shift register that features a 2-MHz guaranteed frequency operation and power dissipation of 0.4 mW/bit typical at 1 MHz. In lots of 100 to 249, price is $6.50 each. Texas Instruments Incorporated, Inquiry Answering Service, Box 5012, M/S 308, Dallas, TX 75222. **373**



Encoding, decoding and computer handshaking for serial data interface are provided with a two-package LSI system. The AY-5-1008 terminal receiver and the AY-5-1010 terminal transmitter are compatible with TTL/DTL and MOS and offer complete TTY interface with power consumption of 150 mW. In lots of 100 prices are $18.70 (AY-5-1010) and $24.15 (AY-5-1008). General Instrument Corp., 600 W. John St., Hicksville, NY 11802. **374**



Arithmetic logic unit 9340 accepts two 4-bit binary words in parallel, performing addition in 24 ns and subtraction in 33 ns. The unit accepts carry look-ahead outputs from three other packages, resulting in an addition time for two 16-bit words of 42 ns. In quantities from 100 to 999, prices, depending upon temperature and package, range from $14 to $30.80 each. Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, CA 94040. **375**



Quad exclusive-OR gate 9014 and quad NOR gate 9015 have been added to the 9000 Series IC's. The 9014 unit has a 9.5 ns delay, typical power dissipation of 22 mW/gate. The 9015 unit operates with a speed of 8 ns and 20 mW/gate power dissipation. In lots of 100 to 999, price ranges from $1.60 to $5.30 (9014) and from $0.97 to $3.19 (9015). Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, CA 94040. **376**

Dual one-of-four decoder/demultiplexer MSI 9321 features two independent decoders, each designed to accept two binary weighted inputs and provide for mutually exclusive active low outputs. Typical propagation delay is 15 ns from enable to output, fanout is 10 TTL loads and power dissipation is typically 150 mW. In lots of 100 to 999, prices range from $5.30 to $11.70 depending on package and temperature range. Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, CA 94040. **377**

MODEM ICs include the MC1488L quad line driver and MC1489L quad line receiver that are designed to provide systems interfacing between communications networks and data terminal equipment. Both are supplied in dual in-line 14-pin ceramic packages and operate from 0 to 75°C. Prices in 100-up quantity are $7 (MC1488L) and $6 (MC1489L). Technical Information Center, Motorola Semiconductor Products Inc., Box 20924, Phoenix, AZ 85036. **378**

Single sideband transistor PT6738 furnishes 30W across the 1.5 to 18 MHz band, offers a power gain of 13 dB, and intermodulation distortion is guaranteed 30 dB or better. Operating voltage is 28V dc and the unit is packaged in the TO-59 container. Price in quantities of 999 is $20 each. TRW Semiconductor Div., Communications Transistor Plant, 14520 Aviation Blvd., Lawndale, CA 90260. **379**

MSI integrated circuit US7442A is a four- to ten-line decoder that is packaged in a 16-pin dual in-line plastic case and operates from 0 to 70°C. A military temperature unit also is available. Sprague Electric Co., 491 Marshall St., North Adams, MA 01247. **380**

Bipolar 256-bit random access memory, Type 3102, operates with a companion decoder to make mainframe memories with a 120-ns maximum access time. The unit dissipates 1.5 mW/bit, is packaged in a 16-lead DIP and in lots of 100 to 999 is priced at $51.20 each. Intel Corp., 365 Middlefield Rd., Mountain View, CA 94040. **381**

TTL bipolar 64-bit random access memory, IM5501, is organized into 16 × 4 bit words. On-chip address decoding along with chip select, write enable and uncommitted collector outputs provide for simplified connection into larger arrays. Features include access time of 40 ns, power dissipation of 6 mW/bit, temperature operation from 0 to 75°C and from −55 to 125°C and a 100-up price tag of $26.50 (commercial) and $33.50 (military). Intersil Inc., 10900 N. Tantau Ave., Cupertino, CA 95014. **382**

Quad bilateral switch CD4016 is a COS/MOS unit designed for transmission or multiplexing of analog or digital signals. Quiescent power dissipation is 10 nW, distortion is typically <0.5%, ON resistance is 400Ω typical over a 14V pk-pk input signal range, package is a 14-lead flat pack or dual in-line ceramic container and price is $9.35 each at the 1000 unit level. RCA/Electronic Components, 415 S. Fifth St., Harrison, N J 07029. **383**

Dual voltage-controlled multivibrator MC-4324/4024 is a monolithic IC that offers a maximum operating frequency of 30 MHz that can be varied over a range of 3.5 to 1 by a dc control voltage of from 1 to 5V. Power dissipation is 150 mW and price in 1000-up quantities is $10 (−55 to 125°C) and $6.60 (0 to 75°C). Motorola Semiconductor Products Inc., Box 20912, Phoenix, AZ 85036. **384**

Transistor PT6728 delivers 80W power output across the 100 to 160 MHz band with a minimum 7 dB gain. Source voltage is 28V, and, at the 1 to 99 level, price is $72 each. TRW Semiconductor Div., Communication Transistor Plant, 14520 Aviation Blvd., Lawndale, CA 90260. **385**

Dual 8-bit shift register 9328 features a two-input multiplexer in front of each data input and offers 25 MHz clock frequency operation as well as active pullup outputs. In lots of 100 pieces, price is $18 (−55 to 125°C) and $15.40 (0 to 70°C). Advanced Micro Devices Inc., 901 Thompson Pl., Sunnyvale, CA 94086. **386**

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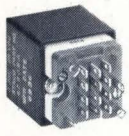

The switch price? A low $6.95, 100 piece quantity (2PDT Switch and Display). Get complete details today on the rectangular Model 2R and square Model 2S pushbutton switches and indicators from STACOSWITCH, Inc., 1139 Baker Street, Costa Mesa, California 92626 . . . telephone (714) 549-3041.

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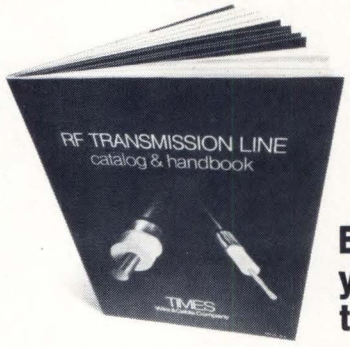

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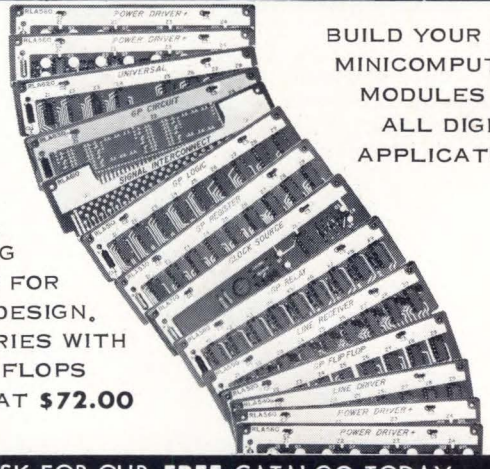

