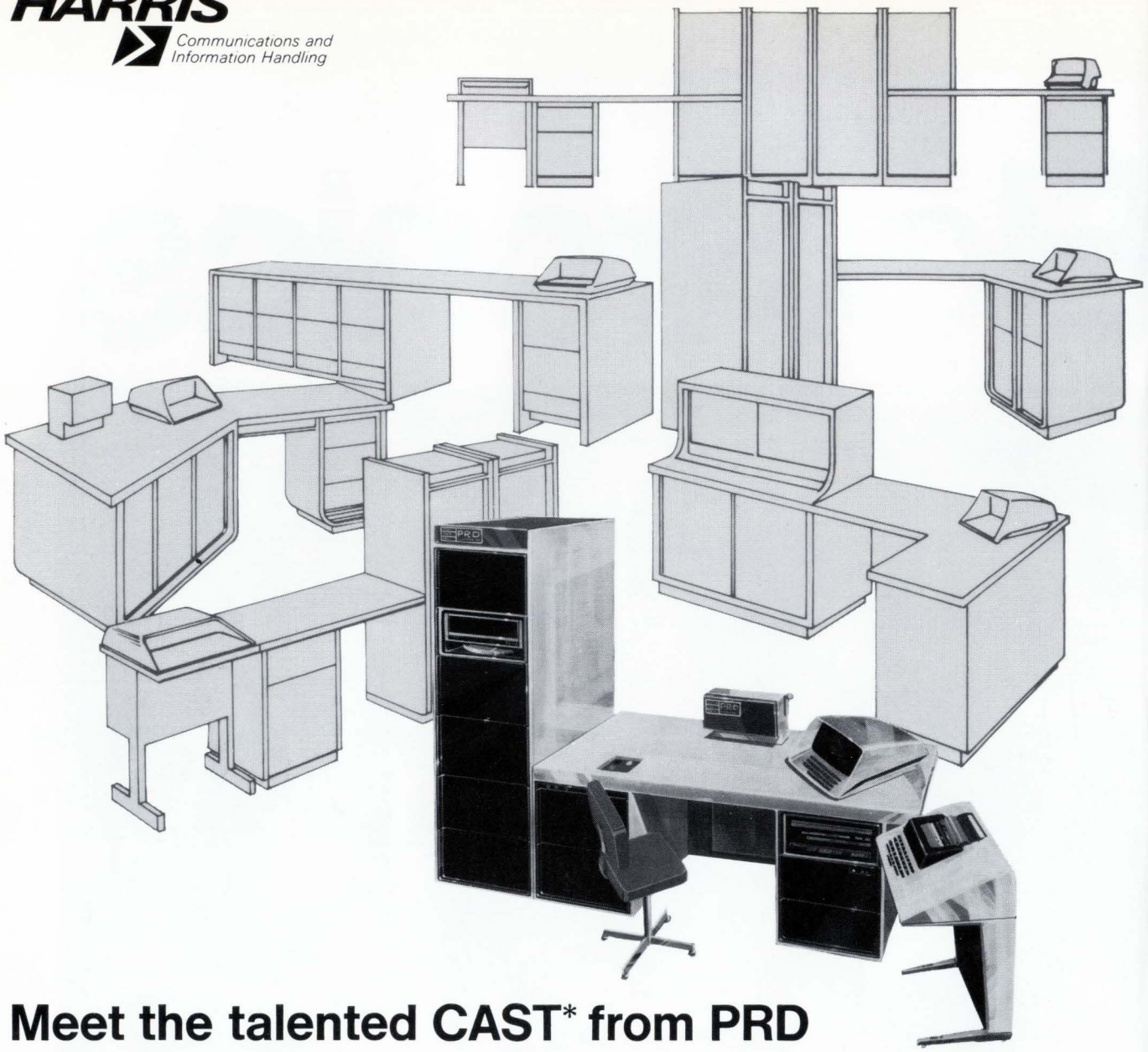
November 20, 1972 $1.00 A McGraw-Hill Publication

Electronics

FOR JAPAN'S ELECTRONICS, A YEAR OF RECOVERY

HARRIS
Communications and Information Handling



Meet the talented CAST* from PRD

Our Computerized Automatic Systems Testers are fully integrated hardware/software systems. They test everything well:

☐ analog, ☐ radio frequency, ☐ digital systems, ☐ sub-assemblies, ☐ modules and ☐ circuit boards. They also provide ☐ Go/No-go end to end testing, ☐ fault diagnosis, ☐ data processing and trend analysis. In short, they're born performers.

Cost-effective performers. CAST systems are modulary designed to permit addition or deletion of individual stimulus or measuring units, according to your needs. Not only are they talented and economical, they're cooperative. They offer simplified ☐ English language programming, ☐ self check, ☐ CRT or hard copy readout, ☐ training and service.

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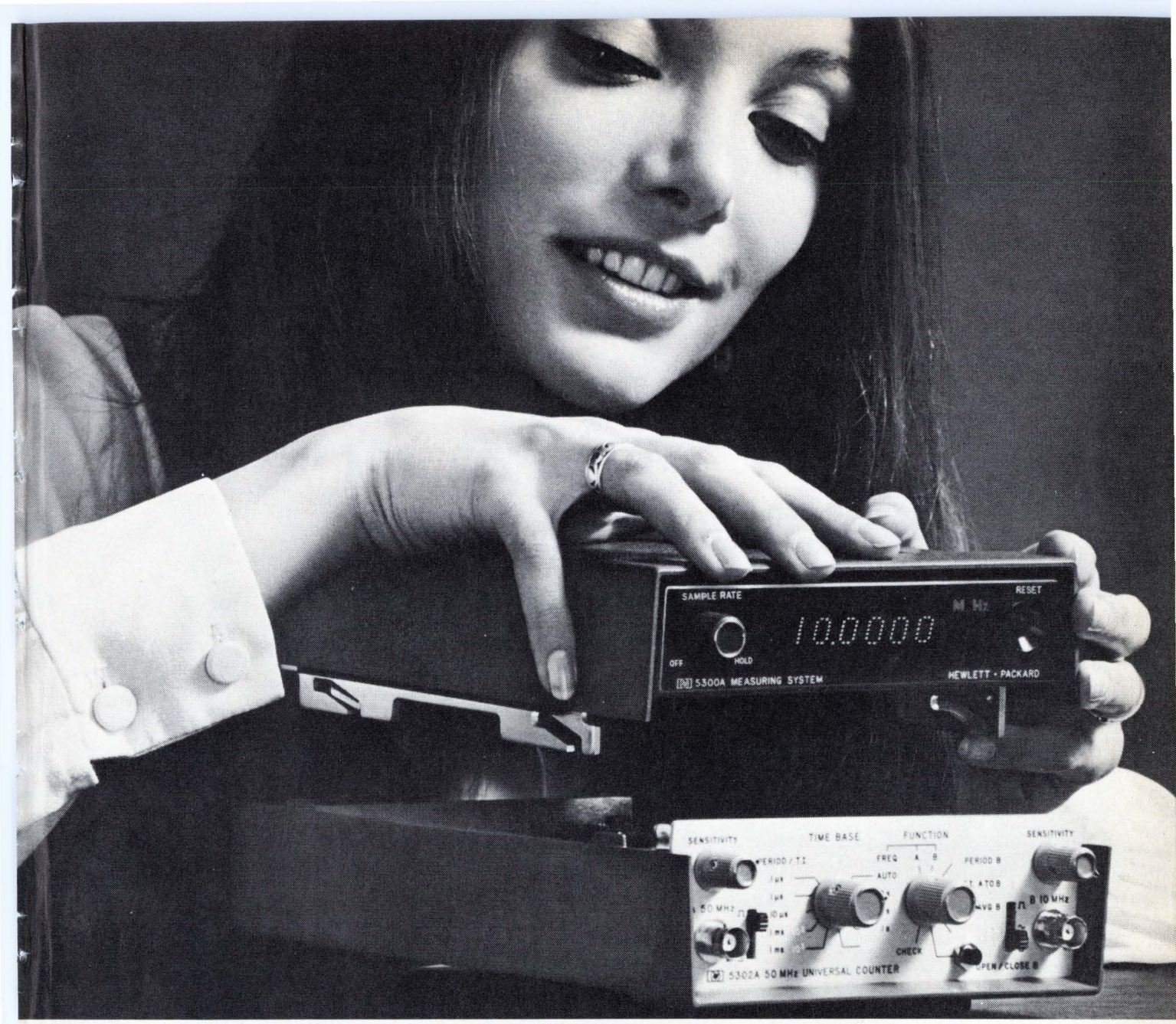
Automation In Measurement

PRD ELECTRONICS, INC. | HARRIS

* Computerized Automatic Systems Tester

Circle 900 on reader service card



Introducing the little counter that can.

It can become four different systems.
It can go anywhere you do.
It can protect you against obsolescence.
It can make buying and maintaining a counter less expensive than ever before.

Meet the Hewlett-Packard 5300, the snap-together counter that's not much bigger than the palm of your hand. It has six digit accuracy, solid-state display and autoranging. It'll make period, frequency, time interval and ratio measurements, operate on its optional snap-on battery pack and drive a printer. Rugged dust-proof aluminum case resists almost any bumps it might get in the field. Prices start at only $540 for one of the most amazing counters you've ever owned.

Start with the basic mainframe ($395). Then snap on any of the following modules (more on the way) to make just the counter you need, and avoid obsolescence, too:

10 MHz frequency module. Model 5301A, $145.

50 MHz all-purpose module includes period, time interval. Model 5302A, $275.

525 MHz module with both 50Ω and 1 MΩ inputs. Model 5303B, $800.

100 ns time interval module with: unique "time holdoff" feature, dc coupling, slope and trigger level controls, and period and frequency measurements to 10 MHz. All the functions you'd pay $1200 for in a universal counter. Model 5304A, $325.

Rechargeable battery pack module works with any of the other modules for cord-free operation. Model 5310A, $195.

The 5300 is one system you have to use to appreciate. If you've ever needed to accurately measure frequency or time interval, you owe it to yourself to call your nearby HP field engineer for further information. Or write Hewlett-Packard, Palo Alto, California 94304; Europe: P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland; Japan, Yokogawa—Hewlett-Packard, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

02109B

HEWLETT hp PACKARD

ELECTRONIC COUNTERS

Circle 1 on reader service card

Until you try HP's new IC Troubleshooting Partners, you'll never know how simple logic circuit testing can be.

Just push a button on the Pulser on the left, and let the Probe on the right automatically monitor the response downstream.

How? HP's new 10526T Logic Pulser injects a single 300 nanosecond pulse anywhere in your TTL and DTL circuitry. Low nodes are momentarily forced high, high nodes automatically pulled low. There's no unsoldering or trace cutting. Just press the button and the pulse is there. $95.

And HP's new 10525T Logic Probe checks the result. A single, unambiguous light at your fingertips tells you exactly what's going on. If no pulse is detected, something's wrong.

The Probe may be used to look for much more than just pulses. Highs, lows, bad levels, open circuits and pulse trains to 50 MHz are faithfully displayed. Even single shot events as quick as 10 nanoseconds are captured and stretched. And high impedance won't load even low power TTL, yet the Probe is fast enough to keep up with Schottky. $95. (We also have a high threshold level version, Model 10525H, also $95.)

For other applications, the HP 10528A Logic Clip monitors all pins of DIP TTL/DTL IC's simultaneously. Use the Clip with the Pulser – the Pulser injects clocks, transfers, shifts, etc. HP 10528A Clip, $125.

All three troubleshooters team up as the 5015T Troubleshooters Kit for $285 which gives you a 10% discount and a handy carrying case to boot.

For more information on these and other IC Troubleshooters call your local HP field engineer or write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304; Europe: P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland; Japan: Yokogawa – Hewlett-Packard, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

HEWLETT hp PACKARD

02206

Circle 2 on reader service card

Electronics

The International Magazine of Electronics Technology

November 20, 1972

 Volume 45, Number 24

Highlights

The sound of silence, 69
Noise-reduction systems for tape and disk recording have long been a Dolby Laboratories monopoly. But now two new manufacturers are challenging the firm in the studios, though not yet in the home.

Japanese electronics regains its vigor, 91
After a poor two years, this year is expected to break even, and a return to solid growth is expected in 1973. According to this Special Report, Japanese electronics companies expect much from communications and computers, less from the post-color-TV era. Technologically, too, they are almost abreast of the U.S.

Alarm senses moving infrared sources, 111
A passive detector with a range of up to 1,000 feet has a low false-alarm rate because it responds only to moving targets. None of the five prototypes in use has been discovered by intruders.

C-MOS simplifies electronic organ circuitry, 114
Many voices and smooth, click-free sound reproduction are features of a relatively uncomplicated electronic organ built around C-MOS ICs and linear diode gates.

And in the next issue . . .
The Japanese EE . . . IC transducers are good and cheap . . . new solid-state sources for microwave designers.

The cover
Doll from Takashimaya, the Japanese department store of Tokyo's Ginza and New York's Fifth Avenue, represents a dragon god who rises from a lake in a traditional Noh drama about good fortune.

Electronics

Publisher's letter

Japan is halfway around the world, but for Jerry Walker getting there to gather material for our annual Japanese market survey (see p. 91) was nothing compared with the hazards of getting around Japan.

Walker and our Tokyo bureau manager, Charles Cohen, visited dozens of companies and talked with scores of industry representatives both in Tokyo and other cities. Cohen snapped the photo below in Tokyo as Walker talked with Sony Corp.'s senior managing director, Noboru Yoshii.

It was on their way to Yokohama that the most dramatic of the travel hazards struck. A typhoon hit with its hurricane-force winds and heavy rains as they drove from Tokyo to interview executives at Nippon Electric Co.'s wireless communications division. "The main problem," Jerry recalls, "was that we were not the only ones crazy enough to be out in the storm. The traffic congestion was horrendous."

Another travel hazard occurred in Osaka on the way to interviews at Sharp Corp. Cohen and Walker took a taxi that turned out to be one running on liquid petroleum gas, which is less expensive than gasoline but, at least in this taxi, produced a sickening exhaust odor. The taxi also had an exhaust leak that poured the fumes into the car.

"It took us 3 minutes of choking and gagging before we could go into the interview, which really scared the solicitous receptionist," Jerry reports. "I wished then that the Japanese had perfected the electric car."

But offsetting the hazards were some pleasant events. "For one, Matsushita raised the American flag at its corporate headquarters during our visit, a touch of hospitality typical of the company. For another, the trip back to the hotel from the Sharp visit was in one of the host company's fancy limousines. And it did not run on LPG."

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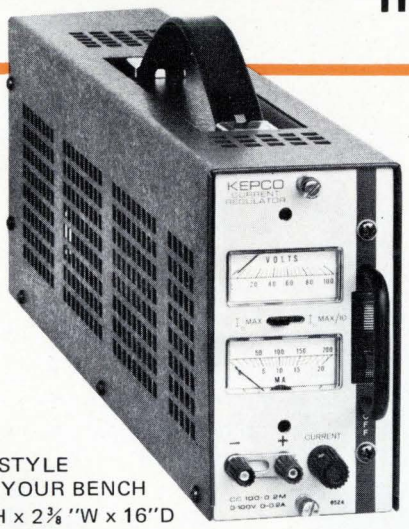
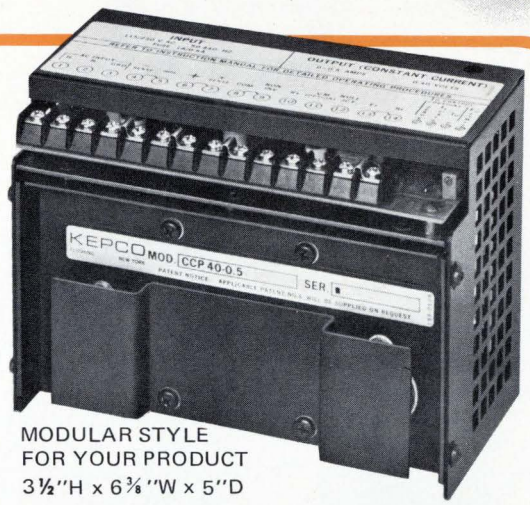
CURRENT STABILIZED POWER

from KEPCO



LAB STYLE
FOR YOUR BENCH
5¼"H x 2⅜"W x 16"D



MODULAR STYLE
FOR YOUR PRODUCT
3½"H x 6⅜"W x 5"D

The Kepco CC design provides a precision current controller in a convenient plug-in bench style. Housings are available to mount one, two or three units side-by-side or six units abreast in a standard 19-inch rack. The CC Power Supplies feature built-in dual range, 10-turn current control (0.05% resolution), plus isolated voltage and current metering.

The Kepco CCP Series offers an OEM the same selection of current stabilizing power supplies in a compact modular format suited for remote control. A 0–1000 ohm rheostat controls current through the full range and a built-in (optional) voltage repeater will run your meters without loading the output. CCP modules feature a built-in, adjustable voltage limiter.

In either style, the Kepco current stabilizers offer extraordinary performance:

Source effect (line regulation):	0.0005% or 0.2 μA.
Load effect (load regulation):	0.005% or 2 μA.
Temperature effect coefficient:	0.01% per °C.
Ripple (Continuous or Random Unprogrammed Deviation):	0.02% I_o max.

The heart of each power supply is a monolithic I-C comparator to insure high stability, even in an adverse thermal environment. A unique feature is a fast-recovery, capacitorless output circuit that allows current to recover from a load (voltage) change up to 2 μsec. per volt.

OUTPUT AMPS	OUTPUT VOLTS	BENCH MODEL*	PRICE	OEM MODULE	PRICE
0–2A	**0–7V**	CC 7–2M	$209.00	CCP 7–2	$150.00
0–1.5A	**0–15V**	CC 15–1.5M	209.00	CCP 15–1.5	150.00
0–1A	**0–21V**	CC 21–1M	209.00	CCP 21–1	150.00
0–0.5A	**0–40V**	CC 40–0.5M	209.00	CCP 40–0.5	150.00
0–0.3A	**0–72V**	CC 72–0.3M	209.00	CCP 72–0.3	150.00
0–0.2A	**0–100V**	CC 100–0.2M	209.00	CCP 100–0.2	150.00

*Single unit case, Model CA–3: $22.00

ALL KEPCO POWER SUPPLIES CARRY A FIVE-YEAR WARRANTY

For complete specifications and applications notes – write Dept. DX–14

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Readers comment

Pioneer people mover

To the Editor: It is disconcerting to read your article on people movers [*Electronics,* Sept. 11, p.74], which omits credit to the pioneer in the field, Alden Self Transit Systems Corp., of Milford, Mass.

It was Alden that foresaw the need, developed years ago the system on which the Morgantown project is based, and did the preliminary work leading to that project. Others entered the picture much later. Alden, which has a major subcontract on the Morgantown project, also holds basic patents in the people-mover field.

Sidney Hoffman
Senior vice president
Proctor, Cook & Co.
Boston, Mass.

Signal generator noise

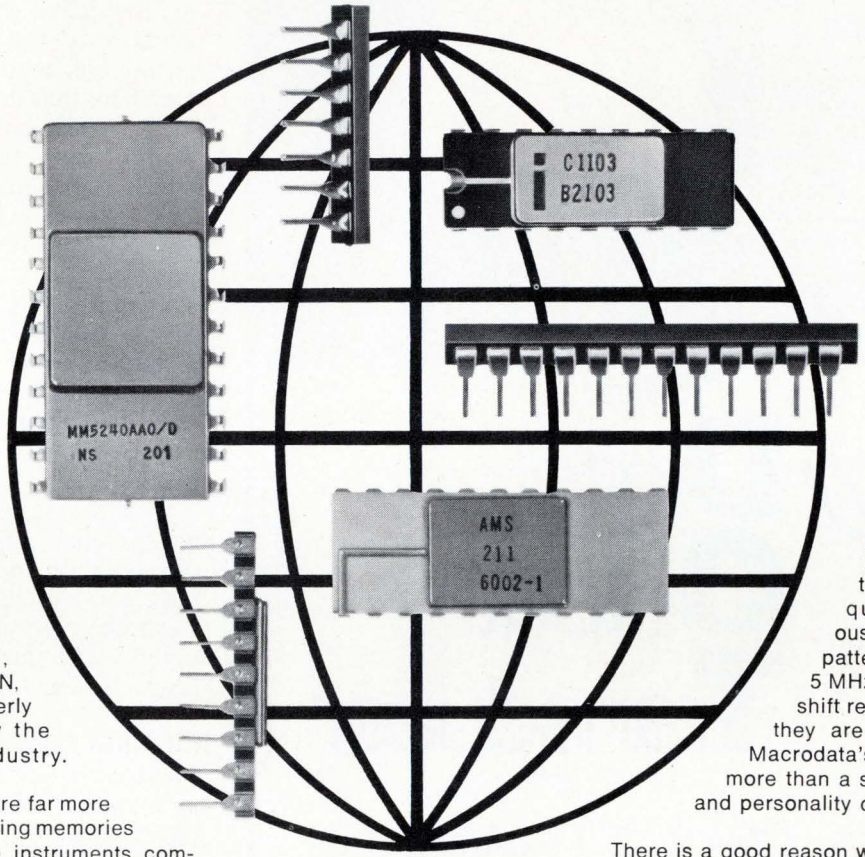
To the Editor: Your Electronics newsletter [Aug. 28, p. 22] contains an item stating that Hewlett-Packard is just announcing a new signal generator. It is emphasized that the noise feature of 140 decibels per hertz is an order of magnitude better than that of other solid-state signal generators.

Marconi Instruments' solid-state model 2012, which equals this performance, was introduced at the IEEE conference in 1970. Since that time, we have added to our line of low-noise signal generators with the models 2011, 2013, etc.

Keith Elkins
Manager
Marconi Instruments
Englewood, N. J.

■ *We should have said that the H-P generator's noise figure is an order of magnitude better than that of other* general-purpose *solid-state signal generators, since it spans the frequency range from 450 kilohertz to 550 megahertz. The Marconi 2012 provides more limited coverage (400 MHz to 520 MHz), and it is specifically intended for testing uhf/fm narrow-band receivers. The other two Marconi instruments are also single-band units: the 2011 covers 130 to 180 MHz, and the 2013 covers 800 to 960 MHz.*

Supporting the world of semiconductor users... MACRODATA'S MD-100 TEST SYSTEM – the 'no-contest' champion of the industry!

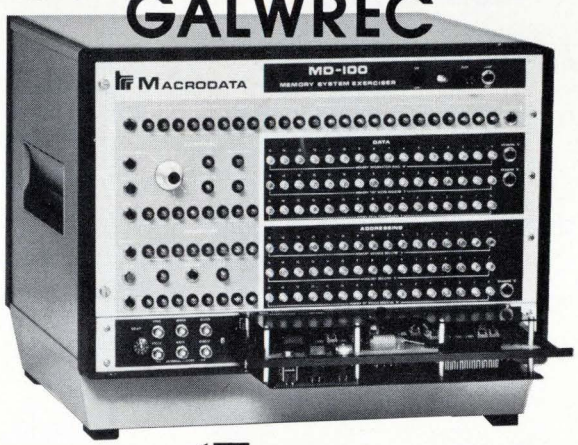


When Macrodata introduced its remarkable MD-100 Memory Exerciser, all the old-fashioned IC testing concepts were changed. Such new Macrodata test programs as WAKPAT, GALPAT, GALWREC, MASEST, MSCAN, MARCH, etc. were eagerly adopted and are now the standards for the industry.

That is why today there are far more MD-100's in the field testing memories than all the competitive instruments combined. And the MD-100 is not only the standard bearer of the industry in the U.S.A. but also throughout the rest of the technological world.

Unlike its predecessors, the MD-100 was not designed for the IC manufacturer alone. It was designed for the user, for incoming inspection and evaluation. And with it, users are now testing both bipolar and MOS — RAM's, ROM's, shift registers, random logics — even UAR/T! They are testing devices in chips, packages, memory cards, subsystems, and final systems, handling memories of one word by one bit up to 65,536 words by 16 bits. They are running their devices either sequentially or continuously, through millions of patterns, at rep rates up to 5 MHz. They are even testing shift registers at 20 MHz. And they are taking advantage of Macrodata's extensive library of more than a score of test programs and personality cards.

WAKPAT
GALPAT
GALWREC



There is a good reason why MD-100 sales lead all the rest. No other tester has hundreds of thousands of hours of reliable field usage under its belt. So why should you gamble on another tester — or a company — that hasn't really been tested?

Why not do business with Macrodata — the company that all the others are following? But even from us, don't buy a pig in a poke. Make us prove that our MD-100 is as good as we say. For a free demonstration in your plant now, call us directly. (For a brochure, use the reader service card.)

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40 years ago

From the pages of Electronics, November 1932

The coming of Dr. Albert Einstein to the United States to serve as a member of the Princeton College faculty will remind many electrical men here that the wizard of relativity has a personal reputation in electronics and electrical invention, quite independent of his mathematical abstractions. His best-known electrical device before the European public is undoubtedly the "Einstein piano," a musical instrument which employs the vibrations of piano strings to actuate microphones, the output of which can then be modified by electrical circuits to produce a variety of instrumental effects.

By changing switch contacts, various familiar standard instruments can be reproduced, or the player may soar off into new Einsteinian harmonies, creating musical notes of timbres and qualities never before heard in nature.

Electrical failure in radio and electronic circuits is too often caused by mechanical failure. This is mainly due to wear, inadequate strength, and insecure bracing.

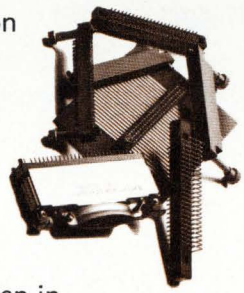
Volume controls, rheostats, loudspeaker moving coils and cones, jacks, switches, and relay armatures and contacts are subject to mechanical wear when in use.

Tube-socket contacts, brittle lock soldering lugs, and insecurely fastened wires, especially when soldered too cold, often cause electrical trouble by their mechanical weakness. Overrated resistors get too hot and often change their resistance or break, rendering the circuit less sensitive or inoperative. Frequently the fastening and bracing of heavy parts is inadequate. Too often the electrical designer overlooks these points.

When is a radio set not a radio set? When it is mounted on an automobile, says Uncle Sam. For then, according to the obliging official interpreters of the United States Treasury, a radio receiver is no longer such, in the eyes of the law, but becomes an "automobile accessory," taxable at 2 per cent instead of 5 per cent.

It takes a very smart bird to make an electronic package design fly. The kind of searching, sharp-eyed bird who beats his wings hard. Who soars high with new ideas. And lands on a nest of problems with sharp solutions.

If you're that kind of electronic packaging design engineer, we want you to know about Winchester Electronics 42 Series Input/Output Connectors. What's so special about them? They're not just advanced and reliable. They're the surest, most convenient, most adaptable way to interconnect busy, multi-wired cables. Even in tight places. With 42 Series Connectors, you can plug in to a back panel. To a printed circuit board. To an instrument panel. Or to another cable. And you'll plug in 50 or 74 high density input/output interconnects at one time. Anywhere, we repeat, in the package you want. It all happens neatly. Compactly. With minimum weight. In line with MIL-E-5400 airborne requirements.



Another point, now. In a sense, you're really the designer of your own 42 Series Connectors. Because just about any variation you want, to suit your package design, is possible.

Beginning with moldings of diallyl phthalate offering 50 or 74 .100 centers high density positions for pin and socket contacts. With 24 center row positions to use for polarizing pins, if you want them. With polarized guides. With fixed, short turning or long turning jackscrews. And with anodized aluminum hoods.

You specify whatever kind of pin and socket contacts your particular design, prototype, production and field servicing require, too. Dip solder contacts for printed circuit board interconnections. Solder cup for wire. Or crimp removable contacts.

For extra design freedom. Greater choice in circuity. Ease in modification. And simple, lower cost field servicing.

The 42 Series Input/Output Connectors from Winchester Electronics. Great to help your design fly. Compute. Count. Control. Remember. Or do any job you want it to do.

Great to help you complete your design in one fell swoop. Without getting into a flap.

For complete data and specifications, contact: Winchester Electronics Group, Main Street & Hillside Ave., Oakville, Conn. 06779. (203) 274-8891

Litton **WINCHESTER ELECTRONICS**

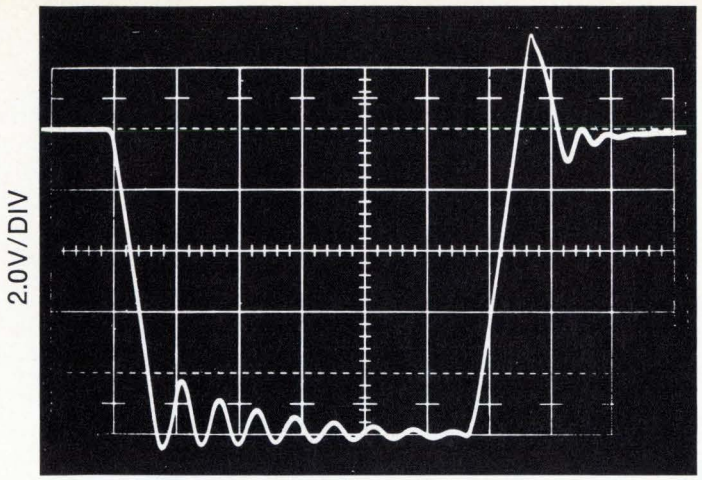
Circle 9 on reader service card

National's 118: Some good news. Some bad news.

If you only have a few National 118's in stock, you're in luck!
Send us one and we'll send you two of our AMD 118's.
(Put one back in stock and put the other into test.)
Two to a customer, please. We're excited, not crazy.

Circle Bingo card #204

The National 118 is a good product.



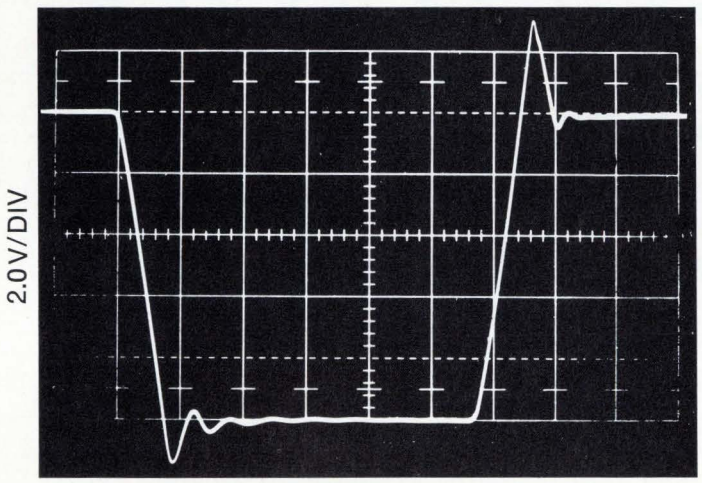
It's a high speed linear op amp that does magical things in A to D convertors, active filters, sample and hold circuits and wide band applications.

It comes in three temperature grades with these super specs: Slew rate, 70 volts per microsecond! Input offset voltage, 2mV. Input bias current, 120nA. Offset current, 6nA. Voltage gain, 200K.

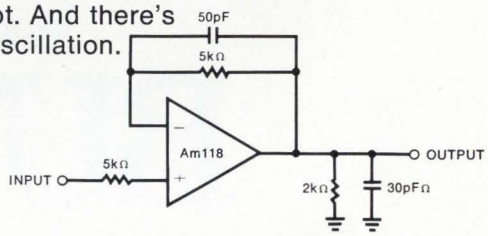
It's internally compensated. If you want to add external compensation, you can double bandwidth and slew rate.

It's a good product.

But AMD's 118 is a great product.



Significantly better. It has all those specs and something more. It's more stable. Its phase margin is 35° with less than 2db overshoot. And there's no oscillation.



Both scope pictures were made using this voltage follower, slew rate test circuit.

Did you know we're going to be the sixth largest integrated circuits company in the United States by 1975? Do you know how?

One product at a time.

Advanced Micro Devices

(We're going to be #6)

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GENERAL AUTOMATION SAYS BUY DEC

If you're shopping the minicomputer market for raw hardware at rock bottom cost, it's hard to know where to stop. With more than two dozen price lists to choose from, it can get confusing. And time consuming.

We're here to make it easy for you. Buy DEC.

When you cut through all the claims, DEC's priced as low as anyone else. And they have built a business fulfilling the needs of the low-end iron buyer.

We make low cost hardware too. And if you're price shopping, you'll find us competitive. But raw iron is not our primary business.

The cheapest machine vs. the cheapest solution:

Sure, our goal is to save you money too. But our long suit is squeezing these savings out of your total systems cost rather than off of our price list. So if you need more from the machine or the company that sells it to you, we recommend us. General Automation.

Take *the world's most powerful minicomputer,* for instance.

The General Automation SPC-16.

The SPC-16 possesses the most powerful instruction set you can buy in a minicomputer today. Think about that. The *most* powerful. As a result, the SPC-16 does more things in less time. It will actually reduce the total cost of your system.

Depending on your specific needs, you can choose from six different models in the SPC-16 family. Each backed by the best software and peripheral capability in the business. There's another very important reason why you should buy from us.

It's called involvement.

All the other big mini manufacturers today are touting the fact that they're "end-user oriented" or that they're now "in the systems business."

We've been doing exactly that for more than five years now. And it's nice to see that others have begun to recognize our leadership.

We learned a long time ago that the only way to really help our customers in solving their systems problems was to fully understand those problems.

So we got involved with our customers. Both end-users and OEMs. Listened attentively. Learned a lot. Got answers. And wound up building systems to solve some very tough, very complex problems.

Emissions analysis and electrical test systems for the nation's largest automobile manufacturers.

Production machine control systems for some of the biggest companies in the machine tool business.

Telecommunications and message switching systems for the world's leading communications companies, to name just a few.

In short, we've built our company and our reputation by offering answers, not just iron.

Who's it gonna be?

Actually, we've made your choice fairly simple.

If all you need is raw minicomputer hardware at a "rock bottom" price, we recommend DEC.

If you'd like something more–from a mini with more oomph to the total solution of a complex systems problem–we recommend us.

General Automation.

Our phone number is (714) 778-4800.

Or write:

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People

Hart finds tight ship at TRW Components

Many executives would like to be in the shoes of George J. Hart. He's just officially taken over as vice president and group executive of the Electronics Components division of TRW Inc., and the division he has headed de facto since June is a profitable business; he's not expected by his superiors to do a house-cleaning job.

Until this promotion, Hart was vice president of the Cinch unit of TRW, where he worked 34 years. But he doesn't expect any big surprises: "The parts of TRW I now head serve much the same market as Cinch—my main concern is to continue the growth and profits." Under his wing are such diverse components operations as TRW Semiconductors, Globe Motors, UTC Transformers, Cinch-Graphik and Cinch Connectors, Holyoke Wire and Cable, IRC Potentiometers and Resistors, TRW Capacitors, and TRW Automotive Electronics. But the company is always looking for other opportunities through internal growth and acquisition.

"The company expects to grow about 10% across the board next year," says Hart. "But we want to grow in a very controlled manner, using a rifle, not a shotgun, approach. For example, our semiconductor operation is studying and working on integrated circuits—we even make SUHL [transistor-transistor logic] for the phone company—but we have no intention of pouring money in to go after Fairchild or Motorola."

Hart does feel that the biggest opportunities lie in development of markets the division already serves, observing that "we're very heavily involved in the computer business. We find our computer business improving, especially in a number of products we gambled on a few years ago."

Anticipating close relations with other parts of the TRW organization, Hart points out, "We use the marketing arm of automotive divisions in talking to people about our automotive electronic products, and also have close ties with our systems people to take advantage of their technology and talent, as in compacting powders, their work in LSI, and in packages. They also look at trends for us."

Hart finds overseas promising. "There are many opportunities offshore, especially in Europe," he remarks. "Because of antitrust problems here, we expect to be more active in acquisitions in Europe than in the U.S."

Litton's EW team enlists "fastest human"

Competition is still the name of Mel Patton's game, but as the new marketing vice president for Litton Industries' Amecom division outside of Washington, he is running a different kind of race than he has in the past. He achieved fame in 1948 at the University of Southern California, where he was tagged by sportswriters as "the world's fastest human" after running 100 yards in what was then a record-shattering 9.3 seconds. That same year, the 24-year-old Patton won two gold medals for track performances at the Summer Olympic Games in London. And in 1949 he added two more world records while running for USC.

Now 48 and somewhat heavier,

Patton: Sprinter runs Litton's "spook shop."

If Rolls-Royce made a compact, would you try it?

Try this.

Our new 4300. Its features far exceed its price.

There are 5 DC ranges, 4 AC ranges, 5 ohm ranges.

The LED display is highly readable. The brightness self-adjusts to ambient light conditions. There are 4 full digits and a 5th for 100% overranging.

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Ultimate portability.

The 4300 is virtually unbreakable.

It weighs only 7½ pounds *with* its self-contained battery pack. You don't add on additional size to go portable. Two screws remove the case, and the pack plugs inside. So does the display.

A battery check shows operating hours remaining. And when the battery is low, an automatic shut-off prevents wrong readings.

We've also made it impossible for you to select improper range and function combinations.

Tom Krueger can arrange for you to try this remarkable new instrument. Call him collect at (714) 833-1234. Call him.

The 4300 is very portable.

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People

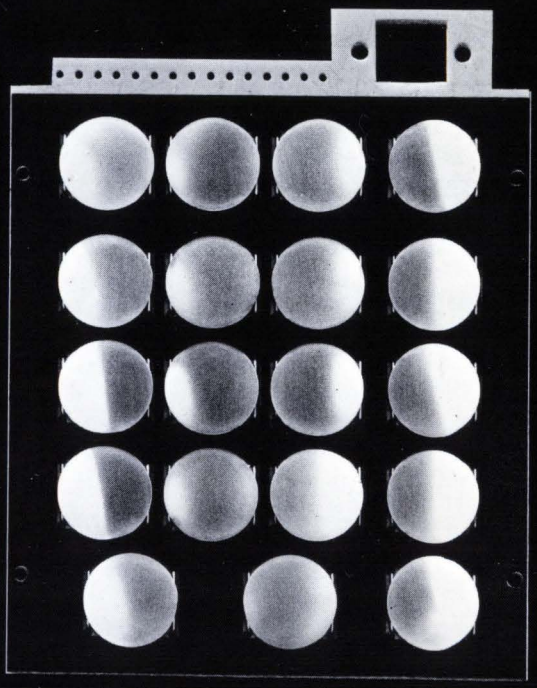
Melvin E. Patton is playing a more cerebral game as the man responsible for marketing the military electronic surveillance systems, antennas, simulators, electronic proximity fuzes, and antisubmarine warfare hardware. This gear is developed by the 700-man operation at College Park, Md., that one of his Litton colleagues dubs "the company spook shop." And if military spending patterns follow the classic pattern of reemphasizing requirements in surveillance and communications during periods when hot wars grow cold, then operations like Patton's at Amecom will be pushing hard to develop new business.

Patton, a member of such honorary fraternities as Blue Key and Skull and Dagger while he gained his bachelor and master of science degrees at Southern Cal, now also belongs to the Association of the U.S. Army and the Association of Old Crows, the organization of Army electronic warfare specialists.

Initially interested in teaching and coaching, Patton made the transition to military electronics in 1959, when he discovered that the appeals of Wichita, Kans., his first teaching assignment, weren't quite up to those he knew in Southern California. "The thought of spending three years there" quickly drove him back to the Pacific Coast and into the offices of Northrop Corp.'s Nortronics division. Later he joined Litton's Data Systems division as marketing manager for Marine Corps programs, an assignment he left to serve as director of Sanders Associates' Washington operations for 18 months before returning to the Litton fold with Amecom.

Now the father of a married daughter and a son in college, Mel Patton exercises less strenuously than he did as a record-setting collegian. Week-end hikes around some 300 acres in West Virginia that he acquired with a group of friends is among his strongest interests. Does he share the current American interest in jogging? "Lord, everybody asks me that," Patton groans, adding that the answer is "no." The reason: Running by yourself isn't the same as running in competition.

Dunk this page into a cup of coffee.



What happened to the paper? Nothing. Because this page is protected with a plastic film. A film similar to the Mylar™ that protects the heart of our Klixon® keyboard. The keyboard that is used by more pocket calculator manufacturers than any other type. Protects it from dust, lint, and accidents like coffee spills that would put ordinary calculators out of commission.

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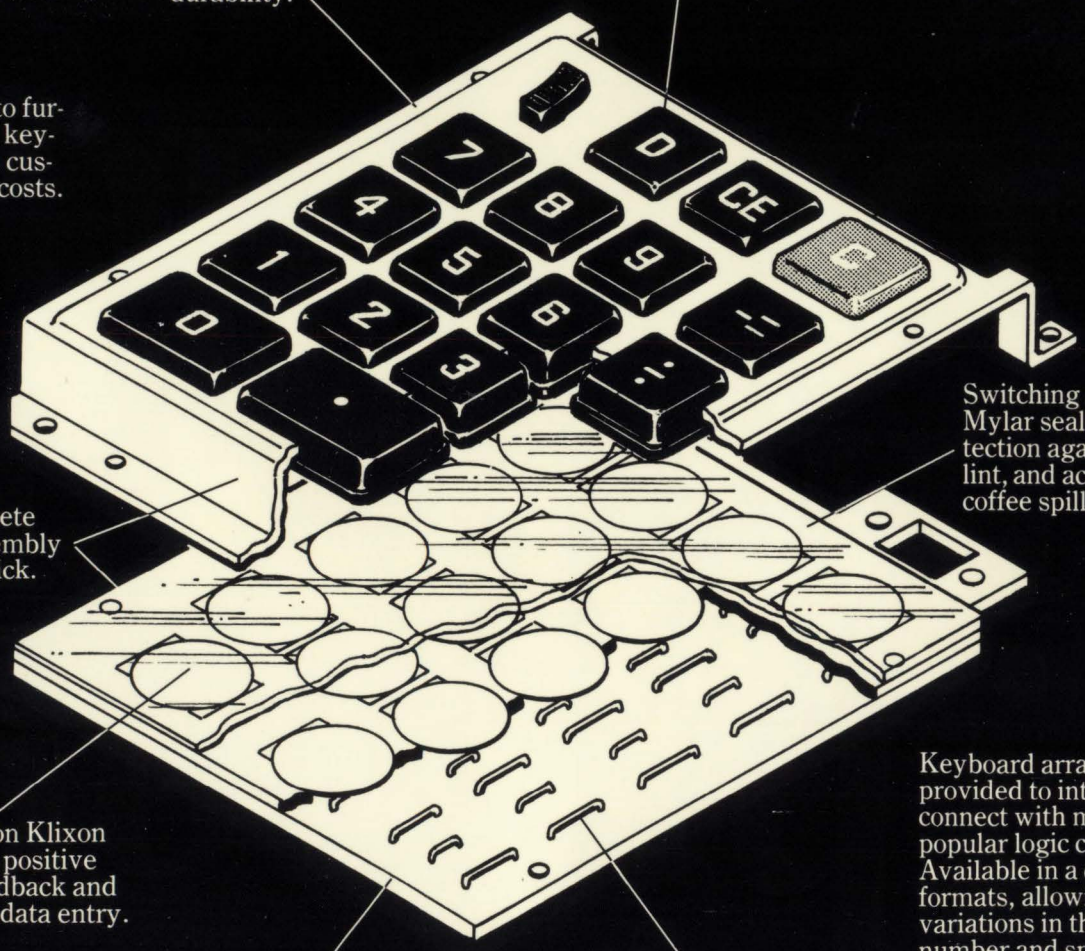

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The DC-38-S
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Datacraft

Hewlett-Packard Series 9800. The Name And Number That'll Shorten Your Path From Concept To Final Solution.

Get your hands on a Series 9800 Calculator System and you'll experience why it's the shortest, simplest path. From the outset you're certain to notice four outstanding features.