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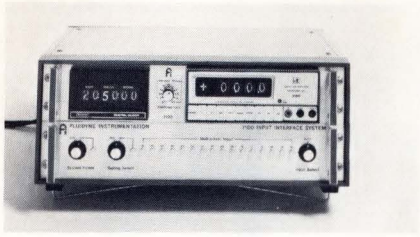
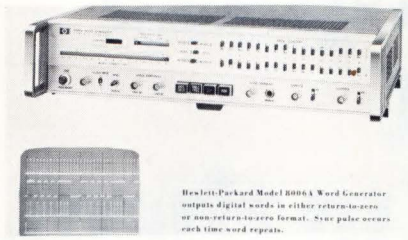
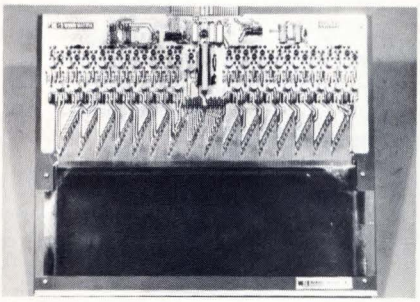


Data acquisition interfaces, when used with the Wang 700 series desk calculators, permit automatic measurement of both ac and dc voltage, dc millivolts and resistance from any one of 16 random-access inputs with complete program control of measurement function, data storage and output writer formatting. Both 4-1/2 digit, 0.02% accuracy and 5-1/2 digit, 0.0025% accuracy DVMs are offered. Fluidyne Instrumentation, 3685 Mt. Diablo Blvd., Lafayette, CA 94549. **387**

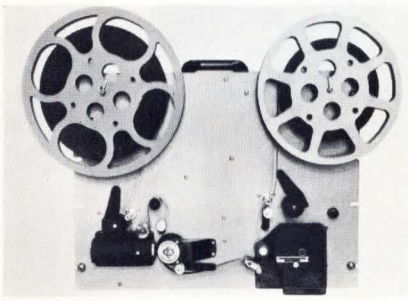


Word generator supplies two 16-bit words or one 32-bit word for digital testing. Model 8006A also can generate pseudo-random bit sequences up to 65,535 bits long. Word length is selectable from 2 to 32 bits, RZ or NRZ format. Words are generated repetitively or one at a time on command, and bit rate can be up to 10 MHz with either internal or external clocks. Price is $1100. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, CA 94304. **390**

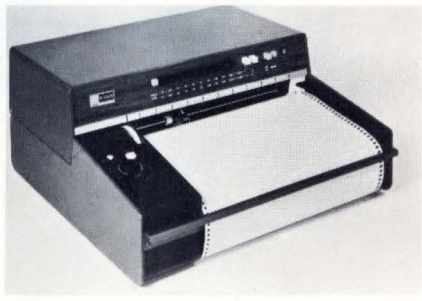
Pulse pattern generator, Model 916, provides 16 parallel channel outputs or up to 480 bits serial. Applications include simulating digital inputs and outputs of computers and computer peripheral equipment, tape devices, and telemetry and teletype data. Operation is at speeds to 10 MHz with either internal or external clock. Data output is RZ or NRZ with positive or negative logic sense. SRC Div., Moxon, Inc., 2222 Michelson Dr., Newport Beach, CA 92664. **393**



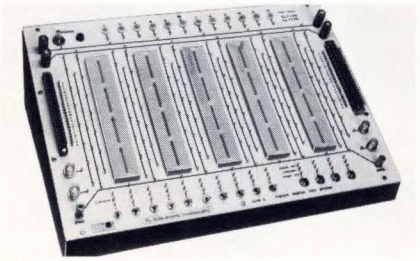
Plated-wire memory family, the System/300, features 300 ns cycle time for read or write, and 150 ns access time. There are two 12- by 15-in circuit boards: a "word" board and a "sense digit, timing and control" board. Each contains a 256-word by 80-bit plane driven by a 16 by 16 floating switch-diode matrix. Price is under $0.05/bit for OEM quantities. Memory Systems, Inc., 3341 W. El Segundo Blvd., Hawthorne, CA 90250. **388**



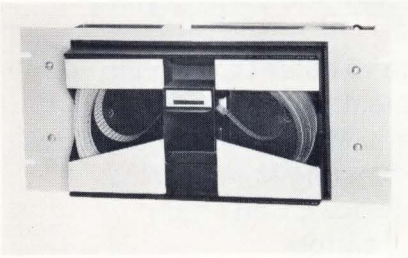
Optical/electronic transmitter, Model T16R, converts 16 mm motion picture film to electronic impulses and transmits the picture to any number of television sets or monitors. Film may be run continuously without damage, and the unit is portable, requires no special installation, can be set up in seconds and is extremely quiet in operation. Comspace Corp., 350 Great Neck Rd., Farmingdale, L.I., NY 11735. **391**



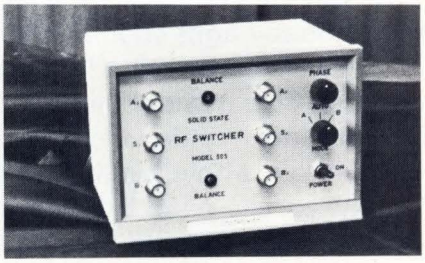
Strip chart recorder, Series G-2500, has 20 chart speeds from 1 to 1000 in/h or 0.01 to 10 in/min, and provides instant start and stop. Also featured are electric pen lift, 10 ranges from 1 mV to 1V, 0.5s pen response, 0.15% accuracy, horizontal platen with 10-in usable chart width and ±100% zero adjustment. Operation is single- or dual-channel. Prices start at $1025. Varian Aerograph, 2700 Mitchell Dr., Walnut Creek, CA 94598. **394**



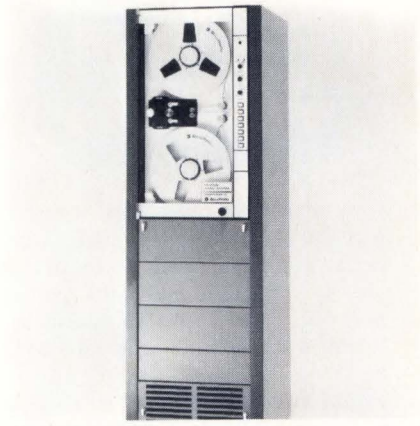
Circuit design test system for construction of breadboard circuits and logic, the ELite 3, will accommodate all integrated circuits in TO-5 and dual in-line packages, as well as transistors, resistors, capacitors and diodes. Desktop size and short-circuit proof, the ELite 3 requires only 5W at 110V 50/60 Hz. Price is $350. EL Instruments Inc., 61 First St., Derby, CT 06418. **389**