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That's the idea. Here's the payoff. On the left is a typical equation solved with the HP Alpha Printer. On the right, the same equation solved without alpha.

```
SOLUTION TO                          1.000*
QUADRATIC
EQUATION
OF THE FORM                          1.000*
   2
AX +BX+C=0                           1.000*

ENTER A=
          1.000*                    -0.500
ENTER B=                            -0.866
          1.000*
ENTER C=                            -0.500
          1.000*                     0.866


COMPLEX ROOTS
REAL PART=
          -0.500
IMAGINARY PART=
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The benefits? Instant verification of your program and input data. Positive identification of each portion of your solution. And the confidence that you can send data to your colleagues and have them understand it.

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092/6

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Meetings

International Conference on Magnetism and Magnetic Materials: AIP, IEEE, et al., Hilton, Denver, Nov. 28–Dec. 1.

National Telecommunications Conference: IEEE, Astroworld, Houston, Dec. 4–6.

International Electron Devices Meeting: IEEE, Washington Hilton, Washington, D.C., Dec. 4–6.

Annual Fall Conference: IEEE, Sheraton-O'Hare, Chicago, Dec. 4–5.

Fall Joint Computer Conference: AFIPS, Convention Center, Anaheim, Calif., Dec. 5–7.

Nuclear Science Symposium: IEEE, Deauville, Miami Beach, Dec. 6–8.

USNC/URSI Meeting: URSI, IEEE, Williamsburg Conference Center and College of William & Mary, Williamsburg, Va., Dec. 12–15.

Business and Equipment Exposition: NRMA, New York Hilton, New York, Jan. 7–10.

Aerospace Sciences Meeting: AIAA, Sheraton-Park, Washington, Jan. 10–12.

International Solid State Circuits Conference: IEEE, Marriott, Philadelphia, Feb. 14–16.

Aerospace and Electronic Systems (Wincon): IEEE, Sheraton-U. of Pa., Philadelphia, Feb. 13–15.

IEEE International Convention (Intercon): IEEE, Coliseum and New York Hilton, March 26–29.

Southwestern IEEE Conference and Exhibition (Swieeeco): IEEE, Houston, Texas, April 4–6.

International Symposium on Circuit Theory: IEEE, Four Seasons Sheraton, Toronto, Canada, April 9–11.

International Magnetics Conference (Intermag): IEEE, Washington Hilton, Washington, D.C., April 24–27.

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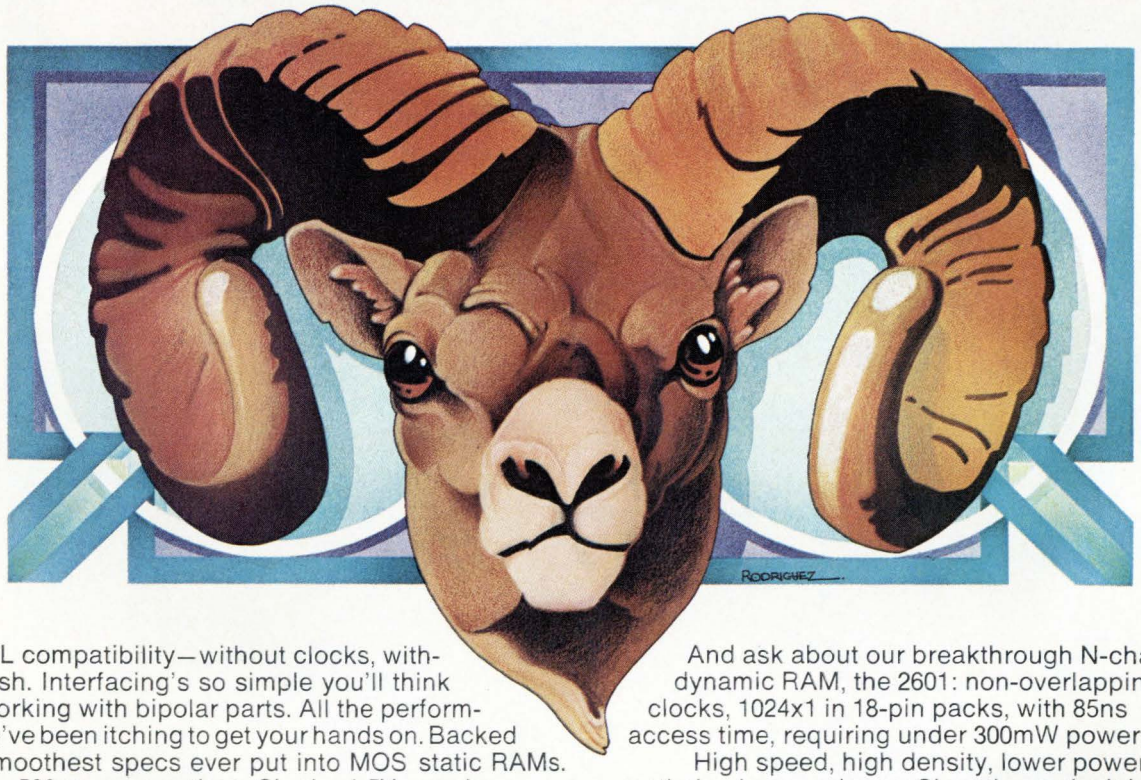

100% TTL compatibility—without clocks, without refresh. Interfacing's so simple you'll think you're working with bipolar parts. All the performance you've been itching to get your hands on. Backed by the smoothest specs ever put into MOS static RAMs. 1024 bits. 500ns access time. Single +5V supply.

N-channel technology developed by Signetics makes the difference. We designed out the kinks in competing devices, and came up with a new trouble-free line of ion-implanted N-channel MOS static RAMs.

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2602

In production now in a 16-pin package. For full details, write Signetics, or call your Signetics rep, salesman or distributor.

And ask about our breakthrough N-channel dynamic RAM, the 2601: non-overlapping clocks, 1024x1 in 18-pin packs, with 85ns access time, requiring under 300mW power.

High speed, high density, lower power, optimized convenience. Signetics make it in MOS. Of course.

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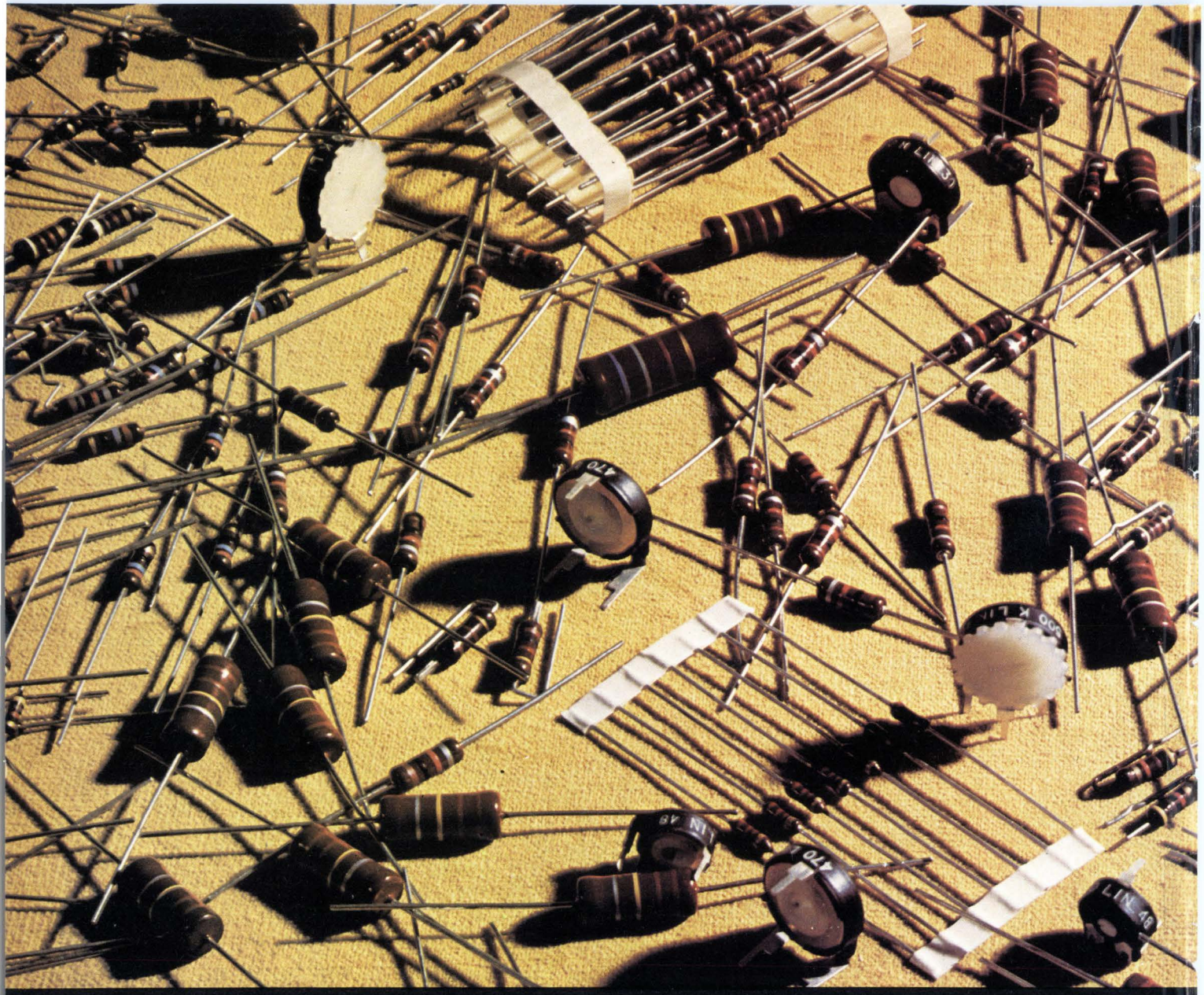

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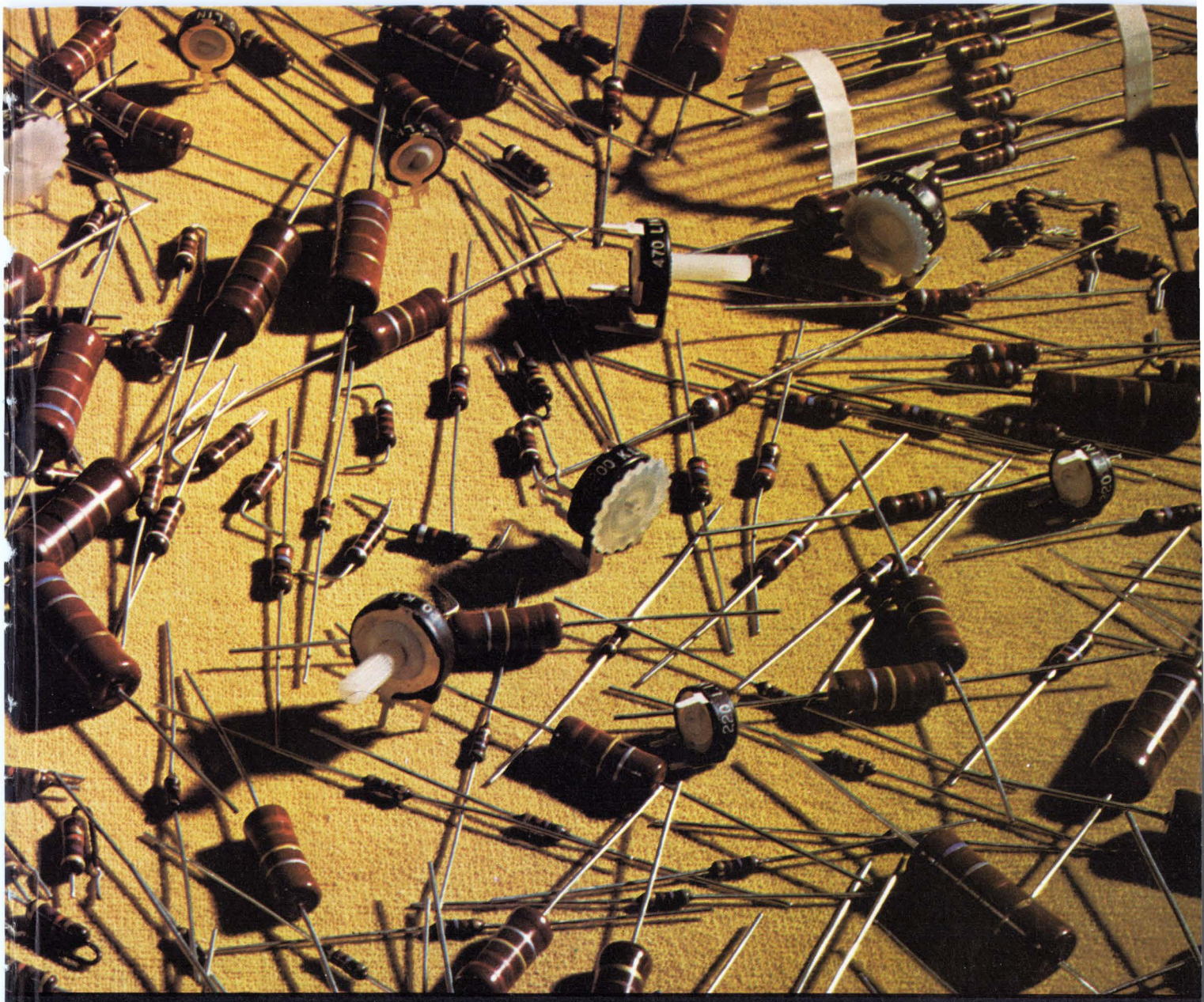

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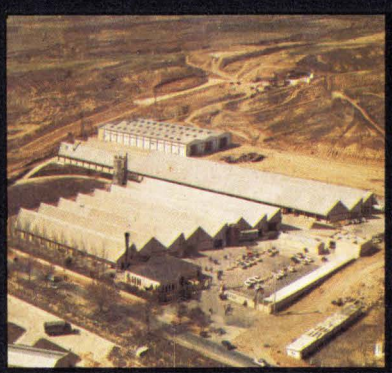

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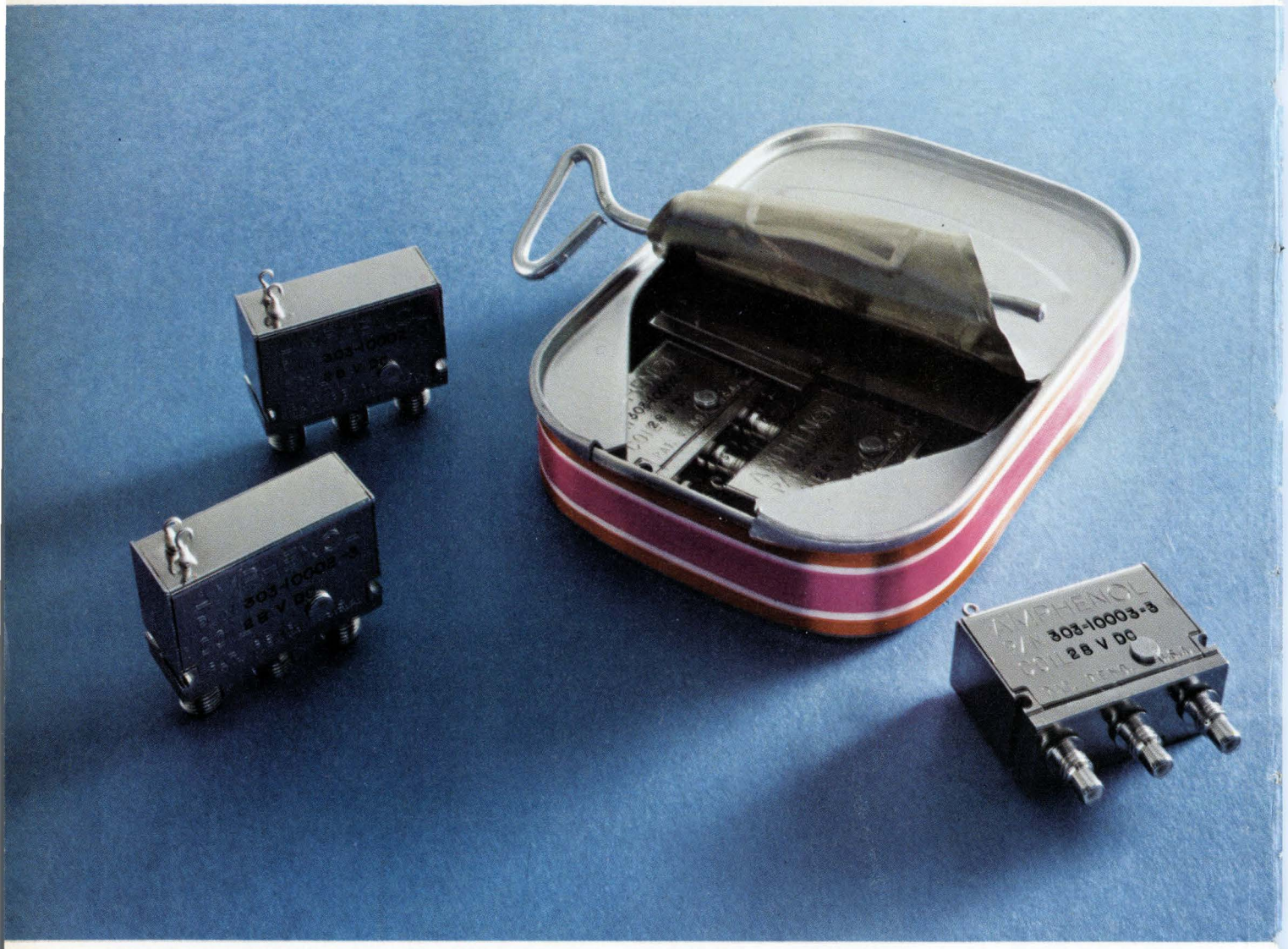

and save you up to 50¢ on your dollar.

Amphenol's new 303 Series MINIform coaxial switch line is the answer to today's biggest component problem: Getting higher performance, using less space at the lowest possible cost.

High performance we have. From 0 to 1.0 GHz, the MINIform switches handle up to 150 watts CW, maintain maximum VSWR of only 1.1:1, 80 dB minimum crosstalk attenuation and 0.1 dB insertion loss. Maximum VSWR over the 1.1 through 3.0 GHz range is only 1.2:1 with power handling capabilities up to 70 watts CW.

True to their name, MINIform switches weigh only 1.2 ounces and occupy less than ½ cubic inch of precious space.

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To find out more about MINIform and how it can cut your switch costs in half, write to Amphenol RF Division, Bunker Ramo Corporation, 33 East Franklin Street, Danbury, Connecticut 06810.

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Electronics newsletter

Modem to open way to 1-minute fax

Development of the key to the long-awaited one-minute facsimile machine, **a high-speed adaptive MOS modem, should be announced by a major manufacturer in mid-December.** The modem, roughly one-tenth the cost of present stand-alone units with similar capability, will permit use of regular phone lines instead of leased lines.

Three groups work on fabrication rules for hybrid ICs

That plague of the hybrid IC manufacturers—a lack of fabrication standards—may be close to a cure. Working on the problem are the EIA, the American Society for Testing and Materials, and the Society of Automotive Engineers. **And at least one of them, the SAE, plans to publish late in 1973 its standards** on die attachment, thermocompression bonding of gold beam leads, machine lap soldering, and ultrasonic wire bonding.

Atomic frequency standard shrinks

The high frequency and low drift of atomic frequency standards may find their way into new applications with the 2.9-lb rubidium frequency standard, measuring 4 by 4 by 4½ in., newly announced by Frequency and Time Standards Inc., Danvers, Mass. **Thought to be the smallest and lightest such standard available in the U.S.,** the 10-megahertz reference, designated the model FRK, drifts less than one part in 16^{-10} per month.

Its sellers are looking for customers making on-board and base-station radio-navigation electronics—**Loran and Omega both could be made more accurate through use of such time standards.** Other customers could use the stable output to multiply to a proportionately stable radar frequency, while others would use the small time cube to reduce synchronization and drift problems in data transmission.

Keithley to offer wide-ranging DMM for $895

The trend toward ever higher performance/price ratios in digital multimeters, from 3½-digit field-service gear to high-performance laboratory instruments, is growing. Keithley Instruments of Cleveland, Ohio, is about to announce a 4½-digit DMM with an exceptionally large array of ranges and functions. Selling for $895, the new meter can measure ac and dc voltage and current, plus resistance. It can resolve dc voltage down to 1 microvolt on its lowest range, while handling 1,000 Vdc on its highest range. Similarly, dc current spans 0.1 nanoamperes to 2 amperes, and resistance covers 0.1 ohm to 2,000 megohms.

Meant for laboratory—not field—use, the new meter is line-operated and uses shaped-character gas-discharge tubes in its display. **The instrument's extremely wide dynamic range makes autoranging prohibitively expensive, but extensive overload protection is provided.** All voltage ranges can withstand up to 1,400 Vdc, and additional protective circuitry, plus diode clamps and fuses, protect the other function ranges.

Fairchild to join 10-k ECL club

Fairchild Semiconductor has decided it would rather switch than fight— at least for the time being. The firm will soon announce the availability of series 10,000 emitter-coupled logic, joining Motorola,

Signetics, National Semiconductor, and Texas Instruments as a supplier of the new ECL family.

But the Fairchild parts will not be exact copies of the Motorola circuits. The Motorola devices, as well as those from Signetics and National, are uncompensated; **the Fairchild parts will be voltage-compensated, making them similar to the TI devices.** Recent additions to Fairchild's proprietary 9,500 line of ECL components, which is both voltage and temperature compensated, had 10,000-series pinouts, and it is believed that the temperature-compensation feature could easily be eliminated by a metal-mask option. Thus, no circuit redesign appeared to be necessary for the new 10,000 parts.

Roadside radio getting popular

An experimental a-m radio service to give traffic and parking reports to motorists at Los Angeles International Airport on their car radios may signal the beginning of a small boom in such limited-range systems. The so-called roadside radios have been used in wildlife parks; the Department of Transportation has considered them to give directions at complex highway intersections. **Now, an FCC spokesman says that a number of license requests have been filed, and some have been granted.**

The Los Angeles system operates at 530 kilohertz and blankets the airport by means of a 15,200-foot cable system that parallels the main roads. A 10-watt transmitter feeds the network. The installation was by RTV International Inc. of New York on a $130,000 contract.

White House and Congress slow education R&D

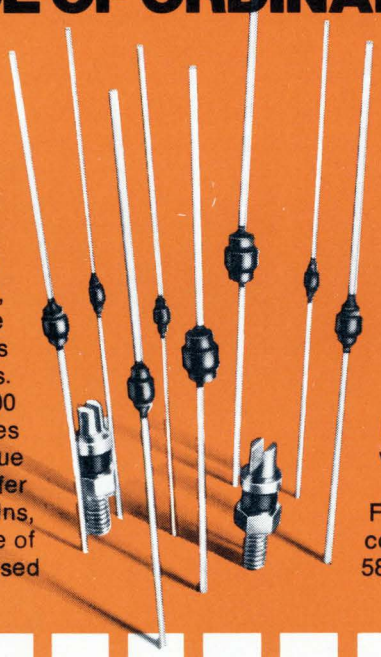
Prospects for Federal funding of research and development in electronic educational technology appear dim, at best, as both the administration and Congress appear to be against it. As a forerunner to his newly announced "no-fat" administration, President **Nixon has twice vetoed the Department of Health, Education, and Welfare budget containing some $30 million in educational R&D funds.** And Congress, which doubts the utility of teaching machines, is **unlikely to pass an education-technology bill in the new session.**

Addenda

NRMEC has developed a pocket calculator with an ambient-light liquid-crystal display; it's tooling up to manufacture the unit for market next year. **The passive LCD display permits 30 hours of battery life, up to 10 times that of LED units.** Also, World Book is in the NRMEC fold as a customer for complete desk calculators, joining Sears and Rapid Data, and replacing Logic Data, which canceled its order. World Book will sell the $99.95 unit by direct mail. NRMEC also will provide chips for the Bowmar calculators. . . . Fairchild has received an order from Delco Electronics to supply **a hybrid electronic ignition system for General Motors.** The system will become standard in all GM cars by 1975. Cars at the top of the Pontiac line have offered electronic ignition as an option for several years. . . . Standard Microsystems Corp., Hauppauge, N.Y., says prototypes of an n-channel, 4,096-bit RAM chip will be available in January. . . . Varian Associates has introduced its Multipoint Distribution System, a limited-access institutional service to provide omnidirectional microwave broadcasting. **The forecast is for 150 systems by 1976, with revenues of $300 million and an equipment market of $27 million.**

state-of-the-art zeners

UNITRODE OFFERS THE HIGHEST SURGE RATINGS IN THE INDUSTRY, AT THE PRICE OF ORDINARY DEVICES.



Whatever your needs in hi-rel and military zeners from 1 watt up, Unitrode will give you more. 10 watt zeners from Unitrode will give you 600% higher surge protection than conventional 10 watt types — 35% higher than ordinary 50 watt types. And Unitrode 1.5 watt, 3 watt, 5 watt and 6 watt devices provide proportionally higher surge capabilities than their conventional counterparts. Some series are available up to 400 volts. These unmatched capabilities are achieved through Unitrode's unique fused-in-glass construction. A silicon wafer is bonded directly between the terminal pins, eliminating the whisker. A sleeve of hard glass is then fused to the exposed silicon surface resulting in a voidless, monolithic structure that exceeds the environmental requirements of MIL-S-19500. The 1.5 watt IN4461 series is available as JAN and JANTX devices to MIL-S-19500/406 and the 5 watt IN4954 series is available as JAN and JANTX devices to MIL-S-19500/356. And Unitrode can really service these specs. Shipment is from inventory.

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- DC/AC voltage from 100 μV to 1.5 kV;
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And accuracy is good for 12 months.

The $435 price includes real portability. The 3300A operates continuously 20 hours off its internal rechargeable battery. You can make measurements while recharging the battery. And the battery's good for 1000 recharges.

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You'll also like the automatic polarity and decimal point position, the out-of-range indication, 1500 volts off ground operation, and the continuous automatic zeroing. But you expect these from the company which was first with LSI circuits in digital multimeters.

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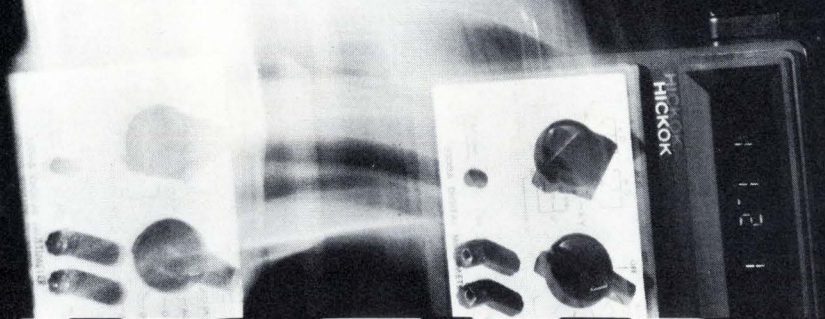


HICKOK

Solid-state version of Dolby B noise reducer is ready

Signetics part to be sampled next month; back orders for hi-fi circuit said to total 1 million

After a gestation period of about 18 months, the Signetics Corp., Sunnyvale, Calif., is beginning delivery of a solid-state version of the Dolby B audio noise reduction circuit for home hi-fi systems [see p. 69].

Dolby Laboratories is evaluating preproduction circuits now, says Morley Kahn, vice president and manager of U.S. operations for Dolby. Samples should be available by early December, he says, after which Dolby will supply its licensees directly for six months through Signetics production. For the six months after that, Signetics will be able to sell to Dolby licensees directly. Kahn says that about 1 million circuits already are back-ordered.

Dolby spokesmen say that the new IC may be the most complex linear IC ever developed by Signetics, or perhaps by any firm. This may be one of the reasons for repeated delays in a program projected to take about one year. Signetics' consumer marketing manager, Jack Mattis, says that circuit design problems were more difficult than anticipated; "It was a matter of finding ways of duplicating [as yet unduplicated] discrete functions in IC forms," he says.

Although "it was tough," Mattis says he feels it was worth the effort. Mattis not only claims that the IC version yields less distortion than the discrete circuitry it replaces, but it also has 10 decibels less residual noise. Whether or not the effort has been worth the money is not known: neither Dolby nor Signetics will state the value of the development contract, or how this cost was shared—or even if it was.

Mattis predicts that Signetics will sell "several million" such circuits to Dolby licensees. There are about 45 consumer firms with licenses, many of them already using discrete-component Dolby noise reduction in open-reel tape recorders, cassette decks, and in at least one fm tuner.

Outboarding. The chip itself is about 100 mils square and housed in a 16-lead dual in-line package. About a dozen external components must be outboarded to make the IC work; among them are components for oscillator and calibration circuitry, metering, and switching.

The circuit breaks down into seven main blocks on the chip: a unity gain input buffer, a 16-dB-gain second stage, a metering circuit, a 10-dB amplifier stage, an ac-to-dc convertor, a so-called variable impedance, and—at the output—a summing amplifier with 10-dB gain.

Specifications include an input impedance between 50 and 100 kilohms. The IC is said to be capable of 600 millivolts of output. Dolby Labs in London points out that the input and output characteristics of the circuit should enable some users to substitute it for input and output amplification stages.

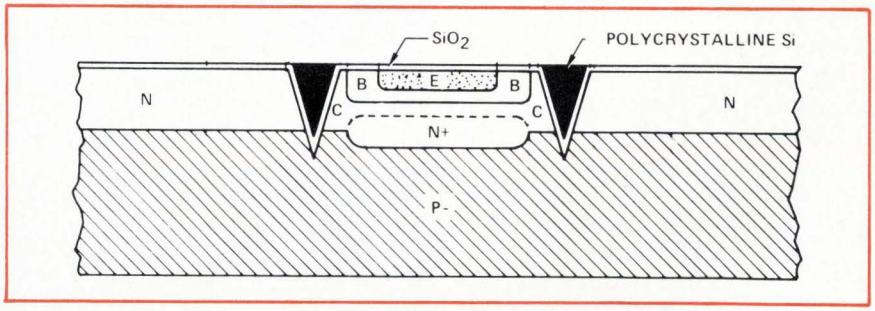
Power supply demands are also uncritical and thus another potential savings area for users; the IC should draw about 20 milliamperes from an unregulated 10- to 24-v supply.

At a projected price between $2 and $3, Signetics expects the new chip to sell well. So do Motorola, Texas Instruments, Valvo (the West German IC subsidiary of Philips), and several Japanese IC makers. All are waiting Dolby permission to get on the bandwagon after Signetics' year of grace expires. □