Punched-tape reader, a miniature 600 cps unit with fanfold handler, uses a nine-section fiber optic array that operates from a single light source. Interface circuitry is available for direct interface to many computer systems. Logic 0 is 0V and logic 1 is 5V in both input and output electronics. Decitek, Div. of Jamesbury Corp., 15 Sagamore Rd., Worcester, MA 01605. **392**



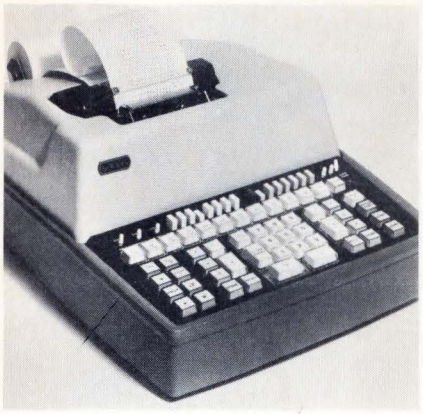
RF switcher, Model 505, uses ICs and computer switching diodes to achieve exceptional reliability. Specifications include switching rate of 30 Hz on 60 Hz supplies, impedance of 75Ω, return loss of 26 dB, isolation at 50 MHz of 40 dB and an insertion loss of 2 dB from dc to 220 MHz. Coltronics Ltd., Sub. of Magnetic Head Corp., 250 Marcus Blvd., Hauppauge, L.I., NY 11787. **395**



Magnetic tape recorder/reproducer, Model VR-3700B, operates at a wide range of speeds and frequencies and meets stringent requirements for use in research and aerospace applications. The nine speeds range from 15/16 to 240 ips. FM frequency response is dc to 600 kHz and time base error is ±0.5 μs. Channel options include 7, 14 or 28. Bell & Howell, Electronics & Instruments Gp., 360 Sierra Madre Villa, Pasadena, CA 91109. **396**

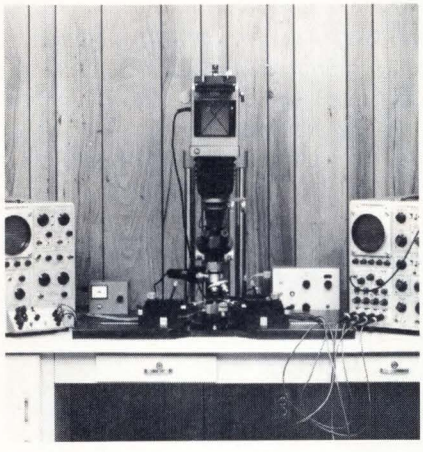
IC core-memory system, Model ICM-161, can be expanded in 4096-word increments to a total of 16,324 words. The basic system is organized for random-access addressing and operates on a full cycle time of 1.6 μs, with 650-ns access time for read/regenerate and clear/write operations. Honeywell Computer Control Div., Old Connecticut Path, Framingham, MA 01701. **397**

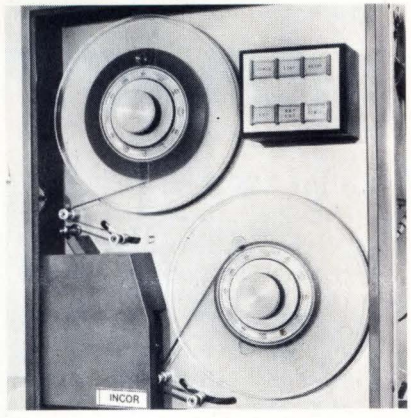
Data coupler that operates at a maximum of 300 baud for both transmit and receive mode, full or half duplex, is intended to interface Bell System 103 Series MODEMS through the telephone system. Model IT-332A plug-connects to the Model 33 "Teletype" and allows both acoustic and magnetic coupling. Price is $210. ITI Electronics, Inc., 369 Lexington Ave., Clifton, N J 07015. **398**



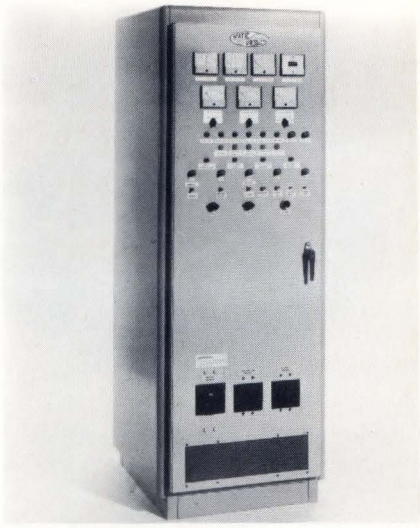
Printing calculators, Series 100, offer up to 14 individual calculators in one package. First in their price range to run trig, degrees-to-radians and many other functions at a single key stroke, the units combine a scientific and a business calculator in one unit. Registers may act separately or interact with the other registers. Prices of the various models range from $1495 to $2295. Wang Labs., Inc., 836 North St., Tewksbury, MA 01876. **410**

Failure analysis probe station, the Mark X, connects standard test equipment with any point on the surface of a microcircuit. Connection is made through joystick-controlled probes that can be positioned on an area as small as 0.2 mil². Probe needles can be supplied with points of less than 2 μm if required. Price of the basic station is $9700. Comaltest, Inc., 124 S. 8th St., New Hyde Park, NY 11040. **411**



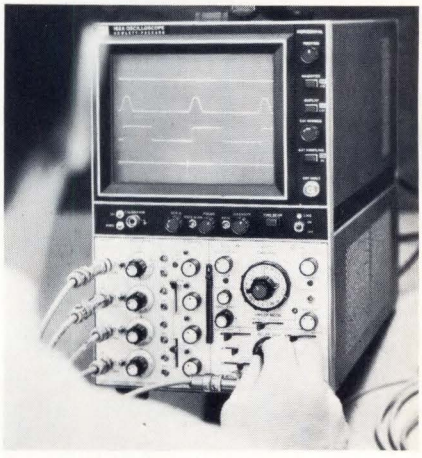


Tape drive, IBM- and USASC II-compatible, can be supplied in table-top or rack mount. Data is written at densities of 1600, 800, 556 or 200 cpi in either 7 or 9 track formats in the following modes: incremental write to 1000 cps, synchronous read and/or write 4 to 37 1/2 ips, incremental write/synchronous read 1000 cps/37 1/2 ips. Standard computer quality 1/2-in tape on 10-1/2- 8-1/2- or 7-in reels is used. Incor Corp., Box 156, Feasterville, PA 19047. **412**

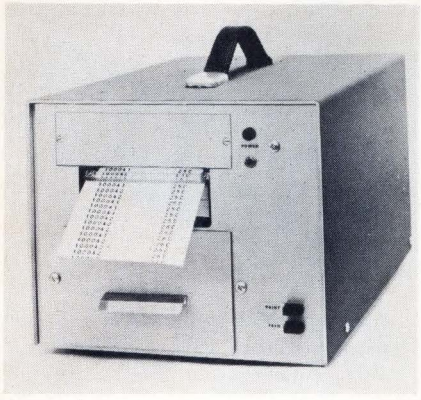


25 kVA uninterruptable, three-phase ac power supply protects against transients, interruptions, fluctuations and outages of utility power. Featuring both higher efficiency and lower operating temperatures, the new unit occupies only a 25- by 30- by 72-in space. Static Products, Inc., 2511 National Drive, Box 2226, Garland, TX 75040. **413**

Flying disc pack heads that operate at 2400 or 3600 rpm are available in 4400 bpi, 200 tracks/in and 2200 bpi, 200 tracks/in types. Custom tailored designs can be specified with or without erase function. Applied Magnetics Corp., 75 Robin Hill Rd., Goleta, CA 93017. **414**

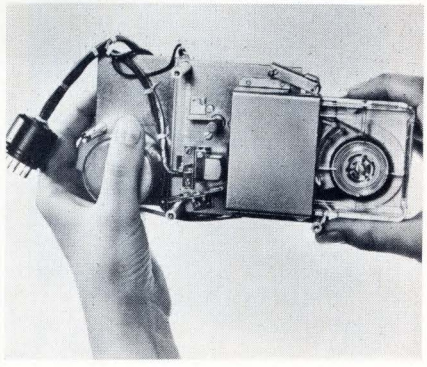


Scope has 7-in CRT and 100 MHz response. The new plug-in Model 182A accepts all plug-ins designed for the 180A/181A scopes. Improvements in CRT design provide the greater beam-deflection magnification. Mainframe price is $1100. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, CA 94304. **415**



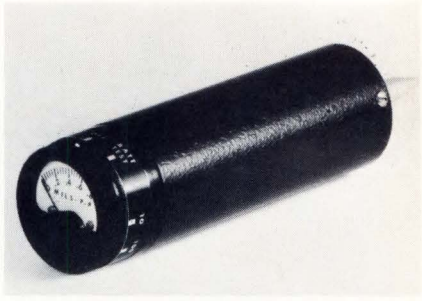
Digital printer, Series DP-650, is priced as low as $745. Featured are reliability of over 5-million print cycles without adjustment, field expandability of columns to a maximum of 21, internally stored roll or fan-fold paper and red/black printing. The unit is compatible with 1, 2, 4, 8 binary code, positive true, DTL/TTL logic inputs. Printing speed is 3 lines/s, asynchronous. Anadex Instruments Inc., 7833 Haskell Ave., Van Nuys, CA 91406. **416**

Simultaneous integrating fluxmeter and Hall-effect gaussmeter, Model MF-1HR, provides all the signaling data required for testing B-H or B-H vs H curves. Fluxmeter range is 100 to 99.9 × 10^4k maxwell-turns (accuracy: 1% ±10 maxwell-turns). Maximum drift rate is ±100 maxwell-turns/min. Gaussmeter range is from 10 to 30,000G full-scale. MSI Div., O. S. Walker Co, Inc., Rockdale St., Worcester, MA 01606. **417**

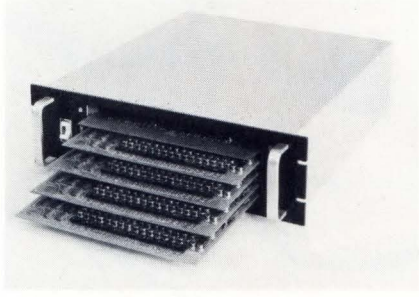


Endless-loop tape transport features a miniature eight-track cartridge loaded with 1/4-in industrial-grade lubricated tape. Maximum playing time at 3-3/4 ips is 5 min. Model TD-100 has a 6V mechanically governed motor, Model TD-110 has a 110V, 60 Hz synchronous motor and Model TD-120 has a 12V brushless electronically-governed speed control unit. Heads available include stereo record/playback, mono record/play/erase and stereo record/play/erase. Acron Corp., 1209 River Ave., Rte. 9, Lakewood, N J 08701. **418**

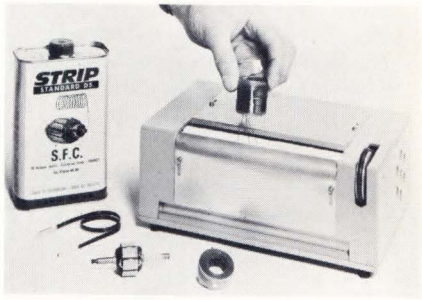
Inverter is crystal controlled, changes 12V dc to 120V 60 Hz ac with frequency accuracy of 0.005% over the temperature range of −40 to +55°C. Model PI 1002 has a 200 VA rating and is short circuit proof. Case size is 4.4 by 5.4 by 6.7 in. Unit price is $169. Electronics-Atlanta, Inc., 5300 New Peachtree Rd., Chamblee, GA 30341. **419**



Vibration meter, miniature and pocket sized, measures the total vibration displacement of rotating or reciprocating machines. Model 5160 is battery operated and has selectable full scale ranges of 1, 10 and 100 mils pk-pk. Response is from 600 to 100,000 cpm. Metrix Instrument Co., 5760 Rice Ave., Houston, TX 77036. **422**



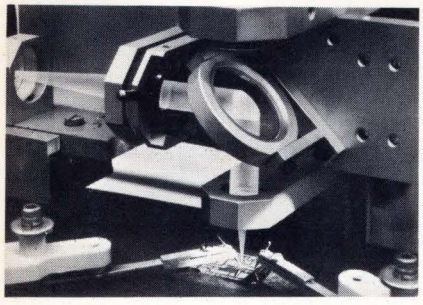
Core memory system with 4096-word 18-bit basic capability features closed cooling. Full cycle time is 1 μs, and access time is 350 ns over a 0 to 50°C temperature range. A basic 4k by 18 system without power is priced at $4065. Cambridge Memories, Inc., 285 Newtonville Ave., Newtonville, MA 02160. **420**



Wiping machine for chemically treated magnet wires, Model S8MAT, eliminates the need for human contact with the treated wire ends. Sizes from AWG 45 through 18 can be accommodated, and several wires of different sizes can be handled simultaneously. Price is $195. Siemens Corp., 186 Wood Ave. S., Iselin, N J 08830. **423**

Automatic raster-scanner/plotter for microcircuit mask preparation prepares or inspects semiconductor masks at 10X or actual size from taped digital output or computer. This eliminates cut-and-strip process as well as photo-reduction cameras. Model DSP-35 is priced at $75,000. Dacom Inc., 1060 Morse Ave., Sunnyvale, CA 94086. **421**

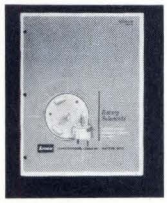
Laboratory preamplifiers, LA/AC Series, are available with choice of either bipolar or FET input and in gain ranges of 20/40 dB, 40/60 dB or variable 20 through 60 dB. Frequency response is from below 2 Hz to above 5 MHz, and price is $245 in small quantities. AMF Alexandria Div. of AMF Inc., 1025 N. Royal St., Alexandria, VA 22314. **424**