Memories

Passive isolation used in a PROM

It's hard to find a development that found its way into more products faster than the new passive isolation techniques of the type first an-



Note the notch. Harris uses Polyplanar technique—a notch backfilled with polysilicon—on its new programable read-only memories. First part is 2,048-bit version featuring high density.

nounced by Fairchild Semiconductor almost two years ago. Already a mature technology for random-access memories, passive isolation is now being applied to read-only memories—programable ones at that.

Harris Semiconductor, Melbourne, Fla., is first to do it with a new 2,048-bit PROM that permits twice as many bits on a chip no bigger than the one used in Harris' 1,024-bit PROM built by a standard technique. This leads to significant savings in system package count, board space, and power needs.

Pepe Pietra, a Harris spokesman, points out that the isolation technique, called Polyplanar because it's essentially a notch backfilled with polysilicon, can't show its greatest potential with PROMs, since a good portion of that device is passive to begin with. Space is saved principally in the decoding and output peripheral circuitry and not in the memory array itself. In fact, to get the 2-kilobit density meant tightening fabricating rules in the array, as well as using Polyplanar in the periphery.

Harris will make optimum use of Polyplanar in soon-to-be-announced 1-kilobit bipolar and 256-bit C-MOS RAMs, as well as a host of linear products. Harris designers feel that their process, which is similar to the Motorola VIP technique, has the advantage of simple metalization, because it's planar; unlike other air-notch isolation techniques, it does not require metal lines to traverse valleys. Another advantage is Polyplanar's ability to function with conventional epitaxial thicknesses (say, 5 to 6 micrometers) instead of the very thin epi layers that appear to be required by most oxide-isolation techniques.

The new Harris PROM has conventional Nichrome fusible links for programing; a 10-millisecond pulse is required to open the link. The part, which comes in a 16-pin package, will fit the same sockets as most of today's 1-kilobit PROMs by converting one of the existing chip-select pins to address the 2,048-bit product. Organized as 512 words of four bits each, the Harris unit is available with either three-state or open-collector outputs. □

Industrial electronics

ICs help control diesel locomotive

The latest market to be cracked by integrated circuitry may well be the toughest commercial environment in existence: diesel railroad locomotives. The product is a solid-state control system.

The new IC "transition programer" replaces the 100 relays that control the switching between various drive motors, the constant-speed dc generator, and other parts of the drive system. But the big problem is the horrendous electrical and physical environment. A typical locomotive generates and consumes 1 million to 2 million watts, say, 1,000 amperes at 1,000 volts. Switching this power among the inductive components generates spikes of up to 20,000 volts.

"You wouldn't believe the EMI!" says Robert R. Shepard, manager of railroad products at Genisco Technology Corp., developer of the system. In addition to the electrical problems, locomotives, covered by grime and oil, operate in temperatures that range from -40° F to deserts where the electronics will reach 160° F. Parts of the system are subjected to greater shocks than the products Genisco builds for space. Nevertheless, the units have come through three-year field trials on Union Pacific locomotives, and will go into production in January.

In developing the systems, Shepard discovered that the railroaders didn't really know what they needed. Switching transitions (equivalent to gear shifting) were controlled by sensing voltage and current, but he found that the switching should occur at certain speeds that weren't directly related to the power. So Genisco developed a tachometer sensor coupled to the drive wheel. The most rugged part of the system, it is encased in a 40-pound steel casting.

Stopping. Transitions also occur in braking: going downhill, the drive motors turn into generators, and their output energy is dissipated in resistors to effect dynamic braking. The six resistors are typically 0.84 ohm, quite a load for 1,000 V.

The unit uses about 80 series 5400 military-grade ICs, carefully isolated from the 74-V control power of the locomotive and from controlled relays. It's not a plug-in replacement for the relays, but Shepard says that the salvage cost of the relays is more than the $1,500 price of his system. After installation, the unit can be serviced rapidly because of its self-test facility, fault detection, and modular construction.

Shepard says that Genisco is still alone in the field, and he is optimistic about cracking what was a huge new industry. "There are about

All the live-long day. ICs have been introduced to the violent environment of the diesel locomotive in a "transition programer."

27,000 diesel locomotives in use, with about 2,000 added each year." To go with the programer, he's developed a digital speedometer, and he hopes eventually to put a minicomputer on the locomotives to eliminate many of the other relays still used. □

Companies

Scott files for bankruptcy

With receivables of about $1 million in September, and the best sales season of the consumer electronics year on the way, H.H. Scott Inc. of Maynard, Mass., producer of high-fidelity equipment, has filed for Chapter XI bankruptcy.

Even the New England Merchant's National Bank of Boston felt secure until the final days. The bank bailed Scott out of severe financial trouble about four years ago when Scott suddenly, and for reasons still cloudy, ran very low on working capital.

The bank had been supporting Scott continuously since then, and meanwhile, Scott had been rebuilding its product line. Ironically, the revised product line proved so popular, asserts a marketing man, that the firm's manufacturing capacity imposed the only real limit on sales in the last two years.

More money came in when Eastern Air Devices Inc., a Long Island firm, purchased an option to buy the company in exchange for a credit line of about half a million dollars. Insiders say, however, that Eastern actually made little real investment in Scott, although it did purchase the instrumentation operation for about $250,000.

Instead, Scott had been holding during 1972, hoping for a Government-insured multimillion-dollar loan. This had been promised—as Scott management understood it—as early as July, but the loan never came through.

Scott has never made it to a safe financial position because credit lines were too small and bank loans were too few. Instead, the company was forced to bootstrap itself along,

Companies gearing up calmly for inevitable conversion to the metric system

Slowly but inexorably, conversion to the metric system is coming. It's so close—the Senate last summer passed a metric conversion act—that electronics firms are beginning to plan a gradual switch.

Industry does not appear to be the least bit nervous about conversion. Executives feel that it won't be rammed down their throats, and that even if the law is not enacted, a change to the metric system will evolve naturally. In fact, the measure passed by the Senate calls for an orderly transition covering 10 years and sets up an 11-person board to supervise the move. However, because the House failed to act on the measure, both chambers will have to act in the next session of Congress.

Hewlett-Packard, Palo Alto, Calif., isn't waiting for a law. W.B. Hooley, manager of technical services, says that H-P will start within the next year to implement some of its plans to make the change. One of the most important initial steps, says Hooley, is to educate employees. Then the ramifications of the new method will be examined. But the biggest step was the decision to go ahead. "A lot of people are fighting it. They don't like change."

Hooley doesn't think the process will be costly if it isn't done overnight. For one thing, H-P's European affiliates won't have to convert their drawings to show metric measurements. Also, instruments always have been built to read out in the metric system.

Another company that isn't going to wait is IBM. Last summer, it embarked on a 10-year program to make the metric system the company's "basic measurement language in design, manufacture, test, and service" of its products. This base will include such things as parts catalogs, conversion tables, and design standards. Metric specifications in new-product designs will begin in the 1974–1978 time frame, followed by phasing the inch system out of products completely by 1982.

A source from Texas Instruments in Dallas says that TI has made no specific plans for conversion. "I suspect that whatever kind of law finally emerges, it's not going to be an oppressive one at all—rather, one that invites the cooperation of industry. It will be a response to the market requirements. Either by planned action, or as diffused requirements occur, we'll just change over. That's how the market works. And I think we'll find that our approach toward ultimate metrification will be at different paces in different parts of our company."

NASA is getting behind the metrification effort, with William A. Mrazek of the George C. Marshall Space Flight Center, Huntsville, Ala., in charge of the project. Early in October, a letter from Mrazek's boss and Marshall's director, Eberhard Rees, was sent to major contractors stating the agency's intention of converting to the metric system and asking each firm to appoint a liaison man. Already NASA is insisting that the metric system be used in publications, and, according to the letter, "to the degree practical" in engineering.

RCA foresees little impact in its consumer and broadcast electronics markets because, says Harry Kleinberg, director of corporate standards at Cherry Hill, N.J., so many international standards have been generated by American technology. On the Government side, however, RCA will follow the wishes of its customers and hope things move smoothly. "Our economic interests lie in not getting caught in a situation where requirements and supplies get out of phase," he says.

paying last month's bills out of current receipts. And in the highly seasonal high-fidelity industry, this fast became an impossible situation. Finally, on Friday, Oct. 13, Scott simply shut down when it couldn't meet its payrolls. Now, after several abortive negotiating sessions with Eastern over purchase of the company, Scott has found itself forced to declare bankruptcy.

What happens now? Some creditors look toward buyers who have been in the wings for some time, said to include Fairchild, GTE Sylvania, and several Japanese firms. The Japanese may bid highest in order to acquire manufacturing facilities on U.S. soil, something that would give them a tariff advantage over competition still forced to manufacture in Japan. Sony management already is on record as hoping to switch to Sony-owned U.S. production facilities within the next few years. And Pioneer, another Japanese firm, is also said to be interested in Scott □

Manufacturing

Etching done with beam of ions called cleaner, more accurate

In manufacturing ICs, whether monolithic or thin-film, cumbersome wet-chemical solutions are generally used to etch out desired circuit patterns. But they present difficulties. For one, a variety of chemicals must be kept on hand to etch different materials. Then, too, chemical undercutting of areas that are not to be etched often limits the depth of etch. What's more, new pollution laws are making it increasingly difficult to dispose of processed chemicals simply by flushing them down the drain.

But now Veeco Instruments Inc., a Plainview, N.Y., manufacturer of vacuum equipment and mass spectrometers, has a system—called Microetch—that applies a relatively low-energy beam of ions to metals, semiconductors, and insulators, to etch, mill, and surface-clean them. "It's a brand new technique," says Edward H. Braun, director of marketing at Veeco, which is selling the system under license from France's Thomson-CSF.

The etching system's "solution" is actually a beam of argon ions generated in a vacuum chamber. The beam, at a relatively low energy level ranging between 500 and 2,000 volts, is passed through a set of optically aligned grids that form it into a 3-inch diameter. Then the beam continues into the cooler work section of the chamber, where it is focused on the material.

A "neutralizing" filament, past which the beam travels, can contribute a small cloud of electrons to the ions. This cloud ensures that the beam is no longer positively charged when it hits the target, Braun explains, so that it can be used on semiconducting and insulating materials such as silicon, gallium arsenide, and quartz. "If the beam remained positive, charges would collect on the material, repel subsequent ions, and bring the etching process to a halt," Braun says.

Narrower. With the beam, line widths are limited solely by mask-making technology and can be etched down to 0.2 micrometer, according to Braun. This is almost an order of magnitude smaller than is possible chemically. And there is none of the undercutting and subsequent structural distortions associated with chemical means, he points out. "And the etch depth is independent of either its width or the material itself," he says. Some typical etch rates are: 130 angstroms/minute for alumina, 360 for silicon, 420 for silicon dioxide, 2,500 for gallium arsenide, and 3,000 for silver.

In cleaning the surface of, for example, semiconductor material in preparation for scanning electron microscopy, the risk of distorting the crystal structure with Microetch is less than if conventional sputter etching were used, Braun says. This is because as much as an order of magnitude less energy need be used. In addition, the vacuum of 10^{-} torr is one or two orders of magnitude lower, so there's less danger of bombarding the material with undesirable entrapped gases.

So far, Veeco has delivered eight systems to "R&D labs and pilot production facilities," Braun says. Optics and power supply cost about $20,000; with the vacuum system, the price is about $35,000.

A rotary table in the unit can index 20 wafers, but Veeco is working on a substrate handler suitable for the production line. The company has also set up a special lab where customers can try out their own applications. "The system is so new," says Braun, "we're still trying to find out all that it can do." □

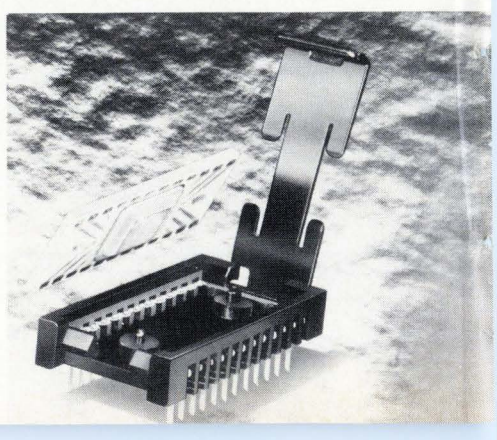
Packaging

Leadless plug-ins gaining ground

System and device designers have, for a number of reasons, been slow to commit themselves to solderless plug-in and leadless IC packages and sockets. But interest in the technique is beginning to heat up as it becomes increasingly clear that this path reduces fabrication costs and enhances maintainability.

As evidence of this, representatives of major computer makers will gather in New York on Nov. 29—at a meeting of the IEEE Computer

Facing up. This is Burndy's face mount leadless IC package.



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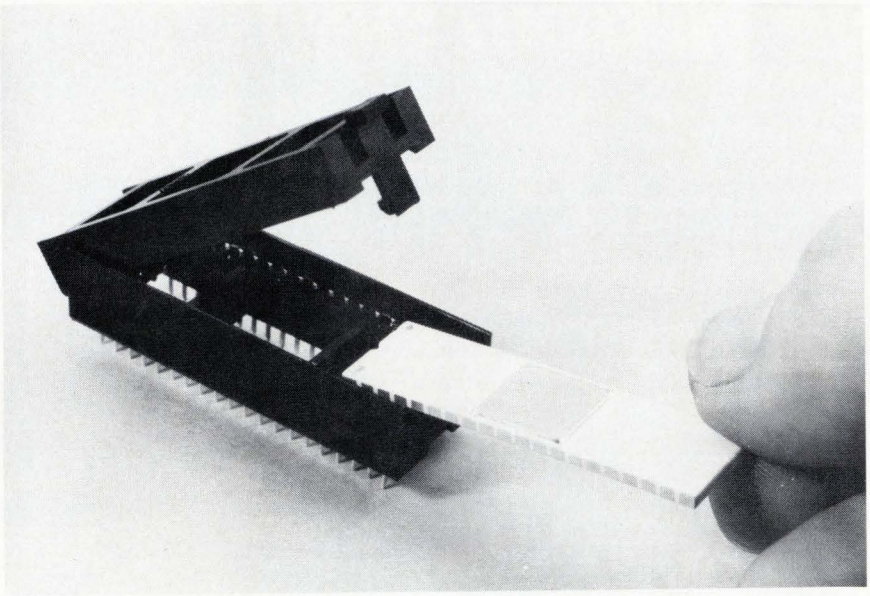

On edge. AMP's dual in-line edge connect joins outside world via metalized pads.

Society packaging committee—to listen to du Pont, Burndy, AMP, and Texas Instruments explain the virtues of leadless packaging, including details on the three types of packages—edge-mount, dual in-line face-contact, and dual in-line side-contact.

Each of the types has its proponents. Edge-mount, which is similar to mounting a printed-circuit board in a pc connector, was pioneered by Texas Instruments. Says TI's Maxwell Peel, chief design engineer for connector products, "Since the package mounts on the edge, the density of packing on a mother-board exceeds the two dual in-line techniques." But on the minus side, the profile is high and the reliability of edge connectors historically has been questionable. Still, SCM Marchant and Hammond Organ have designed them into products and say they are satisfied [*Electronics,* Sept. 13, 1971, p. 106].