Laser trimmer handles thick and thin films as well as doing scribing and cutting. Model 110A has a xenon laser, requires no cooling system or auxiliary power supply and draws 3A at 115V 50/60 Hz. Nominal trimming accuracies are up to 0.01%. Prices start at under $9000. TRW Instruments, 139 Illinois St., El Segundo, CA 90245. **426**

Frequency analyzer, Model UA-10, was designed for ease of interface with digital computers. It uses time-compression techniques to achieve 200-line analysis in real time. A 400-line version, Model UA-14, also is available. Federal Scientific Corp., 615 W. 131 St., New York, NY 10027. **427**

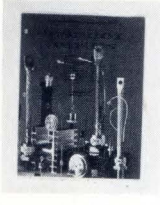
X-Y recorder for harsh field environments, battery powered Model 640, will operate in any attitude and is completely splash-proof. A continuous roll of pressure sensitive paper provides one-hundred 6.5- by 9.25-in sheets. A battery level status indicator meter is included. Hydro Products, Div. of Dillingham Corp., Box 2528, San Diego, CA 92112. **428**



Rotary Solenoid Catalog C-1000 contains 32 pages of performance characteristics on 252 stock model rotary solenoids. Ledex Inc., 123 Webster St., Dayton, OH 45401. **200**

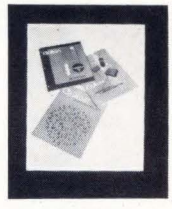
Stepping motors are treated in this 82-page reference manual that covers the range from 1/40 to 10 hp and up to 16,000 steps per second in speed. Icon Corp., 156 Sixth St., Cambridge, MA 02142. **204**

"Series 54/74 MSI Complex Arrays", No. 25655 contains 100-pages on 21 different complex arrays. Semiconductor Div., Sprague Electric Co., 115 Northeast Cutoff, Worcester, MA 01606. **208**



Semiconductor Device Digest 70-71 is a 20-page, full-color short-form catalog on SCRs, triacs, rectifiers, zener regulators, light-sensitive devices and heat exchangers. International Rectifier, Semiconductor Div., 233 Kansas St., El Segundo, CA 90245. **201**

Glass tin-oxide resistors are described in 16-page design guide RBR-2.00. Text, tables and charts give the results of a continuing life test on 600 resistors that support the reliability claims for this type of component. Corning Glass Works, Corning, NY 14830. **205**



Ceramic Capacitor Catalog (76 pages), Low-Pass Broadband Filter Catalog (32 pages) and Thermistor Catalog (32 pages) are three new pieces of literature that contain handbook type information of interest to designers. Gulton Industries, Inc., Metuchen, N J 08840. **209**

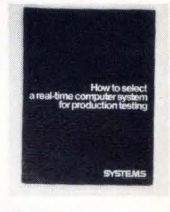
"Multilayer Ceramic Capacitors" is a 28-page, full-color catalog that includes specifications, performance data and application notes on a complete line of chip, axial and radial lead capacitors. Electro Materials Div., Illinois Tool Works Inc., 11620 Sorrento Valley Rd., San Diego, CA 92121. **202**

"Logicware" is a 32-page catalog that describes hardware, software and wiring service for plug-in dual in-line ICs. From a logic diagram input, a system is completed through final hardware. Electronic Engineering Co. of California, 1441 E. Chestnut Ave., Santa Ana, CA 92701. **206**

Transistor and diode condensed catalog contains 80 pages covering a complete line of discrete off-the-shelf products. Key parameters and package outline information for more than 2000 semiconductor devices are included. Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, CA 94040. **210**

Electromechanical Components and Equipment is a 100-page guide book that contains sections on counters, flow meters, precision potentiometers, servo mechanisms, test equipment and timers in addition to a transducer selection guide. Electronics Div., American Relays, 39 Lispenard St., New York, NY 10013. **203**

Dual In-Line, LC Filter Series is a 12-page brochure that gives specifications, feasibility ranges, attenuation, phase shift and group delay characteristics, as well as time response for low-pass, linear phase and high-pass filters. ESC Electronics, 534 Bergen Blvd., Palisades Park, N J 07650. **207**



"How to Select a Real-Time Computer System for Production Testing" is an applications-oriented brochure that emphasizes solution of production testing problems rather than the benefits of specific computers or software systems. Systems Engineering Labs., 6901 W. Sunrise Blvd., Fort Lauderdale, FL 33313. **211**

AC measuring instruments, including large and portable voltmeters, ammeters and wattmeters, a universal cable test set and several electrostatic field intensity meters, are covered in Bulletin 85. James G. Biddle Co., Plymouth Meeting, PA 19462. **212**

"Snap Out" pin probes offer 100 test points or circuit terminals in an area less than the size of a dime. They are described in a new brochure from Everett/Charles, Inc., 2806 Metropolitan Place, Pomona, CA 91767. **213**

"Electrical Contact Assembly Cost . . . and What We Are Doing to Cut It" describes how to lower costs for contact assemblies. Technical Service Dept., Engelhard Minerals & Chemicals Corp., 113 Astor St., Newark, N J 07114. **214**

Tunable bandpass filters cover the range from 1 through 12.4 GHz. Both coaxial connector and waveguide types are covered in catalog No. F-2. Premier Microwave Corp., 33 New Broad St., Port Chester, NY 10573. **215**

Frequency-to-voltage converter, Model 321, develops an output voltage directly proportional to the repetition rate or frequency of the input signal. Bulletin No. 147 is available from VIDAR, 77 Ortega Ave., Mountain View, CA 94040. **216**

Uninterruptible power supplies, static transfer switches, battery chargers and frequency converters are covered in a six-page brochure. Static Products, Inc., 2511 National Dr., Box 2226, Garland, TX 75040. **217**

Low pass active filter Type 42 is computer designed. Complete specifications are given in a new bulletin. KDI Navcor West, Inc., 15551 Cabrito Rd., Van Nuys, CA 91406. **218**

"How Fast Can We Get Crystals?" is the title of a fold-out brochure that covers a line of products and includes prices. Sentry Mfg. Co., Crystal Park, Chickasha, OK 73018. **219**

"Photochromic Glass: Report No. 2" describes and illustrates two applications of Corning's unique color-reversible glasses. Corning Glass Works, Public Relations Dept., Corning, NY 14830. **220**

Ten-bit BCD resistor array, Model 863, for use with the Fairchild μA722 10-bit current source is described in a new catalog sheet. Technical Information Section, Helipot Div., Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, CA 92634. **221**

Communication components are described in a new 16-page catalog that covers over 400 stock parts plus many of the almost 3000 components available. ADC Products, 4900 West 78th St., Minneapolis, MN 55435. **222**

Plastic Transistor Cross Reference Guide covers the nearest equivalents to more than 400 standard industry 2N types. Distribution Center, Fairchild Semiconductor, Box 880A, Mountain View, CA 94040. **223**