The face-contact DIP has a substrate with face metalization and a receptacle with mating contacts. Amphenol uses gold contacts, but polished tin also is available. Lee Eichenseer of the Amphenol Industrial division, says: "our leadless connector is end-for-end and side-by-side stackable. This ensures maximum use of the available pc-board real estate."

Burndy is marketing a version with tin-plated contacts that employs high-pressure to make it gastight. Mike Lazar of Burndy says face contact has an advantage over the side-metalized contacts because the manufacturer does not have to metalize the sides of the package.

The dual in-line edge-connect is wed to the outside world via metalized pads along the edge of the package. Ron Boyer of AMP points out that this technique permits larger die cavities—300 mils square, compared with 210 mils square for the face-contact package. Also, the substrates tend to be thicker, and thus more rigid than the face-mount, face-contact substrate.

Significantly, the military is adopting a wait-and-see attitude. Joseph Brauer of the Rome Air Development Center says, "Our experience with the edge-board connector, in regard to both the copper-gold interface and marginal contact pressures, causes us to be somewhat skeptical of plug-in ICs." Brauer is chief of solid-state applications in the Reliability branch. □

Memories

AMS unveils 7001 with Toko deal

When Advanced Memory Systems of Sunnyvale, Calif., said that its new 1,024-bit n-channel memory would be on the market in the first quarter of 1973, it was only telling part of the story. Introduction of the part also will signal an increased emphasis by AMS on sales to original-equipment manufacturers and, equally significant, the start of an international cross-licensing agreement. [*Electronics,* Nov. 6, p. 57].

The licensee is Japan's Toko Inc., a maker of plated-wire memories, which initially will import packaged chips for its own systems. Eventaully, the chips will be built at a Toko subsidiary, Kyodo Electronic Laboratories. Toko plans to invest $1.6 million in the new operation for, among other things, LSI testers and wafer facilities. And AMS will expand into plated wire. What's more, the California firm hopes to increase OEM sales to 50% of its total.

The new AMS 7001 is aimed at high-density, ultrahigh-performance memory systems that require rapid access and cycle times typical of the main memories of the latest computers, including many still in the design stage. Until now, this performance was available only from bipolar memories at rather high prices; the 7001 gives it for little more than the price of much slower, p-channel memory of similar size. Despite improved performance, the new memory uses standard aluminum gates because AMS engineering manager Thomas Palfi believes in getting more out of the process by circuit techniques, rather than harder-to-handle fabrication techniques. He says that aluminum-gate technology is the best compromise between process simplicity and density. Access time of the memory chip in the TTL-compatible mode is typically 50 nanoseconds, although it can be shortened to 40 nanoseconds when a sense amplifier is used. The read/write cycle time is typically 150 nanoseconds.

The new device is suitable for add-on memories that can replace the bipolar memories in the IBM/370 models 125 and 135 and

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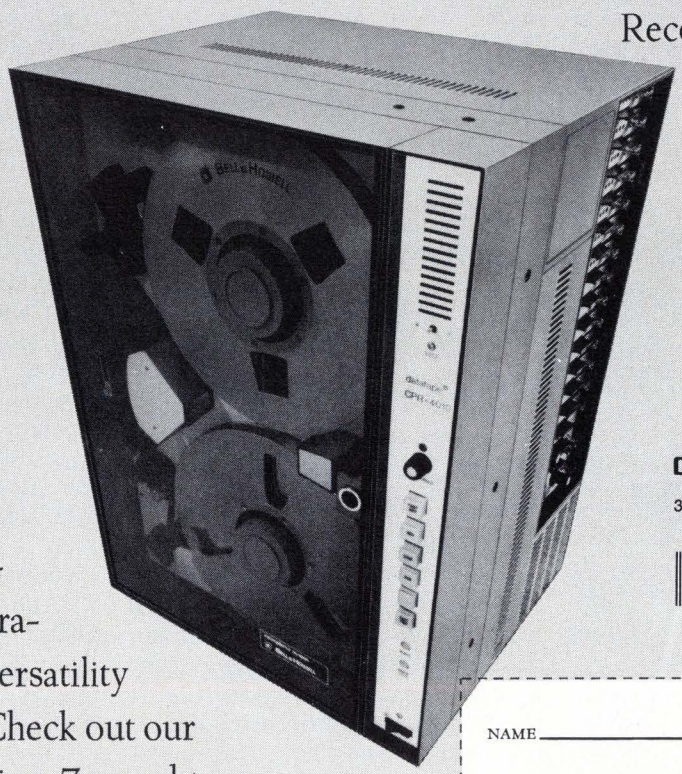

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Circle 37 on reader service card

also for add-on memories that can replace MOS memories in the models 158 and 168.

Toko, however, says that there is no significant add-on memory business in Japan yet, but that the company will concentrate on getting manufacturers to design the system into their computers. By the end of 1973, Toko expects to be able to sell memories with these chips at 1 to 1⅔ cents per bit. □

Commercial electronics

TI to sell new calculator by mail

Texas Instruments is going to sell a calculator by direct mail for the first time since it entered the business. And the new merchandising approach will be used for TI's latest machines—the first of a series of hand-held electronic slide rules. The SR-10 is designed to fill the market gap between simple four-function calculators and Hewlett-Packard's HP-35, a complete electronic slide rule. Interestingly, H-P is selling its calculator successfully through direct mail.

The initial slide rule, the SR-10 is a four-function machine with additional function keys for reciprocals, squares, and square roots. Because both entry and display can accommodate a two-digit exponent, the new TI calculator can handle eight significant digits in scientific notation through nearly a two-decade range, positive and negative numbers from $1.0000000 \times 10^{-99}$ to $9.9999999 \times 10^{+99}$.

Entries in floating point and scientific notation can be mixed, and the calculator will switch automatically to scientific notation to preserve significant figures.

At $149.95, about half the cost of the HP-35, TI's first electronic slide rule does not offer the trig and reverse trig functions of the H-P model, nor e^x, x^y, or memory, Entry, however, is arithmetic, as compared to the HP-35's entry scheme.

The SR-10 also features a 12-character, light-emitting-diode display, positive and negative overflow indication, low-battery warning, and an ac adapter/charger that can be used for either 60 hertz/115 volt or 50 Hz/220 V operation. It will be available first off the shelves of retailer Nieman-Marcus. □

New machine. TI will sell this electronic slide rule through mail, a company first.

International

Another 2nd source for 10,000 series

After a slow start on the European market, demand is beginning to build up for the high speeds in ICs that emitter-coupled logic can deliver. With Motorola Semiconductor ECL circuits dominant in Europe, it has had trouble overcoming hesitation of users who always want a second source available.

"Now they will have it," says Alain Forgue of La Radiotechnique Compelec (RTC). "We are present—in force." The force is a fresh new line of ECL circuits that are pin-for-pin compatible with Motorola's 10,000 series. Forgue is product marketing manager.

RTC is calling its new family the GBX 10,000 series, with product numbers identical to the Motorola equivalents. Among the circuits in development, due for introduction next year, are the GBX 10149 (a 1,024-bit PROM) and the GBX 95410 (a 256-bit RAM). The entire line is being introduced with ceramic packaging, but plastic packages are being studied.

This fall, RTC quietly began production of 18 ECL circuits at its big semiconductor plant in Caen, France. Thirteen more versions will go into production next year, all the result of a massive R&D effort "to close the technology gap to almost nothing—at least in the ECL area," says Forgue. In fact, he claims the 60-strong team of ECL researchers in Caen have managed to improve on the Motorola technique.

"When you're second-sourcing, you can't go in for much innovation," Forgue admits. But he says the RTC circuits include an additional stabilization network at each logic input to make sure the real part of the input impedance is always positive, eliminating the transistor oscillation that becomes negative impedance. "We can ensure positive resistance in a range from 50 to 500 megahertz," Forgue says. Just how the network was worked out, he's not saying.

RTC, a subsidiary of Philips Gloeilampenfabrieken, has given Forgue worldwide marketing responsibility for the new ECL line. All the circuits will be built in France and sold through Philips subsidiaries abroad, including Amperex Electronic Corp. in the U. S. Indeed, RTC hopes to get some U. S. computer firms committed to ECL so that when and if the firms set up manufacturing facilities in Europe, RTC will automatically become their ECL supplier.

In its U.S. market prospecting, the RTC team has estimated a demand of about $130 million in ECL circuits by 1975. The European market will be $12 million to $18 million, RTC says. Forgue is hoping

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ANALOG DEVICES

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to capture about 25% of the European market, "but God knows how well we will do in the U.S."

Motorola, far from being disturbed by having a new competitor in Europe, seems delighted. "It's just what we need," says one Motorola executive in France. "A second source will help us in our own marketing." □

Societies

IEEE members okay amendments to involve society more actively

"Landslide" was the word at the IEEE, as well as across the nation in the Presidential election, as the institute's members voted overwhelmingly in favor of constitutional amendments that permit "greater involvement in the social implications of technology." Of roughly 50,000 votes cast, 85%, a 7-to-1 majority, were in favor of the IEEE's participating actively in legislative, social, ethical, and economic matters affecting the lives of electronics engineers. In the words of an IEEE spokesman, the result augurs "momentous change, insofar as the world's largest engineering society is concerned." The society's worldwide membership is 161,000, of which 88% are in the United States.

The IEEE has "for some time" been anticipating the vote, confides president-elect Harold Chestnut of General Electric's research laboratory in Schenectady, N.Y. Since last March, he has headed an ad hoc "shadow government," the U.S. Activities Committee, which has been "studying like mad" the ways to proceed, should the amendments be passed.

These include, says Chestnut, "participation in the legislative process" by preparing position papers on technological assessment and forecasting, establishing employment-practice guidelines for engineers and employers, and promoting Federal legislation for portable pensions. The IEEE plans to establish a pension plan of its own by the end of 1973.

As for direct lobbying in Congress itself, the IEEE will, for now, rely on its two-year-old affiliation with the National Society for Professional Engineers, a registered lobbying organization. IEEE executive director Donald G. Fink is concerned that the organization's position papers might lose credibility if it began lobbying on its own. Position papers being considered for preparation, with the aid, if necessary, of paid consultants as well as volunteers, include such subjects as energy policy, cable television, and automation and productivity.

Chestnut adds that special attention will also be devoted to converting the defense and aerospace skill of its members, of whom 3% to 5% have been unemployed during the recession. Other areas to be considered include medical engineering, industrial safety, traffic control, environmental protection, criminal-justice automation, and power and utilities engineering.

The next steps for the IEEE include modifying the bylaws to legalize the new objectives and to "put the shadow organization into place." How much will it cost? Initially, not much. Dues will be increased Jan. 1 to $30 from $25, plus an additional $5 "regional assessment" for the U.S. and Canada. □

EIA consumer group gains top spot

Consumer electronics manufacturers came out of the Electronic Industries Association's annual meeting looking like the organization's new men on horseback. At the meeting, the EIA Consumer Electronics group:

- Put in one of its members, George Konkol of GTE Sylvania, Batavia, N.Y., as EIA chairman.
- Accepted two Japanese corporate subsidiaries as members, raising the number of CEG members to 29, and set a precedent for group expansion by opening the door to U.S. branches of foreign corporations. The additions are Sony Corp. of America, which makes TV receivers near San Diego, Calif., and Matsushita Corp. of America, which has a TV receiver plant in Puerto Rico.

Konkol, who missed the EIA meeting at Beverly Hills, Calif., because of a schedule conflict, is senior vice president for entertainment products at GTE Sylvania. He had served previously in EIA's Parts and Tube divisions and had been a member of the EIA board.

Outgoing chairman J. Frank Leach, president and chief executive of Arcata National, Menlo Park, Calif., called on EIA members to "rally 'round the flag." The association's executive committee, he said, "very carefully examined whether or not the association is properly constituted and organized to do the most effective job in the light of certain questions raised by the resignation of Texas Instruments."

Declared Leach, "we concluded unanimously—with representation from all divisions and groups in the association participating—that we do have the best possible structure" for flexible headquarters operation to provide services to members on issues of engineering marketing services, legislative review, industrial relations, and international standards to members with diverse interests.

At the meeting, EIA also:

- Created a tax panel "in anticipation of the next Congress," which is expected to consider a variety of pieces of tax legislation affecting the industry. The new panel, for which a chairman has yet to be named, will consider bills and make recommendations to the board, divisions, and their member companies on expected industry impact of the legislation, and handle appropriate industry responses, if any.
- Heard its Solid State Products di-

New shortcuts to LONG PULSE operation

Two new Tungsten-Matrix Cathode Tubes from RCA offer you a more efficient way to achieve long pulse operation for a broad range of military, radar, missile and communications applications. With them, you can use simple, economical circuit techniques for long pulse power because their advanced design and sturdy CERMOLOX® construction minimize tube inductance, feed-thru capacitance and induced noise problems. In addition, they assure greater freedom from arcing for more reliable performance throughout life.

Type A2960 (top) accepts up to 500 kilowatts of peak power input at pulse lengths up to 100 microseconds and a duty factor of 1 percent. It employes dc plate voltages or instantaneous peak voltages up to 25,000 volts.

Type A2950 (bottom) accepts up to 40 kilowatts of peak power input at pulse lengths up to 100 microseconds and a duty factor of 8 percent. It also provides 5 kilowatts peak pulse power at 150 MHz with pulse lengths of 5 milliseconds and a duty factor of 4 percent.

For more information on these new forerunners of a full line of RCA Tungsten-Matrix Cathode Tubes, contact your RCA Representative. Ask him, too, for a rundown on the many other RCA Power Types. Or write Manager, Power Tube Marketing, RCA, Section 70K-20 Lancaster, Pa. 17604.

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vision say it will continue to collect and collate semiconductor industry statistics, despite the withdrawal of TI from the program. James Conway, head of EIA solid-state products operation, said in a post-meeting interview that the marketing-services job of data collection and evaluation will be more difficult without TI, considering its large market share, and that estimating its output will not be easy. Nevertheless, said Conway, "We have a good track of their history and know where they are today." With increased staff effort to track TI's output, "we should be able to keep a good, reliable tap on their sales."

Conway said he hopes TI, "despite its political problem with the association overall," will consider a role in the data collection and dissemination program "like other nonmember companies, on a fee basis, which is substantially lower than the dues they were paying." Moreover, he believes TI withdrawal from EIA and its resultant failure to participate in the Solid State group can eventually damage the company's position in the industry.

- Formed an International Business Council to supersede its International Activities Council, authorizing a larger expenditure of up to $50,000 annually for the IBC to "gather and disseminate international business information and data" to members, as well as to "coordinate and activate programs" on exporting, importing, licensing, and follow-on services. The new group is not expected to alter the positions of EIA divisions when it comes to matters of trade. □