High-intensity light systems that provide high-intensity xenon, mercury and xenon-mercury illumination are covered in Bulletin XE-70. Christie Electric Corp., Box 60020, Los Angeles, CA 90060. **224**

AC-DC converters, dc-dc converters, dc-sine wave inverters and switching regulators are among the components covered in an eight-page condensed catalog. Arnold Magnetics Corp., 11264 Playa Ct., Culver City, CA 90230. **225**

Automatic transistor tester brochure outlines an instrument that provides a rapid means to test and sort all ranges of transistors and diodes on a go/no-go basis. Lorlin Industries, Inc., Precision Rd., Danbury, CT 06810. **226**

Audio/electronic connectors are featured in a new six-page publication, EX-1. Amphenol Sales Div., Bunker-Ramo Corp., 2875 South 25th Ave., Broadview, IL 60153. **227**

Lumped constant delay lines packaged in 14-pin dual in-line containers are covered in a new eight-page brochure. Engineered Components Co., 2134 W. Rosecrans Ave., Gardena, CA 90249. **228**

Instrument Catalog, 17-5, includes specifications on dc standards, ac standards, meters and amplifiers and digital instruments. COHU Electronics, Inc., Box 623, San Diego, CA 92112. **229**

Multichannel digital/FSK MODEM, Type 7260, can be a full duplex frequency division multiplexer or a FSK MODEM. It is described in Application Bulletin 7260 from Tele-Dynamics, Div. of AMBAC Industries, Inc., 525 Virginia Dr., Fort Washington, PA 19034. **230**

Automatic Calibration System 8800 is for calibration of FM CBW systems and certifies that every channel is set up correctly before valuable data is gathered. VIDAR, 77 Ortega Ave., Mountain View, CA 94040. **231**

Modular linear power amplifiers, Models IC-100 and IC-50, dissipate 100 and 50W respectively and are completely described in two new data sheets. Inland Controls, Div. of Kollmorgen, 250 Alpha Dr., Pittsburgh, PA 15238. **232**

DC instrumentation amplifiers, attenuators, isolated strain gage power supplies and signal conditioners are covered in a six-page brochure. INCOR Instrumentation, Inc., 29 Newtown Rd., Plainview, L.I., NY 11803. **233**

Potentiometers, trimmers, modules, hybrid circuits, selector switches and frequency control devices are included in a comprehensive, short-form catalog. CTS Corp., 905 North West Blvd., Elkhart, IN 46514. **234**

Standard and custom cable assemblies including flexible, semi-rigid and rigid cables and a wide variety of coaxial connectors are covered in a new brochure from B&W Cable Co., B St., Burlington, MA 01803. **235**

A solid-state, preset counter capable of 60,000 counts per minute and having decimal display is described in a new bulletin. Vorne Industries, Inc., 5641 N. Northcott Ave., Chicago, IL 60631. **236**

Rack and panel connectors for power, signal and coaxial conductors with either crimp or solder contacts are covered in 32-page catalog RP-70. Burndy Corp., Norwalk, CT 06852. **237**

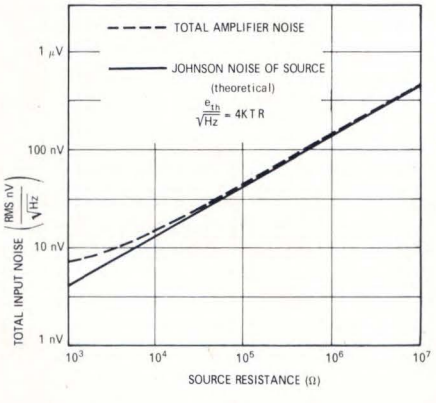
Piezoceramic Catalog H-700 contains 28 pages of information and specifications on a line of piezoceramic materials. Gulton Industries, Inc., Metuchen, N J 08840. **238**

One of Those Days

First thing in the morning, the Editor in Charge of Anomalies accidently kicked the typewriter plug out of the floor socket. Then he hit the carriage return key. When nothing happened, he bent down, replaced the plug in the socket—and caught a shot in the head from the returning carriage.

The rest of the day went something like that. Consequently, an August 1 Design Briefs story about Krannert Inst. of Cardiology's new research system said not a word about Honeywell Test Instrument Division's design—of which they are justifiably proud.

Another lapse in August 15, page 69, assigned TI's RA-12 low-frequency parametric amplifier to make the trip to Mars. Actually, NASA is **testing** the device for a future Mars trip. On the same page, the graph of input noise **should** have looked like this:



You're right—it was a Monday!

Yes, Virginia, ITT Does Make Monolithic ICs

Through a clerical oversight, ITT Semiconductors was omitted from the "Microcircuit Capabilities Chart" (EDN, July 1, 1970, p. 18). ITT should be listed as manufacturing monolithic bipolar DTL, TTL, CTL, memories, diff amps, op amps and regulators and MOS shift registers, counters, memories and logic circuits. ITT devices **are** listed appropriately in the detailed circuit and discrete device tabulations.

...'Scab!'

Gentlemen:
I resent your July 15 Customer Engineering Clinic deeply. It is degrading to see engineers taken advantage of. Mr. Cone will be able to save $300 or $400 by not using the services of a consulting engineer to solve his problem while some unthinking engineer will solve Mr. Cone's problem for a measly $50.

And it is not the principle of the thing, it's the **money**. If we sell our services cheap, we'll never be "professionals".

Bernard P. Tracey
Electronics Engineer
Canoga Park, CA 91304

Marvels of Multiplexing

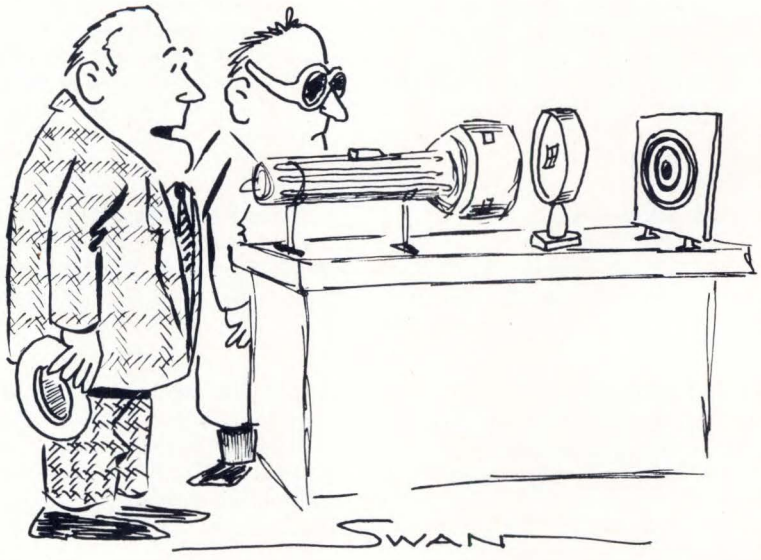
The following paragraphs are taken from an article on malfunctions plaguing the new Boeing 747 jumbo jets:

. . . "But schedule disruptions also have been caused by other aberrations. These have ranged from generator malfunctions and faulty fuel-transfer mechanisms to a so-called "multiplex" circuit that ties together movie and stereo sound, public-address speakers and cabin lights into what was designed as a lightweight, superefficient electrical system.

Unlike most of the nonengine problems, the trouble with the "multiplex" circuit appears to have been chronic.

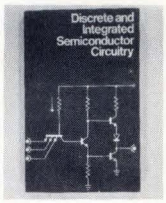
Citing a "typical" incident, one airline spokesman said: "We were showing 'Ice Station Zebra' when an underwater explosion on the screen turned on every light in the passenger compartment". . .

The New York Times
July 29, 1970



"I **had** heard they cut your laser budget."

Discrete and Integrated Semiconductor Circuitry

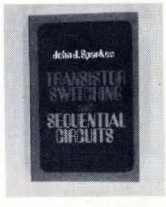


By L. J. Herbst; Barnes and Noble, Inc., New York, N.Y. 10003; 1969; 197 pages; Price: $6.00.

This is an introductory text for undergraduate students or for individuals who have had little previous knowledge of electronics. The book provides a broad, but concise account of integrated circuitry.

Beginning with semiconductor fundamentals, the book continues with a description of low-frequency small-signal amplifiers, high-frequency amplification and switching circuits. A chapter on logic fundamentals precedes the presentation of the role of integrated circuits in digital design. Two sections are devoted to field-effect transistors—one on fundamentals, the other on application. A final survey on device performance and future developments concludes the book. For more information about this book, Circle No. **450**

Transistor Switching and Sequential Circuits



By John J. Sparkes; Pergamon Press Ltd.; Elmsford, N.Y. 10523; 1969; 235 pages; Price: $4.00 (flexicover), $5.00 (hardcover).

This book is intended to help students and beginners in the field of digital circuits. Presentation of design procedures for switching and sequential circuits is short, but sufficiently detailed.

There are two parts to this book. The first section reviews the generation of waveforms used in digital circuits—principally square waves, ramps and delays. The second half explains how to use the basic digital circuits to generate logical functions. Much emphasis is given to sequential circuits. The two sections are independent, therefore it is not necessary to read the first part of the book to understand the second. For more information about this book, Circle No. **451**

Digital Magnetic Logic

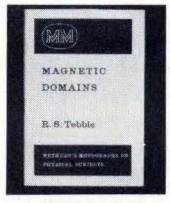
By David R. Bennion, Hewitt D. Crane, David Nitzan; McGraw-Hill Book Co.; New York, N.Y. 10036; 1969; 367 pages; Price: $15.00.

Integrated into a self-contained volume, this text can be used by engineers and technicians with no previous knowlege of magnetic core logic. Coverage ranges from basic theory of magnetic circuits to a detailed analysis of magnetic circuits by a computer.

First three chapters discuss the basic properties of magnetic circuitry and provide the background for the succeeding chapters on core/wire logic. The final two chapters summarize the physics of magnetism, with a detailed discussion of a square-loop magnetic-core model used for the computer analysis of magnetic circuits.

Subjects discussed include a detailed presentation on the transfer of flux from one core to another via an electrical coupling loop; MAD-R, a scheme that has been studied and used more than any other; quantitative design procedure for various other core/wire schemes; and the basic principles of digital logic synthesis. For more information about this book, Circle No. **452**

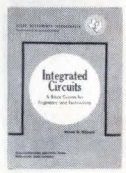
Magnetic Domains



By R. S. Tebble; Methuen and Co., London, England: 1969; 98 pages; $2.70.

This book is intended not only for the physics student, but also for engineers or other individuals with an interest in magnetic materials. The author presents the subject by reference to the results of experimental observations on magnetic domains—using electron microscopy as well as established optical techniques. Diagrams and micrographs have been used freely to illustrate this text. For more information about this book, Circle No. **453**

Integrated Circuits, A Basic Course for Engineers and Technicians



By Robert G. Hibberd; McGraw-Hill Book Co.; New York, N.Y. 10036; 1969; 173 pages; Price: $9.95.

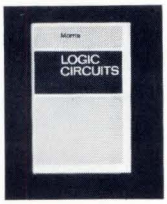
Written as a self-teaching course, this book could be indispensable to junior engineers and technicians of the electronic field. In addition, it is written so that non-electronic personnel can gain a general understanding of integrated circuits. Each of the ten chapters is an illustrative lesson on a specific topic. A glossary of terms and review questions (with answers) are provided at the end of each chapter. Subjects discussed include: solid-state and integrated-circuit technology, logic circuits and theory, linear devices and use of integrated circuits in electronic control. For more information about this book, Circle No. **454**

A Fortran IV Problem Solver

By William A. Manning and Robert S. Garnero; McGraw-Hill Book Co., New York, N.Y.; 1970; 167 pages; $4.50.

Proceeding through an instructive series of cumulative steps, the student is introduced to Fortran IV programming—based on IBM 360 with an H-level compiler. Step by step, the student gains knowledge by solving problems and coding solutions. Practical programming applications are presented in the last half of the book. Answers to all problems are given. For more information about this book, Circle No. **455**

Logic Circuits



By N. M. Morris; McGraw-Hill Book Co., New York, N.Y. 10036; 1969; 189 pages; Price: $13.50.

This book has a wealth of information for individuals involved or concerned with logic design. Using the systems approach, the author presents a comprehensive guide to logic design and the use of logical devices. To aid the reader in understanding logical problems, the organization of this book is systematic, beginning with an introduction to numbers and numbering systems before progressing to the fundamentals of design. However, device theory is limited only to what is necessary for understanding any principles involved with logic design.

Topics discussed in this text include arithmetic processes, asynchronous and synchronous counters, and minimization techniques. The final two chapters are devoted to a discussion of circuit principles—switching devices and integrated circuit technology. This book is illustrated throughout with worked examples, and a bibliography is provided for the reader who desires further knowledge on the subject of logic. For more information about this book, Circle No. **456**

New Publications Available

—Market Research Handbook—A new guide, written specifically for the enginneering-oriented marketer who has little formal training in market research, has been published by Schoonmaker Assoc. The text covers basic market research methods such as questionnaire design, evaluating competition, sales forecasting, and product planning. Available from Schoonmaker Assoc., Box 35, Larchmont, NY 10538. Price: $37.50

—Silicon Technology Manual—Monsanto Co. has made available an evaluation standards manual that covers the electrical, mechanical, visual and structural procedures for evaluating single-crystal silicon and is intended to serve as a working handbook for users and manufacturers of silicon. To obtain the manual, write to David Brooks, Monsanto Electronic Materials, Box 8, St. Peters, MO 63376. Price: $25.