News briefs

Auto assembly lasers

Automotive manufacturers are beginning to try laser welders on their assembly lines. Two systems have recently been announced. Photon Sources Inc., Plymouth, Mich., says it has delivered a triple-beam carbon-dioxide laser system, developing 400 watts in each beam, to a General Motors Corp. plant for "on-line cutting of automotive subassemblies." And Hamilton Standard division, United Aircraft Corp., Windsor Locks, Conn., is developing a 4-kilowatt CO_2 laser welder to be installed in the pilot plant at Ford's Automotive Assembly division for "test and prove-out" as a production machine tool. The prototype laser should be able to make three welds on each underbody at a rate of 180 welds per hour. Thickness of the steel will range from 35 to 75 mils. United Aircraft's Research Laboratories, which has been working on laser welding technology for the past six years, will assist in the development.

NEREM off slightly

The drop in attendance and booth rentals at NEREM earlier this month was less than expected. Paid attendance, estimated at 9,000, was down about 500 from 1971; booth rentals fell to less than 160 from more than 180. The attendance decline may be explained by a limit put on the number of student attendees, and the fact that more than three hours was cut from evening exhibition time by earlier closings. Many visitors traditionally attend NEREM late in the evening.

Voice baggage system

Threshold Technology Inc., Cinnaminson, N.J., has developed and is installing a voice-encoding system to speed automatic baggage handling at United Air Lines' O'Hare terminal in Chicago. Baggage is tagged as usual, but then an agent reads the flight number or destination city into a head-mounted microphone, and puts the baggage onto a computer-linked conveyor-sorter that eventually unloads the bag at the appropriate flight-loading area.

The system stores each speaker's voice characteristics, verifies the destination via a CRT, and has a vocabulary that includes all the digits, eight key cities, and a few special control words.

State faults BART

The first public report criticizing the safety operations and management policies of BART, the automated San Francisco Bay Area Rapid Transit, has been issued by the state legislative analyst, A. Alan Post. The report called the automatic train-control system "unreliable" and said that until it is fixed, trains should not be allowed to run to San Francisco and Concord. BART already has had one minor crackup [*Electronics*, Oct. 9, p. 36].

The San Francisco run was scheduled to open late next year, and the Concord line was originally scheduled to open this month, but BART had already delayed that opening for another six months. Post said that his two investigators, one a transportation economist, the other an engineer from the auditor general's office, based their report on information provided by BART itself.

"The system is inadequate in terms of what it was designed to do," Post said. He said the report was spurred by reports from the California Society of Professional Engineers, a group that pointed out the safety problems a year ago—many of the same ones that Post's report included.

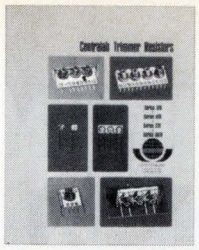
Optoelectronics

Fm video system shines through rain

Although a promising idea for economic and high-speed data transmission, most laser communications systems are stalled in military and Government research because of their complexity and high development costs. A small Washington, D.C. company, however, has developed a laser video system that's also aimed at commercial applications in facsimile and digital transmission.

Unlike systems using a-m or intensity-modulation techniques, Georgetown Instruments' Light Line system employs an fm technique, called "pseudo-standing-wave modulation." Fm communications techniques are better able to penetrate rain, fog, snow, or dust—big problems with laser systems—be-

Centralab Trimmer Resistors... in line with your design requirements



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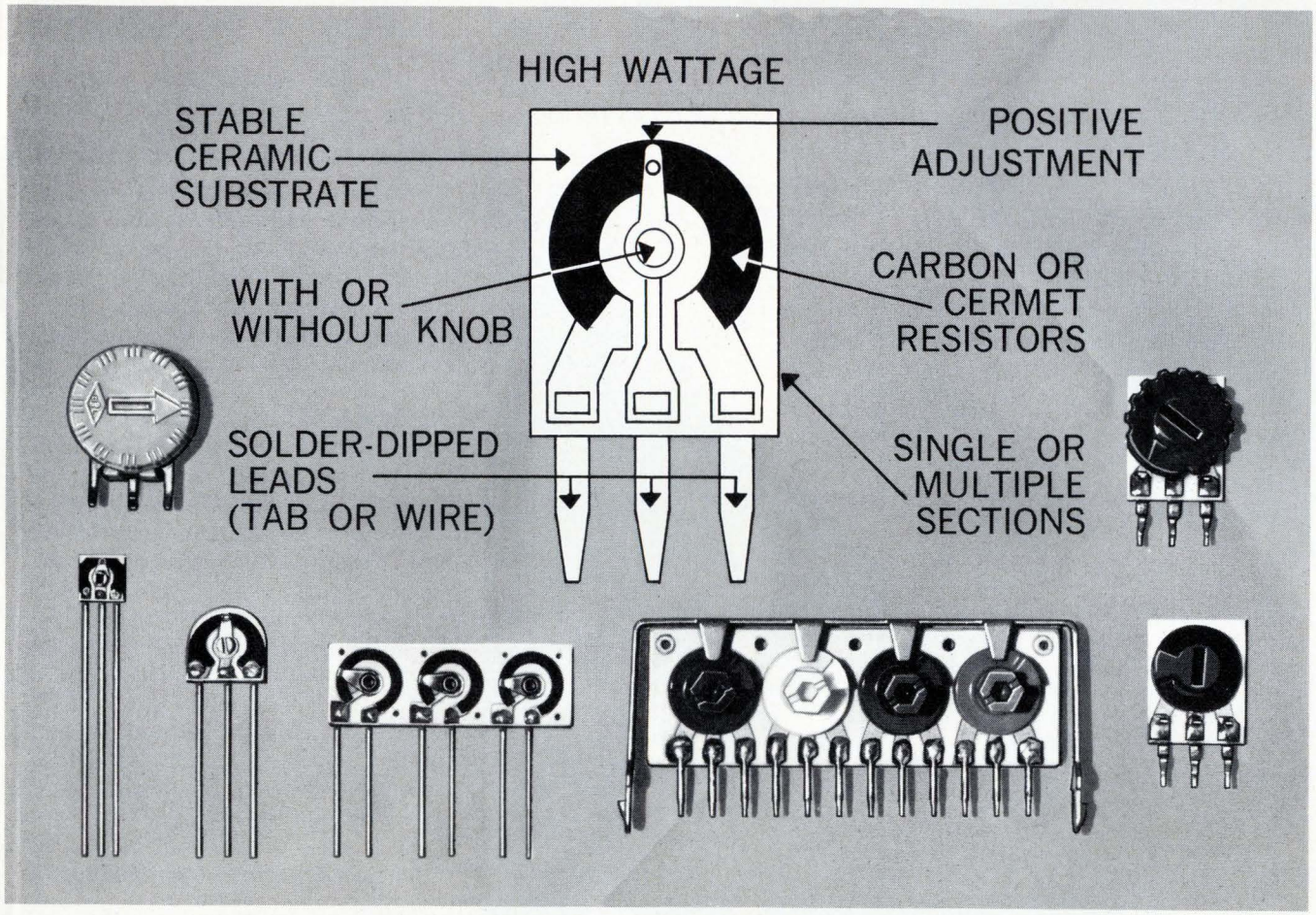

Ceramic–just one reason they're better!

The ceramic substrates of Centralab trimmer resistors—in both carbon and cermet—give them performance unmatched by phenolics. They're *conservatively* rated at *double* the wattage capability! You get higher wattage in a smaller space. They'll withstand higher operating temperatures. At 70° C they accept a full wattage load and derate to zero at temperatures of 105° C for carbon and 125° C for cermet.

Ceramic bases give you dimensional stability you can depend on —they won't shrink. They eliminate the problem of flux migration during flow soldering, too, so you can forget catastrophic failures often encountered with conventional trimmers. And—whether you specify wire leads or one of three tab styles, all are solder-dipped for ease of installation.

Another reason for selecting Centralab trimmer resistors is their smooth, positive adjustment. Their design eliminates the erratic, "slip-stick" effect in setting.

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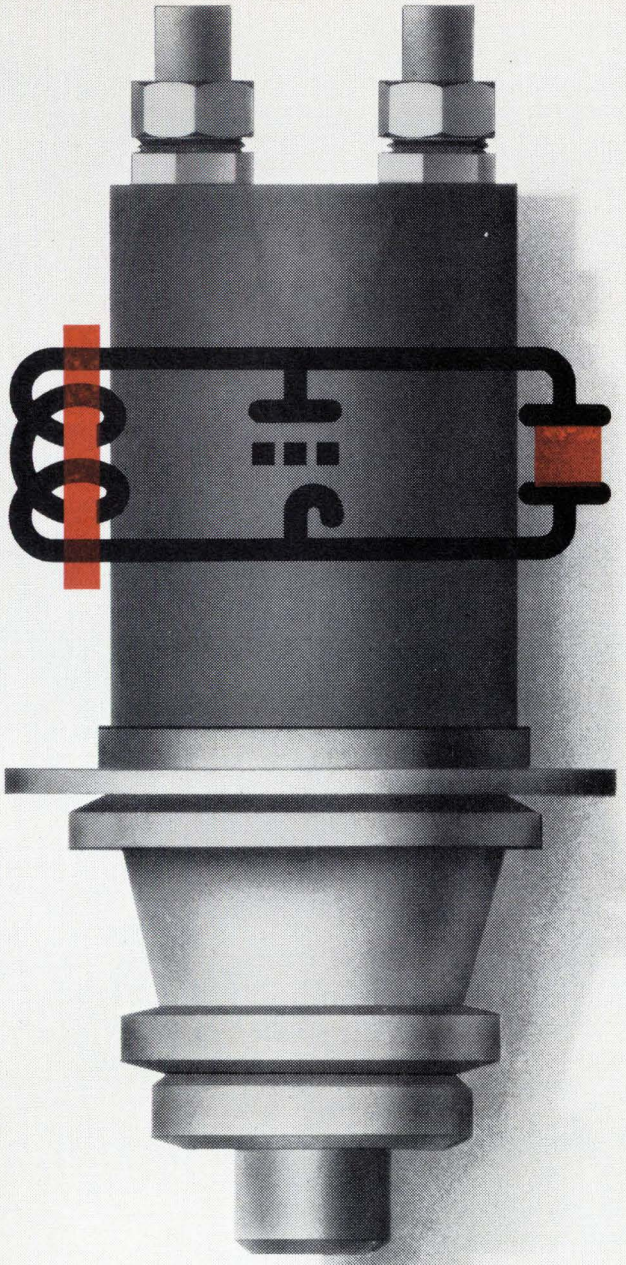
cause these obstacles affect frequency shifting less than they do amplitude or intensity-shifting techniques, claims William F. Thaylor, president of the company and head of Georgetown University's physics department.

The basic system uses a helium-neon laser that fires through acoustic cells, which are fed the video signal reformulated into fm radio frequency-spectrum information. The receiving end uses a photodiode, which reconverts the beam into a video signal through a wideband amplifier and a frequency discriminator. Heart of the proprietary Light Line system is the use of ultrasonic waves to impart the video information across the laser beam by frequency-shifting the laser light, explains Gerald M. Borsuk, research associate. Thus, the video waveform is frequency-modulated on a radio-frequency carrier, generating an fm rf spectrum, which is impressed onto the laser beam.

Mixing. On the receiving end, an optical mixing process occurs on the surface of the diode because of interference effects. The diode regenerates the fm rf spectrum of video information. The rf signal is limited to obliterate atmosphere effects and frequency-discriminated to recover the baseband video signal, Borsuk says.

Georgetown Instruments' unit, developed partially under U.S. Air Force contracts, has been delivered recently to the U.S. Department of Interior as a system to monitor power switches at Bonneville Dam. Company officials maintain that the unit will operate in snow, although it has not been tested in heavy snowstorms. However, fog would be the most difficult medium to transmit through, Borsuk says. In a recent 1.6-mile demonstration across the Potomac, the 6-megahertz system sent clear commercial-quality pictures in moderate rain.

Applying the same principle electro-optically by using electro-optic materials and "launching microwaves into them," under an Air Force contract, the company is aiming for 2- to 3-GHz bandwidths, Borsuk says. □



A SHORT GUIDE TO R.F. HEATING TUBES

Tubes designed for broadcast transmitting don't work well when used for inductive or capacitive heating applications.
The environment is industrial, regulation is poor and loads are not matched, which means that grids get overheated.
Philips therefore developed a special range of tubes for this specialised market.The big difference is the Philips "K-material" grid that can withstand a continuous load of 25W/cm². Moreover this is combined with a thermionic emission of about 1 μA/cm² which remains stable over the total tube-life, even when complicated by the presence of thorium deposit evaporated from the cathode.
Having developed a better tube, Philips then went on to develop a better range. It's comprehensive, going from 2.5 kW up to 480 kW. In addition the maximum frequency for most tubes is 100 MHz with full input power capability.
That's the short guide.

THE LONG GUIDE

The long guide runs to 182 pages. It's the definitive handbook on the subject and combines all our 25 years of r.f. heating experience. It's full of quantitative and qualitative data and we'd like you to have it, provided you're seriously interested in the subject. To receive a copy please write on your company letterhead.

Anode output power (kW)	Frequency (MHz)
2.5	160
4.0	160
7.5	150
15	120
30	100
45*	30
60	100
90*	30
120	100
240	100
480	30

High voltage types.

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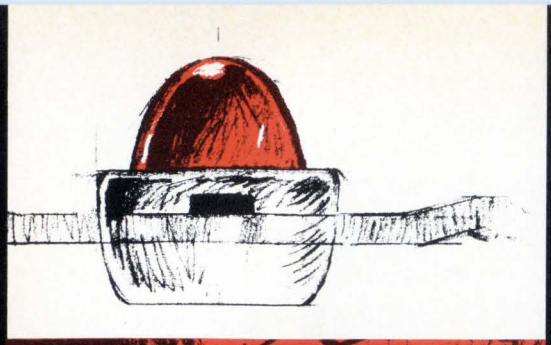
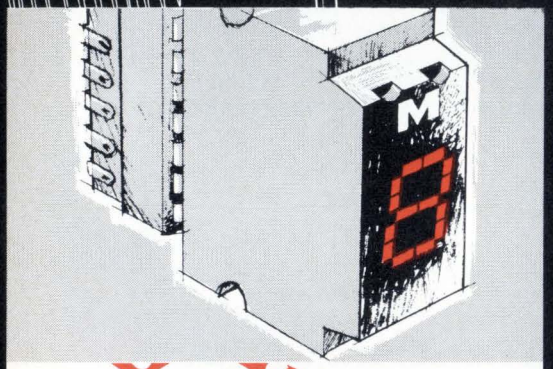


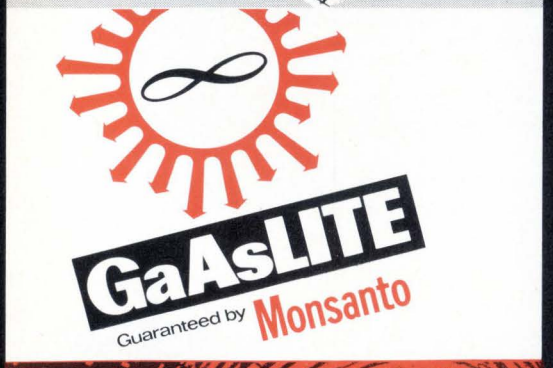
INNOVATION NO. 1. The light emitting diode. We call it the GaAsLITE, because it's made with gallium arsenide phosphide. These solid state light sources were first produced and manufactured in quantity by Monsanto. And we've put them to work . . . Millions are now in use as onboard diagnostics, indicators . . . a whole mosaic of applications.

INNOVATION NO. 2. The GaAsLITE Display. It took some production genius to design, develop and get produced the world's first seven segment light emitting diode displays. That genius was—and is—present at Monsanto. And we've put these displays to work . . . in thousands of man/machine interfaces.

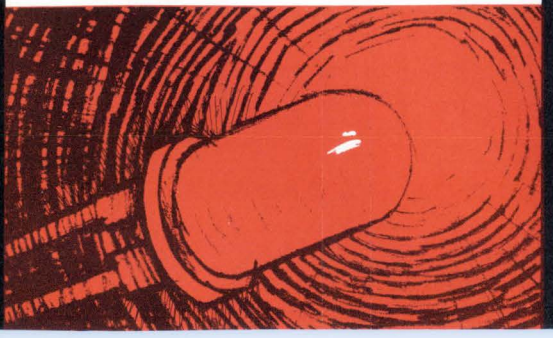
INNOVATION NO. 3. The Opto-Isolator. The idea of getting light-quick switching with isolation of 10^{11} ohms has always been attractive. Only with light emitting diodes could it be possible in a small solid state DIP. And we've put them to work . . . Thanks to Monsanto this innovation is now in a lot of computer-to-peripheral and similar sockets.



INNOVATION NO. 4. Modules. A lot of designers wanted to use Monsanto displays in their applications but didn't want to go through the engineering expense of developing all the driving circuitry. Our module group solved that problem for them. We put the displays to work . . . in a wide line of ready-to-go subsystems.



INNOVATION NO. 5. The GaAsLITE Guarantee. We were making devices that had a lifetime of 100 years or better. We wanted to dramatize that fact to our customers and to give them a sales tool to use for their consumer. We created an innovative lifetime-of-the-equipment guarantee* that the OEM could use as a strong selling point to his customer. Now he's putting it to work.



INNOVATION NO. 6. The Illuminating GaAsLITE. We keep constant pressure on the development and refinement of the materials we use to build our GaAsLITEs. Bright yellow and green devices were the two major innovative results. More recently, brighter material made possible the first solid state lights from Monsanto that actually illuminate a quarter inch circle. And we've put this innovation to work . . . in PBX panels, switches and—where would you like them?

Putting innovation to work.

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The Electronic Special Products Group, headquartered in Cupertino, California, started with one innovation: making a solid material, gallium arsenide phosphide, light up by passing a little electricity through it. We named these light emitting diodes GaAsLITEs.

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Today, that innovation is a $50-million industry. Because we *put the innovation to work* in point-light sources, displays, and in photo-coupled pairs.

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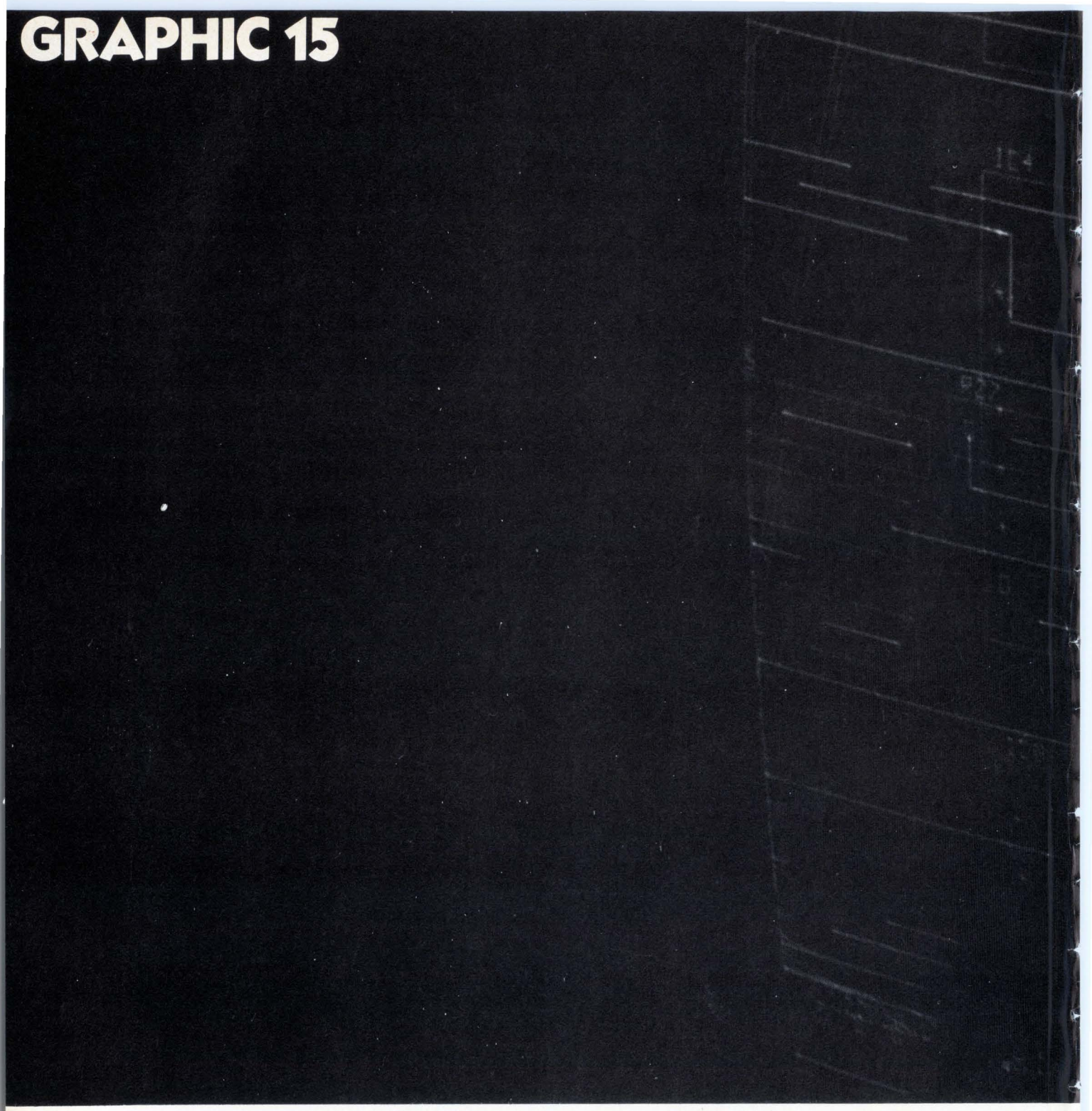
Monsanto

Circle 47 on reader service card

GRAPHIC 15



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But you won't have to become a computer expert. Graphic-15 puts you on line right away, thanks to a complete software application package.

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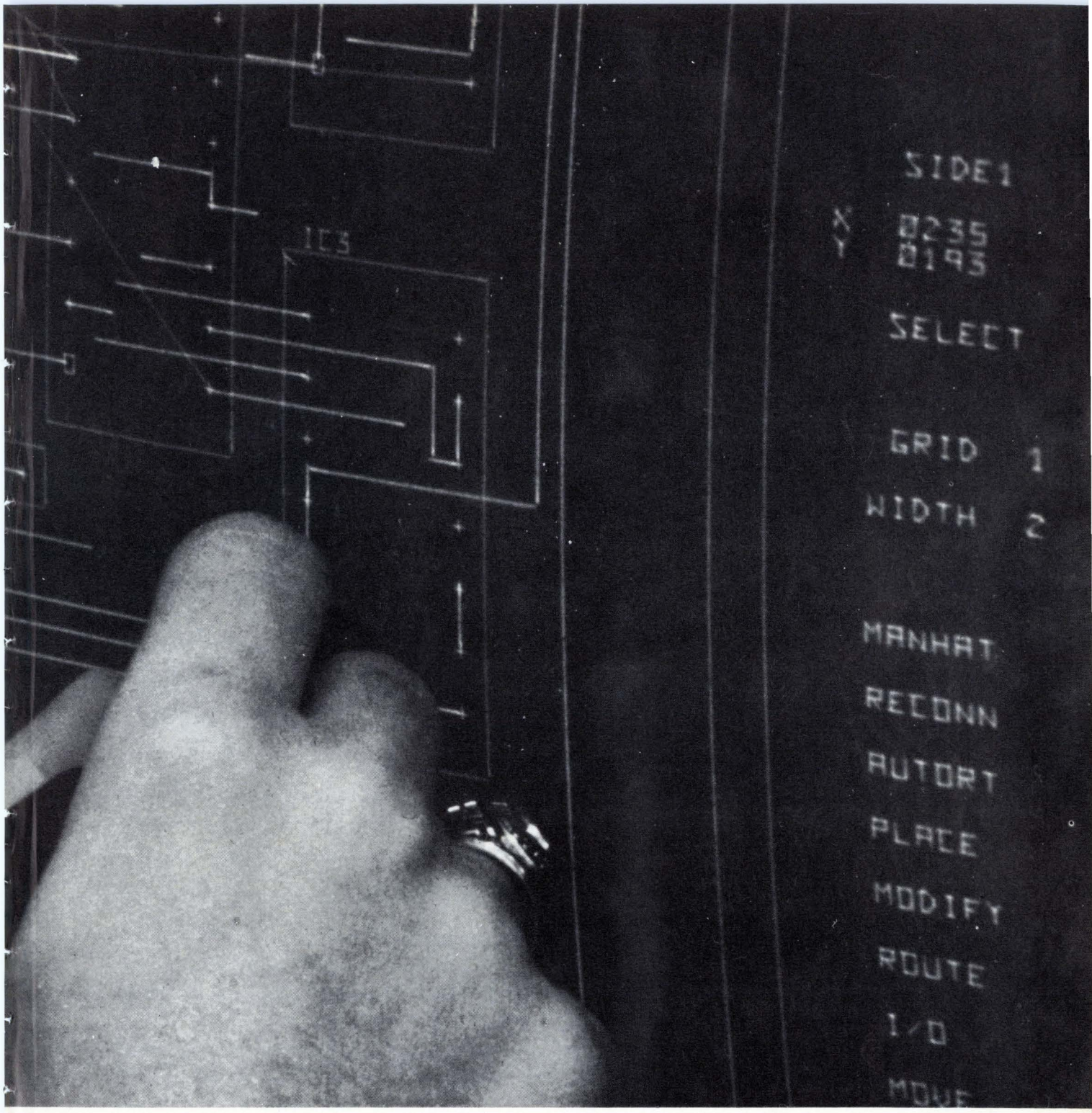

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digital

Circle 49 on reader service card

Plan to attend DECUS, November 29-December 2, Royal Inn Hotel, Anaheim, California.

LET DAN DAVIS TURN ON YOUR CALCULATOR FOR CHRISTMAS

Volume production of LED products at Litronix is allowing Dan Davis to play Santa Claus to the makers of handheld calculators whose products must be on the shelf before Christmas.

Dan is one of The Bright Guys at Litronix, and manager of consumer displays. Despite a tight market for small, high quality displays, here's what Dan offers to all you wonderful calculator manufacturers:

1. Instant pilot production quantities of your very own display.
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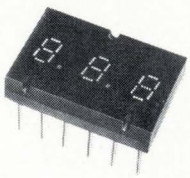
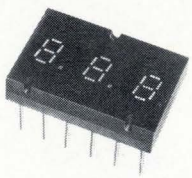


the bright guys

litronix



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Washington newsletter

Daddario touted as technology assessor

Emilio Q. Daddario, father of the bill to create an Office of Technology Assessment in Congress when he chaired the House Committee on Science and Astronautics, is being **pushed for the job of OTA director.** Now an executive with Gulf & Western Industries, Daddario resigned from Congress in 1970 to run for governor of Connecticut but lost.

Reports of Daddario's recruitment are tempering the fears of Federal contractors about OTA, created by the 92nd Congress to give it its first capability to independently evaluate agency programs and spending proposals. **At best, OTA is viewed by industry as one more obstacle** to program approval, and at worst, as a Machiavellian tool with which its overseers in Congress can advance their own political careers. Daddario gets high marks from OTA's congressional members, led by Sen. Edward Kennedy (D., Mass.). **Another candidate: MIT's J. Herbert Hollomon,** former assistant secretary of Commerce for Science and Technology.

Changes coming at FCC and OTP

The Federal Communications Commission is destined for a more youthful but nonetheless conservative look during the second Nixon administration as Chairman Dean **Burch prepares to step down.** The move is not imminent, however, since Burch is determined to resolve the domestic-satellite issue before he goes. **His most likely successor: commissioner Richard E. Wiley,** 37, a Chicago lawyer who has demonstrated impatience with the FCC's regulatory detail.

Also in the running, if he wants it, is Clay T. Whitehead, 34, director of the White House Office of Telecommunications Policy. The OTP is a candidate for at least a cutback, and possibly for phasing out, as part of Nixon's plan to use the White House as an example to the Federal bureaucracy. Walter R. Hinchman, OTP's assistant director for domestic communications, has already departed for the FCC where he will head a new Office of Plans and Policy. No successor has been named.

EPA eyes car pollution sensors

To make sure that auto emission control devices are maintained properly under the tough standards for 1975–6, the Environmental Protection Agency is considering **whether electronic sensors and test equipment should be used.** The sensors would either activate a light or buzzer **to warn drivers or police when a car was violating the antipollution law,** or would indicate emission control failure when a specialized test instrument was plugged in at a vehicle testing center.

Under the proposed rule, EPA is inviting comments on the feasibility of requiring auto manufacturers to install sensors in their vehicles. Depending on the comments it receives, the agency is aiming at **issuing final regulations in March.**

Addenda

TRW Systems, Redondo Beach, Calif., has won $35.9 million from the Air Force for **development of a prototype Fleetsatcom communications satellite** for the Navy, with five flight models to come later. . . . **Four Navy contracts totaling $10.6 million for a 2,000-ton Surface Effect Ship** have gone to Aerojet General, Bell Aerospace, Litton Industries, and Lockheed.

Washington commentary

Four more years of what?

Tracking the decline and fall of George McGovern's presidential campaign is still a popular sport in the capital, though it is about as useful as asking a wounded lumberman which tooth of the buzzsaw cut him first. Far more interesting to electronics managers and engineers is what is in store during President Nixon's second and final term of office.