—Minicomputer Market Report—This report discusses 70 minicomputer manufacturers and their 140 products. Included are evaluations of companies, comparisons of products, anticipated technological developments and pricing. This market research report may be ordered from High Technology West, 1060 Crenshaw Blvd., Los Angeles, CA 90019. Price: $250.

—Analysis of Fairchild Op Amps—This highly detailed report analyzes Fairchild's μA741 and μA741C frequency-compensated operational amplifiers. The report provides a marketing analysis, a complete electrical evaluation, and a critique of the circuit design. Discussed are Fairchild's assembly methods and operations and an analysis of the reliability considerations. The report, published in limited quantity, is available from Gary Orman, Business Development Mgr., Integrated Circuit Engineering Corp., 4900 E. Indian School Rd., Phoenix, AZ, 85018. Price: $1000.

Semiconductor Plasma Instabilities

By Hans Hartnagel; American Elsevier Publishing Co., Inc., New York, N.Y. 10017; 1969; 206 pages; Price: $11.00.

A complete treatment of the phenomena known as semiconductor bulk-effects starts with the basic principles of semiconductor physics and brings the reader to the present-day level of knowledge on this subject. Many references throughout the book are provided for the reader who may have a limited knowledge in semiconductor physics.

The subject of applications is well covered and a number of possibilities are suggested. Topics discussed in the book include:

—Bulk effect equations (Boltzmann, Poisson, etc.) together with phenomena such as scattering processes and carrier temperatures.

—Study of instability properties, the large and small signal analysis.

—Description of various stabilities such as Gunn effect and avalanche instabilities.

—Bulk-effect devices.

For more information about this book, Circle No. **457**

A Guide to Superconductivity

By David Fishlock; American Elsevier Publishing Co., Inc., New York, N.Y. 10017; 1970; 150 pages, Price: $7.00.

Eight experts, known internationally for their work with superconductors, pool their thoughts on the progress and prospects of superconductivity. Uncluttered with detail, this book is easy to read. It presents a complete survey starting with the basic concept and continuing with an optimistic prospect of this new technology.

Individuals who contributed material are Dr. N. P. Allen, Dr. J. A. Catterall, J. E. C. Williams, Dr. P. F. Smith, A. D. Appleton, Dr. W. T. Norris, Dr. P. A. Walker and C. Laverick. These authors point out the many engineering possibilities for superconductivity. For example, the prospects of a superconducting computer memory are once again looking bright. Another application is a superconducting generator for low voltage, high direct current. It is also emphasized in this text that superconductors, like the laser, are finding a place in instrumentation or experimental apparatus where they provide a small, inexpensive service but they are more efficient than the conventional alternatives. For more information about this book, Circle No. **458**

Harry Howard

SC Heat Sink and Socket D.A.T.A. Book

Published by D.A.T.A., 32 Lincoln Ave., Orange, N J 07050. Price: $24.50.

This new reference gives the engineer/designer and the procurement specialist the answers they need for cooling and mounting transistors, ICs, SCRs and diodes. The book includes complete selection, design and outline information on more than 5000 semiconductor heat sinks and sockets and covers 50 American manufacturers. For more information, Circle **459**

Advertiser's Index

Subject Index to Articles

Index to Ads, Products and Literature

Application Notes

IC Voltage Comparator Technical Data and Application Note OC32a-50 contains characteristics, precautions and pertinent equations for applying the Model AD 351J/K/S voltage comparator. Analog Devices, 221 Fifth St., Cambridge, MA 02142. **475**

Three-Phase Motor Protection Application Note One describes how to use voltage balance relays to protect a three-phase motor against overheating and possible damage from any source of voltage unbalance. Beckwith Electric Co., Inc., 1002 Greenfield Lane, Mount Prospect, IL 60056. **476**

"Uses Unlimited", issue No. 38, has ten new application stories, detailed descriptions of three new products and three unique ideas. Included are high performance dc motors, a line of pushbutton switches and indicators and sealed aluminum die cast switches. Micro Switch, A Div. of Honeywell, Inc., 11 W. Spring St., Freeport, IL 61032. **477**

"EMI Control Thru Shielding" reviews the relationship between EMI filtering and shielding. It describes why low frequency magnetic fields and high frequency plane wave fields usually are the predominant shielding problems of reflection absorption and leakage through discontinuities. Brochure ME-31 is available from Metex Corp., 970 New Durham Rd., Edison, N J 08817. **478**

Swept impedance measurement, 0.1 to 110 MHz, is the subject of Application Note 121-2 that details methods, gives set-ups for measurements and discusses the applicable accuracy considerations. Inquiries Manager, Hewlett-Packard Co., 1601 California Ave., Palo Alto, CA 94304. **479**

TTL Schmitt Trigger Integrated Circuit Application Report CA-152 contains seven pages of information on the benefits of using the monolithic IC Schmitt trigger over a discrete device wired circuit. Texas Instruments Incorporated, Inquiry Answering Service, Box 5012, M/S 308, Dallas, TX 75222. **480**

"Two-Way Repeater Station Utilizing Hybrid Thin-Film Amplifier as Building Block" is a six-page technical paper that reports on a development using microelectronic circuit design that is incorporated in a new line of hybrid thin-film push-pull integrated circuit amplifiers. Anaconda Electronics Co., 305 N. Muller St., Anaheim, CA 92803. **481**

"What's really on the inside of integrated circuits" is the subject of a 22-page article that is abstracted from "Product Analysis" reports. Four parts of the article are product evaluation, how to perform a product analysis, analyzing electrical test results and circuit layout and processing. Integrated Circuit Engineering Corp., 4900 E. Indian School Rd., Phoenix, AZ 85018. **482**

Controlling Volume in Dictating Machines is the subject of Clairex Photocell Forum Vol. 6, No. 2. It describes the application of a Clairex photocell for achieving noiseless avc. Clairex Electronics, 560 S. Third Ave., Mount Vernon, NY 10550. **483**

New Performance and Applications Guide contains information on a family of dc permanent magnet servo motors for use with disc storage drives, line printers, tape transports, card readers and optical character readers. Cedar Div., Control Data Corp., 5806 West 36th St., Minneapolis, MN 55416. **484**

"Gate-Oxide Protection Circuit in RCA COS/MOS Digital Integrated Circuits" is the title of Application Note ICAN-6218. It describes a protection circuit incorporated in all RCA COS/MOS ICs to eliminate the problem of static voltages rupturing gate oxides in MOS devices. RCA Electronic Components, Commercial Engineering, Harrison, N J 07029. **485**

Filter analysis is a nine-page application abstract that describes a computer program enabling time-sharing users to select a filter transfer function. Included are the Bessel, elliptic, Butterworth-Thomson and ultraspherical functions. Geometry, desired frequency and impedance transformations also can be selected. Remote Computing Corp., One Wilshire Bldg., Suite 1400, Los Angeles, CA 90017. **486**

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