For the first time in his political life, Richard Nixon does not have to look forward to another election. Nevertheless, he is concerned about transforming his phenomenal personal victory into something the Republican Party can capitalize on during the congressional elections of 1974, as well as the presidential campaign of 1976. In that connection, he believes he reads the mood of the American people as one that is tired of bureaucracy and big Government in Washington. Thus he is moving to cut it, and moving quickly.

Frozen funds

In a Nov. 9 interview with the *Washington Star-News*, the President indicated strong dissatisfaction with the "bloated" Federal bureaucracy, including the civilian staff of the Department of Defense, in which he promised cutbacks, confirming an earlier report [*Electronics*, Nov. 6, p. 51]. What he did not disclose, however, is that he has no intention of waiting until the beginning of fiscal 1974, next July 1, before acting. Other Federal sources forecast a freeze of some $3 billion of the current $81.5 billion in DOD's total obligational authority this year, part of the Nixon plan to put a $250 billion ceiling on Federal spending.

While contracts for electronic hardware are expected to be least affected, some stretchouts are certain as the military services continue to bargain with DOD's civilian leadership on program tradeoffs. Big cuts are forecast in civilian as well as uniformed military personnel who perform staff, rather than line, functions. Other agencies specified by Nixon as "too fat, too bloated": the Departments of Transportation, Health, Education, and Welfare, and Housing and Urban Development.

But the President tipped his hand even before he spoke to the *Star-News*. On Oct. 21, in one of his little-noticed radio addresses during the campaign, he posed these questions: "Do we want to turn more power over to the bureaucrats in Washington in the hope that they will do what is best for all the people? Or do we want to return more power to the people and to their state and local governments?"

Some corporate representatives of the electronics industries in Washington sensed the White House attitude before the President spelled it out. They dutifully notified their managements to begin monitoring state capitals and city halls for programs supported by Federal grants that call for computers, communications, and comparable hardware for use in law enforcement, mass transit, health and education. And present indications are that those local markets will be ranked by the White House just about in that order during the next four years, even though the President pushes for greater revenue sharing.

Confronting Congress

On the coin's other side is the 93rd Congress that convenes in January. It reads its election mandate differently from the President. Democrats are still in control, of course, with a net gain of two more seats in the Senate giving it a somewhat more liberal bent. On the House side, the cast appears to be more conservative and the Democratic margin diminished, yet there will be more first-termers than there have been in recent history. They are still unknown quantities.

More confrontations between the White House and Congress over Federal spending and program priorities seem certain. Defense programs seem relatively safe, although Wisconsin Democrat Sen. William Proxmire, foremost Pentagon critic, is readying a fresh series of assaults on major new efforts. Ironically, any hold on new military program starts could benefit electronics in terms of alternative efforts to update existing weapons systems.

Thus social programs, such as health and education and the taxes they will require, shape up as major sticking points in the coming year at least, with Senators Edward Kennedy (Mass.) and Walter Mondale (Minn.)—leading candidates in the Democrats' "winter book" for 1976—in the forefront of the opposition.

Thus bureaucrats and their Washington counterparts in industry are nervously asking: four more years of what? At worst, the answer is two more years of stalemate between the White House and Congress until the next congressional election. Yet the advantage now lies with the President—not so much because of the size of his overwhelming personal victory, but because of the continuing tendency of Congress to abdicate its role as a separate but equal branch of America's governmental machinery.

—Ray Connolly

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Jerry Hartman, DVM Sales Manager

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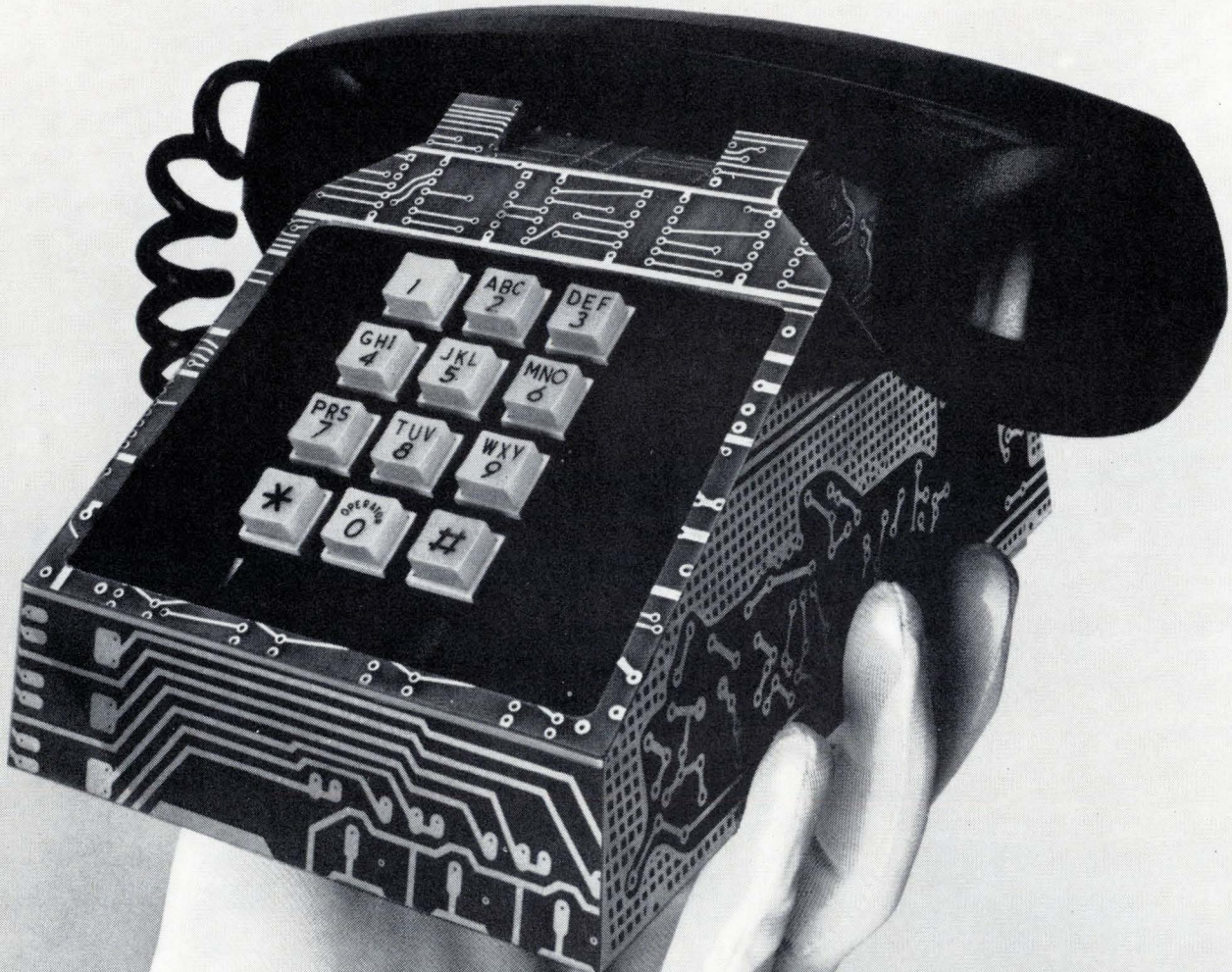

Norplex® laminates by UOP

Circle 54 on reader service card

Plessey harnesses perspective to develop a pseudo-3D radar display

Major airports usually have facilities for processing secondary radar signals from aircraft and displaying altitudes in numerical form on the main displays. This approach is too expensive for small airports, which nevertheless may want to provide controllers with height data on the main displays.

For them, Plessey Radar Ltd. has developed a novel combined plan-and-height display that needs no sophisticated data processing and insertion equipment. The view the controller gets is similar to what a man would see if he were looking at the displayed area from high in the sky and away to the side. That is, there is an element of perspective in the display that requires judgment in interpretation.

Range. Height is indicated not by figures but by bars stacked on the ground-plan position of the aircraft. One bar represents, say, 1,000 feet, so that the uppermost bars indicate the relative height of the aircraft on the display. Range, as usual is indicated by range rings.

Making the range rings elliptical instead of circular reduces positional accuracy slightly, perhaps by 0.5° to 1°, but inventor Ron Elbourn doesn't think that this is a serious drawback.

The ellipses are obtained by simple deflection of circular range rings. The conventional orientation of "north to the top" becomes "north furthest away". It is possible for the height bars for one aircraft to obscure those for a plane due north of it, and to get around this the whole ground plan can be rotated to get a clear view of both indicators. The new north is denoted by an ordinary radar marker.

The biggest modification to a standard display that has been necessary is adding the height-scan generator. Secondary-radar height information comes in digital form and is converted to analog to produce a voltage proportional to height.

This height-oriented voltage is used to control deflections of the writing beam to mark the height bars. On deflection, the beam follows the path of an isosceles triangle, coming back on to radial scan at the point at which it would have been at that instant in time, had it not been deflected. Bar length is equal to the beam width of the radar.

Scan. The radar return that marks the ground-plan position also starts the height-scan sequence. First, there's a delay equal to the radar-pulse width, to enable the ground position to be properly marked, then a 6-microsecond pulse generator is triggered. The back edge of this pulse triggers a second, identical generator.

These two pulses operate switches that feed the analog height voltage into an integrating circuit. The voltage goes directly to one switch, and inverted to the other. Thus, a positive voltage is followed by a negative voltage of equal amplitude. The output of the integrator is a wave with the form of an isosceles triangle. The output is then applied to Y deflection circuits to produce the height scan. □

Great Britain

Pushbutton unit updates dial phones

More and more new telephones have pushbutton number generators instead of dials, but for years there will be millions of dial telephones still in use. To update those dial phones, Pye TMC Ltd. is planning to sell a free-standing pushbutton number generator that connects to any normal dial phone. It wires into the telephone leads at the junction box, leaving the dial unaffected.

The unit, in a hemispherical casing 5¼ inches in diameter, will be made in a choice of colors. It's built around three custom-designed MOS chips—two shift-register, multiple-storage chips in TO-5 cans and one control chip in a 24-lead pack. There's also a thick-film hybrid clock generator.

Memory. As well as functioning as a dial substitute, it can store up to 10 telephone numbers, each identified by one of the ten number buttons. Pushing a "repeat" key followed by the appropriate single button automatically sets that number ringing, saving repetitive dialling of numbers that are used frequently. Each stored number can have up to 18 digits.

In fact, the total storage capacity is 11 numbers, because the number last keyed also remains in storage until erased by keying in the next number. This stored number, reactivated by pushing the repeat key, means that if the number is engaged the user doesn't have to push all the keys when trying again.

To put a new number into memory, two symbol-marked keys have to be depressed, together with the figured key indicating the stored number that has to be erased to make room for the new number. This procedure makes it unlikely that stored numbers will be erased or changed by mistake.

Pye TMC is showing the unit to world telephone authorities and expects some formal approvals soon. It's designed to put out 10 dial pulses per second, which is the most widely used international standard, but it can be adapted to 20 pulses per second and, at a pinch, 16, which is used occasionally. The company will supply the mechanism separately for building into OEM telephone handsets, and already has some OEM orders from Germany. □

The second edition of our microprogramming handbook is more revealing than the first

The original edition made many microprogramming concepts public for the first time. Now we have an expanded 450-page version with information on the Micro 1600, the mini that makes microprogramming irresistible. Our new paperback covers microprogramming from the most elementary stages all the way up to descriptions of complex computer architecture and special purpose applications.

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Microdata

International newsletter

Fairchild plans a European push in semiconductors

Fairchild Camera & Instrument Corp. will mount a strong push in the European market next year. The company currently is well down in the pack of semiconductor suppliers in West Europe, but executives of Fairchild's Semiconductor Components Group **aim to build their market share up to around 20% within the next two or three years.**

The major force in next year's push will be a new "high-technology" plant at the company's European headquarters in Wiesbaden, West Germany. David Marriott, general manager for Europe, says the plant will be operating by late 1973. **Fairchild will start by diffusing 3-inch wafers for transistor-transistor-logic, later go on to MOS and solid-state displays.** For starters, Fairchild plans to put 30 diffusion furnaces into its Wiesbaden plant. Labor-intensive operations, like bonding and packaging the Wiesbaden chips, will be done in the company's Far East plants.

Meanwhile, Fairchild will bid for a larger market share in West Europe with a "massive" addition to its sales force and an MOS design center in Great Britain. The company may find the going deceptively easy at the outset. **Fairchild's push is coming just as shortages of some semiconductor products are starting to pop up in West Europe.**

Toshiba readies black-surround color tubes for U.S.

Japanese color TV sets with black-surround picture tubes—and also the picture tubes themselves—should go on sale next year in the U.S. **First size to be available will be the 13-V, and other sizes—9-, 17-, 19-, and 21-inch—will follow.** The tubes, developed by Tokyo Shibaura Electric Co. for use in its own sets, in those of its customers, and for sale as components, feature in-line electron guns, shadow mask with brick-wall-type pattern, and alternating vertical stripe pattern of red, black, green, black, blue, black. The company claims the design gives 60% higher brightness and 10% higher contrast than previous tubes with heavily smoked faceplates.

Lack of Japanese color tubes with black surround has been caused by unwillingness of patent-owner Zenith to license Japanese companies. However, Toshiba feels that the different geometry of the new pattern eliminates infringement because it consists of black stripes between phosphor stripes rather than black areas enclosing phosphor dots. In Toshiba's tube, the electron beam passing through rectangular slits in shadow mask and impinging on a colored stripe also spills over onto black stripes on both sides, as in Zenith's negative-landing scheme. However, in the vertical direction the electron beam is wholly within the phosphor stripe, as in conventional positive landing. Toshiba says that an advantage of this "hybrid landing" is that changes in the earth's magnetic field encountered when the set is moved about a house merely cause slight vertical displacement of electron-beam landing positions and have absolutely no effect on picture quality.

Facit may gain electronics strength after take-over

Sweden's big office machine maker Facit AB, which is being acquired by household products giant AB Electrolux, will be getting some heavily electronics-oriented management in the deal. Just three days after Facit announced employment cutbacks of 2,400 workers—about a quarter of its work force in Sweden—it was disclosed that Electrolux

would acquire Facit. **Facit has been hard hit by sharply increasing Japanese competition and last year lost $11 million, with a similar loss expected this year.** A basic reason for Facit's troubles was its late start in getting into electronic calculating machines.

The take-over brings Facit into the so-called Wallenberg industrial empire and **brings the company closer to the giants in the Wallenberg stable—L M Ericsson, ASEA, and Saab-Scania—all with strong electronics operations.** The rescuer of Facit is Hans Werthen, once an electronics engineer at AGA, who was put in charge of the floundering Electrolux in 1967. **Within a year, he turned the company around, making it one of the most successful and profitable in Sweden.**

France flooded with low-cost East German black-and-white tubes

A flood of low-cost black-and-white television tubes from East Germany has swamped the French market, causing concern among manufacturers who have been supplying France's so-called "independent" television-set makers. **The East German tubes are going for prices "that have no connection with the real business world,"** says one French company that is hurting. East German tubes were virtually unknown in France in 1970. Last year 37,000 were imported. And at the current pace the 1972 total will be around 100,000. This number represents about half the independent market—the TV makers that have not yet been swallowed up by the Thomson group, Philips, or ITT. Observers expect the flood to continue, **probably taking close to 100% of the independent market by the end of 1973,** or about 20% of total French black-and-white tube sales.

Chinese up Trident orders to 20

British avionics companies hope that the new order by the Chinese civil aviation administration for eight more Hawker Siddeley Trident three-jet passenger transports, making 20 in all on order, indicates that the Chinese intend to standardize on Tridents for internal air services. If so, the ultimate number ordered could be very large. **Avionics orders for the 20 aircraft are valued at between $7 million and $8 million.** Equipment is different only in minor detail from standard Trident avionics fitted in British European Airways aircraft. The main avionics equipment, the flight control system, is by Smiths Industries Ltd. The first aircraft was handed over last Monday.

Laser waveguide pumps data at 500 megabits per second

Using a double-heterojunction injection laser as the transmitting element, researchers at AEG-Telefunken have achieved a bit transmission rate of 500 megabits per second over an experimental mono-mode fiber-optics waveguide system. This bit rate, claimed to be the highest yet attained with such a laser, is made possible essentially by superimposing a dc biasing current on the laser's drive current.

Double-heterojunction lasers allow cw operation at room temperatures and, because they can easily be modulated, are one of the prime contenders as transmitters in future fiber-optics communications systems. However, they suffer from short lifetime, which may be from a few minutes to several hundred hours at best. To get around this problem, the AEG-Telefunken researchers are operating the laser in a quasi-cw mode: the pulsing process is maintained only for a few microseconds and is then periodically repeated.

Cinch Dura-Con
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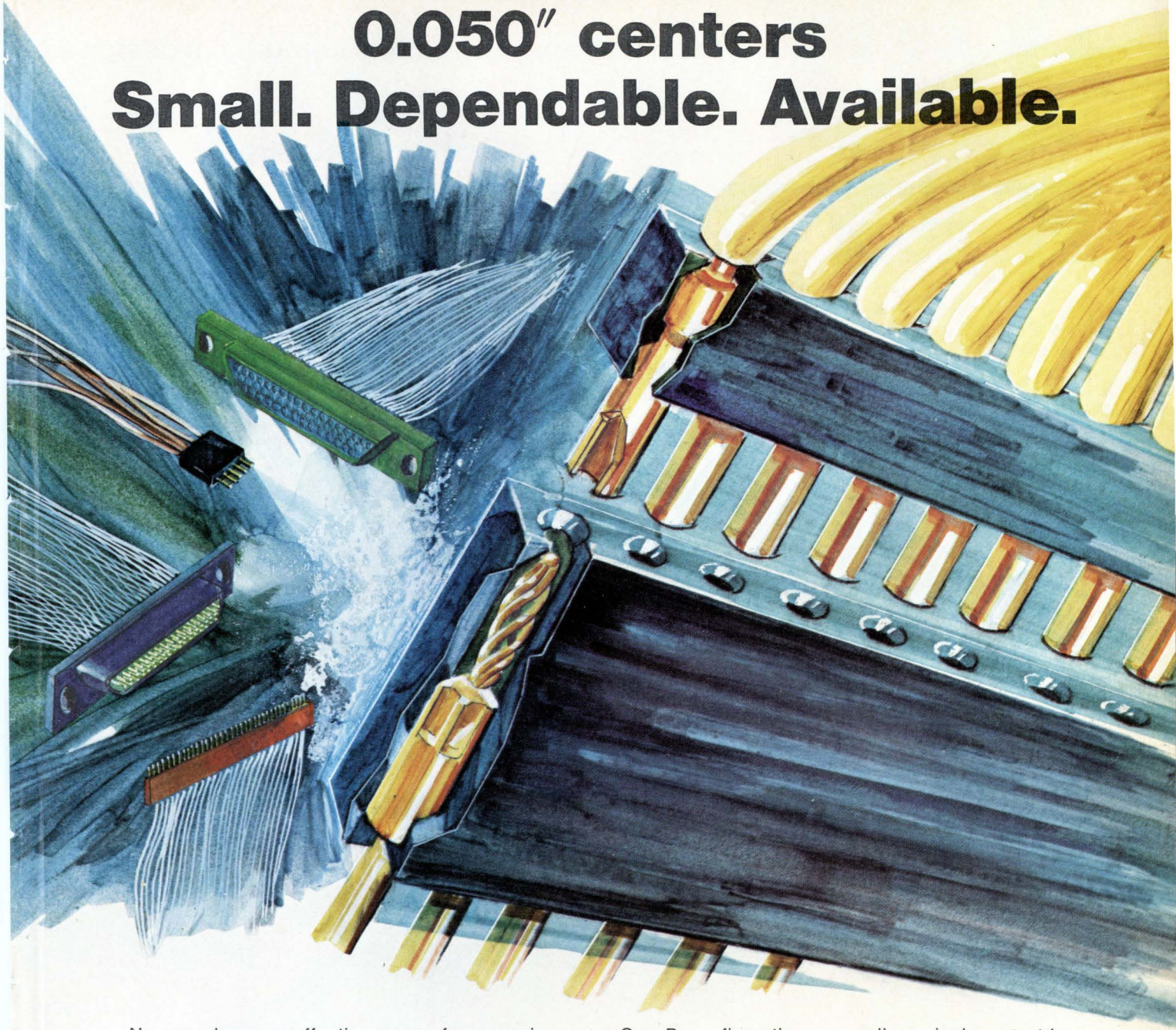

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The size 24 contacts with 0.050″ centers are supplied factory terminated, with pigtail or wire leads. Size 22 contacts, on 0.075″ and 0.100″ centers, are crimp removable.

Cinch Dura-Con Micro-Miniature Connectors are described in Bulletin PBC-174, available free on request from Cinch Connectors, an Operation of TRW Inc. Electronic Components, 1501 Morse Avenue, Elk Grove Village, Illinois 60007. CM-7203

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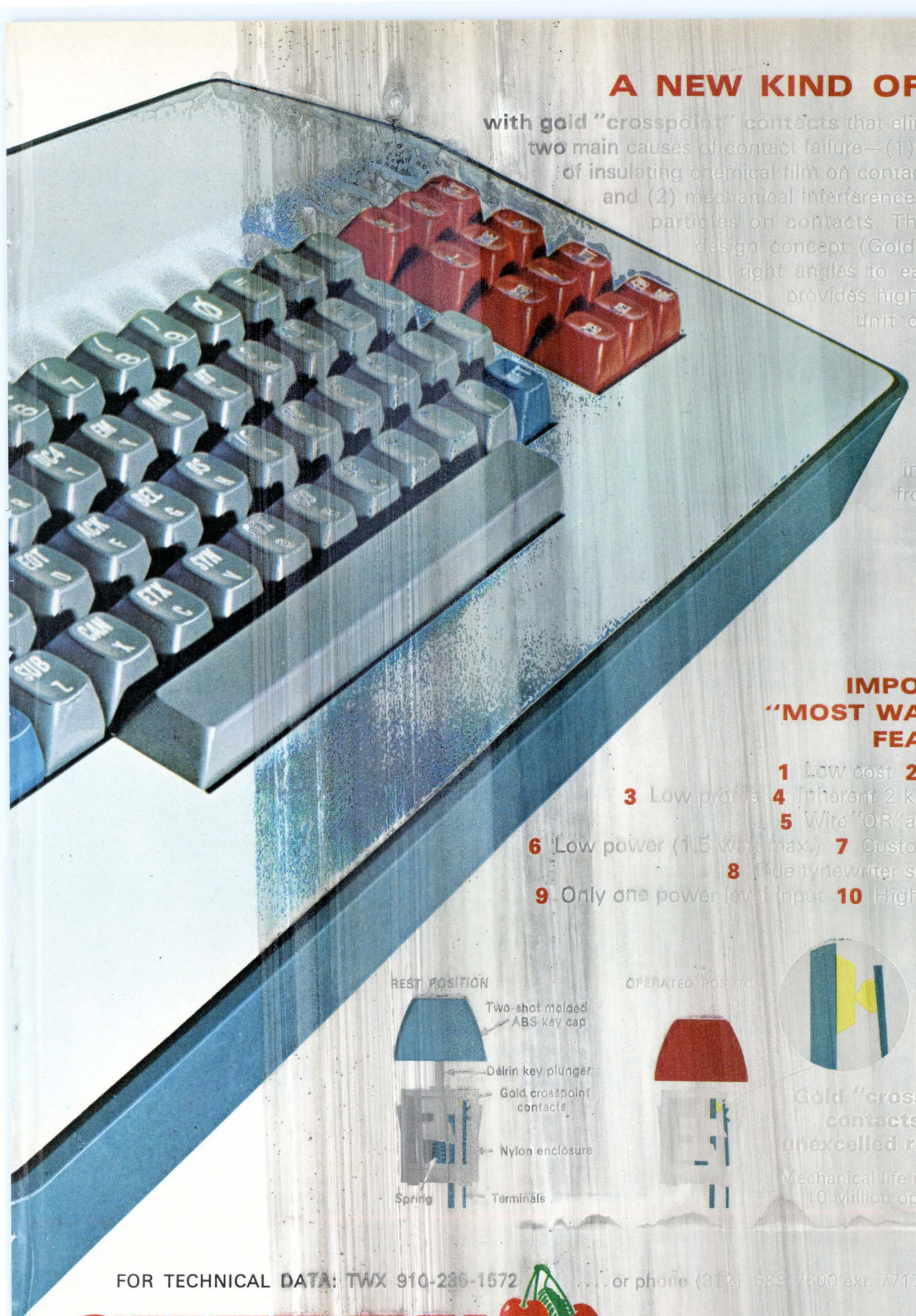

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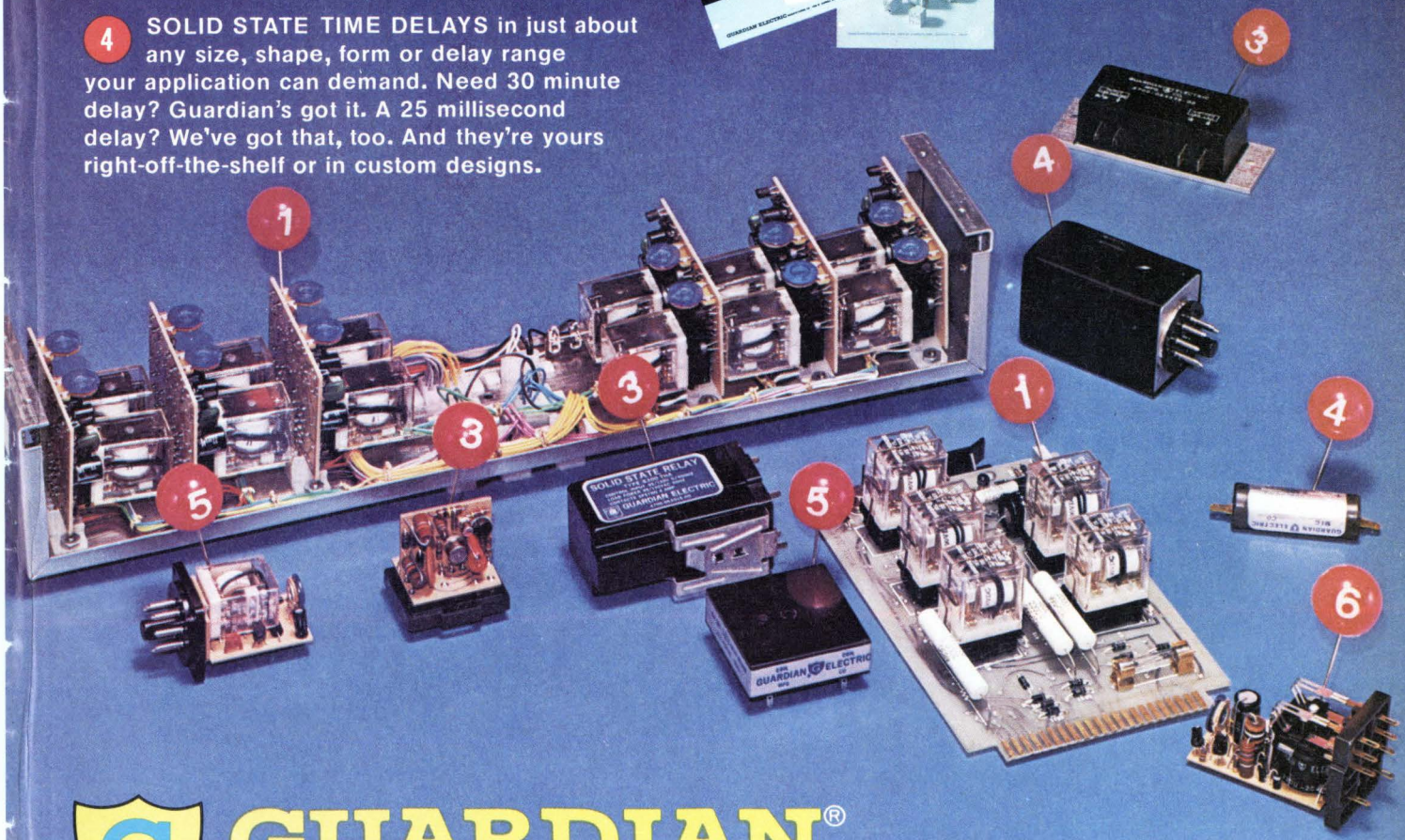

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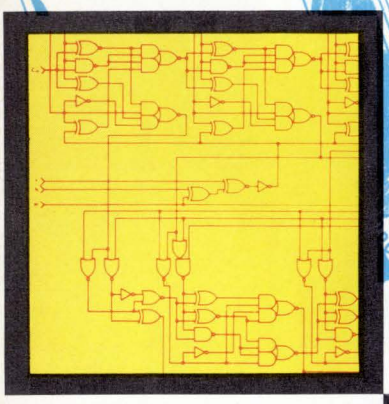
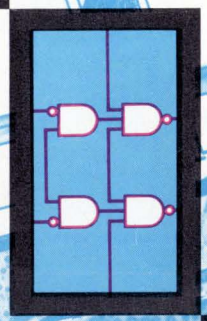
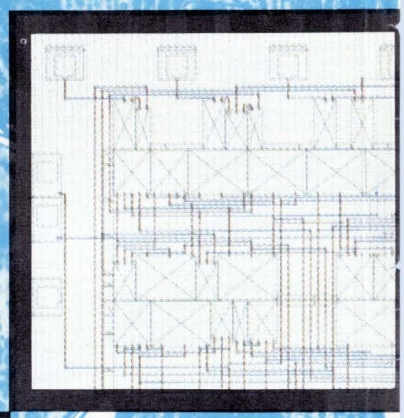
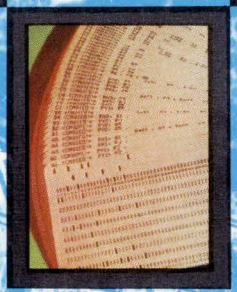
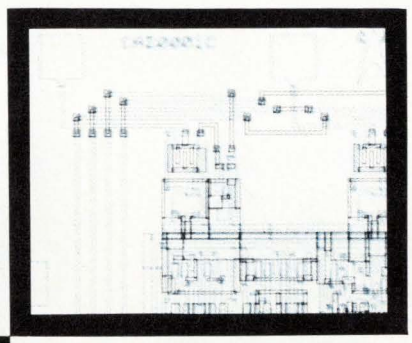








A New Concept in LSI Circuit Design



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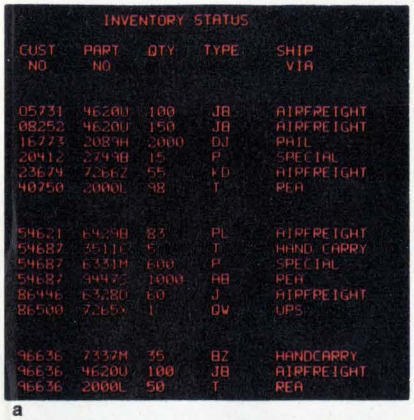

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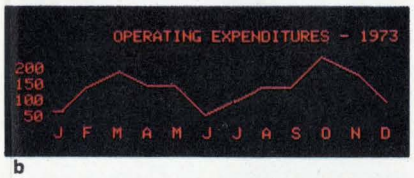

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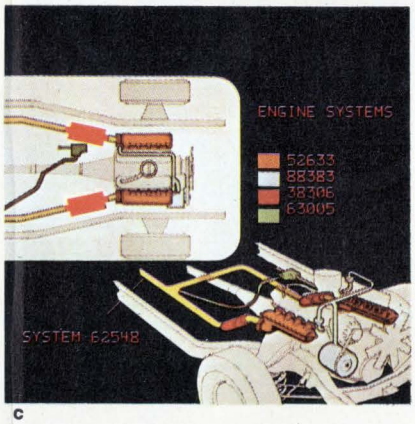

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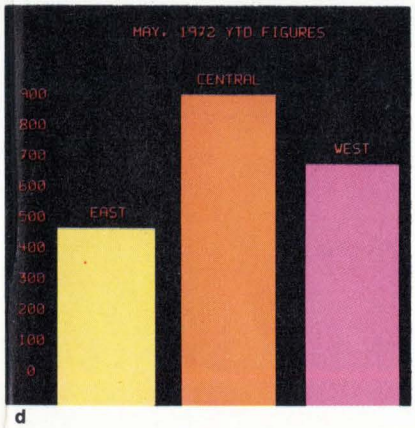

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a/*A Digivue unit in a shipping department relays the day's orders by catalog number, type, quantity and method of shipment. Digivue's inherent memory allows instant retrieval of this information without refresh requirements at any time.*

b/*A Digivue unit on the desk of a financial vice president transmits a twelve-month cost projection. Terminal manufacturers note: Digivue's slim panel depth allows for high-styled consoles and attractive, unobtrusive placement in an almost limitless variety of situations and locations.*

c/*Digivue units help a sales training class with assembly techniques for a new product line. Because Digivue panels are transparent, rear-projected graphics in every color of the rainbow deliver high-impact visuals no CRT system can even come close to.*

d/*With the help of a Digivue unit, a busy executive secretary prepares information for an important meeting—utilizing a combination of rear-projected graphics and computer-generated alphanumerics.*

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Display/Memory Units

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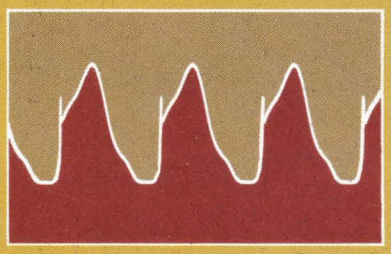

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Two firms challenge noise cutter

Burwen Laboratories and DBX Inc. launch systems to compete with Dolby, which has had recording noise-reduction field to itself for five years

by James Brinton, Boston bureau manager

Out of the hiss and noise of disk and tape recordings has come the Dolby-A noise-reduction system for professional recording studios, but after about five years alone in the field, Dolby is picking up competition. Two firms, DBX Inc., Waltham, Mass., and Burwen Laboratories Inc., Lexington, Mass., are beginning to erode Dolby's dominance.

The pioneer, Dolby Laboratories Inc., New York and London, has sold more than 9,000 channels of noise-reduction gear to professional recording studios—5,000 channels this year alone and half of these in the U.S. But Dolby-A is no longer the monolith it was a year ago.

DBX announced its professional equipment last fall, and the company already has sold about 850 channels to more than 70 studios, according to DBX chief, David Blackmer. This seems a fast start for a newcomer, especially one faced with entrenched competition. Burwen has about 20 systems in the hands of dealers and recording engineers, and although it has yet to start full-scale production of its model 2000, the firm has sales agreements with several studios.

All three systems use dynamic range compression to reduce background noise, but each goes about it in different fashion. Since background noise is most prominent when music is softest, all boost prerecorded sound when it dips too low to mask hiss and other recording noise [see panel].

The DBX system is less expensive than many models in Dolby's professional line. DBX's stock-in-trade is its four-channel model 187, selling at $1,950, or $487 per channel. A single-channel DBX printed-circuit card for a recording console costs $325. The equivalent single-channel Dolby unit is $600. Sixteen-channel units are fast becoming the largest selling class of noise-reduction gear. Dolby's new M-16 sells for $8,000, while the forthcoming DBX-116 will cost $6,800.

Burwen president Richard S. Burwen, makes no pretense of cutting his higher prices. "We are after the perfectionists," he says, and his pricing seems to reinforce the statement. His model 2000 noise eliminator costs $6,500 for two channels. For users with a playback-only requirement, he also offers a model 1000 dynamic noise filter—a two-to-four channel device that makes use of peak detection and fast-acting variable-bandpass, variable-slope, active filters to snip noise from the extremes of the frequency spectrum.

Priced at $6,100 for four channels, the model 1000 cuts noise between master tape and disk cutter, between an fm station's studio electronics and its transmitter.

Pitching products. How is the sales competition going? Dolby has the advantage of five years of acceptance. Thus, to a degree, it has become an industry standard. Since all Dolby and Dolby-licensed systems conform to set specifications, any Dolby recording can be played back on any other Dolby-equipped system. The same is true of DBX and Burwen recordings, but there are far fewer studios so equipped.

Dolby pitches its professional equipment on the basis of the 10 to 15 dB s/n ratio improvement it makes possible in recorded sound. Since most professional tape recorders are in the 60-dB s/n ballpark already, Dolby-ized recordings generally run about 72 dB s/n. This means that 90% of the background noise is eliminated.

Who could ask for more? Hardly anyone—until the advent of Burwen and DBX. "Even though the background noise on a record is 70-dB below signal level," says DBX's Blackmer, "it is perceptible. Even Dolby recordings have a 'veil' to them," he maintains, "which listeners may not be fully aware of, but which they quickly notice upon comparison with DBX recordings."

Because DBX and Burwen systems use more compression and expansion than Dolby, their resulting recorded sound is further above noise level than Dolby's. Instead of an added 10 to 15 dB, DBX and Burwen say that studios using their gear can add 20- to-50 dB and so 90- to 110-dB s/n ratios are obtained and dy-

Silencer. Ray Dolby, whose noise-reduction system is a standard, faces a challenge from two New England firms.

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namic range is broader in proportion.

Morley Kahn, vice president and manager of Dolby's U. S. operations, maintains that there is a significant advantage in dividing up the audio spectrum into four bands which operate independently of each other. "With a single-band system, any strong input—regardless of frequency will, in essence, provide very little electronic noise reduction. And if the program material and noise are far apart in frequency, the program material will not mask the noise."

With four bands, he contends, "if the program material and noise are considerably apart in frequency, the band where the program material is not present to any substantial degree will continue to provide electronic noise reduction."

The problem with this approach, according to DBX and Burwen, is that the transfer coefficient of the total system from tape recorder to playback must be perfectly calibrated.

Kahn emphasizes the importance of proper calibration in the Dolby system. And he adds that no matter what noise reduction system is used "if the entire tape system, including noise reduction electronics, isn't properly adjusted, the results will be deficient. With a single-band compandor (compression-expansion) system," says Kahn, "you cannot have even 10-dB of noise reduction without audible effects." DBX's Blackmer, in turn, notes that "the large amounts of high frequency pre-emphasis in the DBX and Burwen systems makes such side effects inaudible."

On the other hand, DBX and Burwen note that multiband systems may separate a loud fundamental from its weaker harmonics—or pulse from its Fourier components. This places a burden of extreme phase accuracy on the tape recorder electronics—and often tape recorders are deficient in this area. This is perhaps the explanation for the "veil" which Blackmer claims to notice as the key difference between his system and Dolby's.

DBX and Burwen also sell on the basis of "head-room"—the ability to handle orchestral peaks. They argue that a low-level sound may have peaks 20 to 28 dB higher than its average level.

Both Burwen and DBX make peak-reading volume unit (VU) meters, and say that most recording engineers are impressed when sounds that barely wiggle their standard VU read 20 dB or higher on peakmeters. Both Burwen and DBX claim that their systems handle such transients better than Dolby equipment—DBX claims 10 dB of extra head-room. In addition, Dolby's competitors claim that the Dolby-A system clips these peaks because of overload.

Consumer market. But Dolby-B, the system for consumers, seems almost unassailable. The company has signed more than 45 licensees within the high-fidelity community, asserts Dolby's Kahn. And things can only get better. ICs made by Signetics Corp. will soon replace discrete components in the Dolby-B system (see p. 31).

Use of Dolby-B is expanding fast. Until now restricted to use with open-reel tape recorders and cassette decks, Dolby noise-reduction systems already are finding applications in fm broadcasts and thus in fm tuners.

DBX competes with, and complements, Dolby in the home. The DBX $155 model 117 consumer unit uses many of the same principles as DBX professional units, but instead of aiming to improve tape recording, it is largely aimed at expanding the dynamic range of prerecorded music. But because the 117 reduces its internal gain when music grows softer or is absent, it also acts as a playback noise-reduction system.

Sales of DBX to date have been not only production-limited, but limited geographically to the Northeast. DBX is building its distribution network and moving into larger plant, but so far, it has only been able to produce about 400 model 117s a month.

As Blackmer points out, "Until these things are selling in much higher volume, we are not going to be able to take advantage of custom integrated circuitry." □

Silencing noise

All three major noise-reduction systems use dynamic-range compression prior to recording, and on playback, they expand signals to the original parameters. But each system handles the job differently. Dolby-A operates by dividing the audio spectrum into four bands and applying a 10- to 15-dB boost to individual bands when audio input falls below a preset level. Assuming that the playback and record levels are properly set, Dolby-A can increase signal-to-noise ratio from 10 to 15 dB with no perceptible effect on the program material.

DBX treats the audio frequency band as a whole, but because tape hiss increases with record signal amplitude, high-frequency pre-emphasis is added at the input of this system. This boost, which rises to 20 dB, begins at 1,600 Hz. A voltage-controlled amplifier with a dynamic range of 130 dB is controlled by a so-called true-rms detector circuit. This circuit gives a more accurate reflection of musical dynamics and peaks than other detectors, say its developers.

The sensor tracks the incoming signal and compresses it by a 2:1 ratio. On playback, the signal is expanded to its original dynamic range, and the high-frequency boost is removed. The full audio band is treated as a unit, and the system offers 20- to 30-dB s/n improvement with overload characteristics, said to be capable of withstanding 24- to 26-dB peaks without distortion.

The Burwen model 2000 is similar to the DBX system, but it differs by use of peak detectors and the addition of low-, as well as high-frequency pre-emphasis. Burwen offers three different frequency-weighting curves suited to recording speeds of 15 inches per second, 7.5 in./s, and 3.75 in./s. Burwen has selected a 3:1 compression ratio, and thus, in theory, its equipment can obtain a signal-to-noise ratio higher than is possible with the other two systems; Burwen claims a 110-dB signal-to-noise ratio for music processed through his equipment; thus, figuring the average studio tape machine as capable of 60-dB s/n ratio, the s/n improvement should be approximately 50 dB.

Solid State

Interface sales set growth pace

Economies through increasing complexity and second-sourcing attract buyers for applications like data communications and MOS interfacing.

by Paul Franson, Los Angeles bureau manager

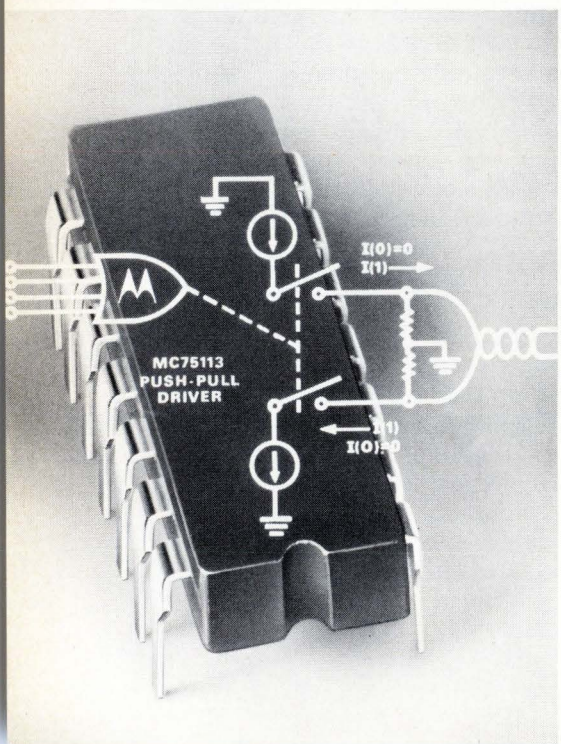
Interface circuits, the stepchildren between analog and digital circuits, are approaching maturity, with rapid growth and extensive second-sourcing, accompanied by more interest in cost than technology or specifications. Sales of interface circuits have grown about 100% over last year, says Charles Phipps, manager of strategic planning at Texas Instruments, Dallas. "They're not the largest of the linear segments, but are one of the fastest-growing." Phipps says that the total interface market, by TI's definition, was about $15 million in 1971, and it will be over $25 million this year.

William Howard, linear IC product manager at Motorola Semiconductor Products division, Mesa, Ariz., defines interface circuits as those "connecting the analog and digital worlds." In practice at Motorola, he adds, "it's the parts that have an analog signal input and digital output, or vice versa." Larry Housey, linear product manager at TI, defines interface circuits as ones with inputs and outputs at different logic levels. Generally, this means line drivers and receivers, sense amplifiers, peripheral and memory drivers, and sometimes, other parts.

However they are defined, the recent spurt in the development and sales of interface circuits can be attributed to several interacting factors:

- The growth of data-communications systems and a corollary interest in party-line applications.
- The realization that system costs can be cut through the use of more complex interface circuits and through the competition stemming from second-sourcing.
- The need to interface MOS circuits, particularly memory devices, with solid-state TTL and with power-consuming devices, such as transmission lines and light-emitting diodes.

One of the fastest growing areas, says Ronald D. Campo, manager of Motorola linear integrated-circuits planning, is line drivers/receivers, up 104% over last year. The present market, he says, is $15 million. In telephones, Motorola's 1488/9 quad RS-232-C drivers and receivers seem the standard, but TI has just introduced a receiver, the 75152, that can be used in both RS-232-C and MIL-STD-188C applications. RS-232-C, an EIA specification for interface circuits, details the relationships among input resistance, voltage, and switching speed. MIL-STD-188C is essentially its military counterpart. Motorola's Howard is concentrating on commercial parts because he sees a much larger market for them.



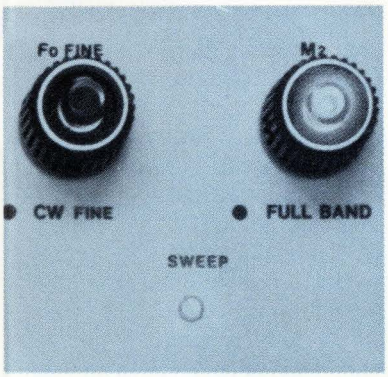
For party lines. New Motorola line driver is useful where several drivers and receivers share a common line.

Communications. There's more new activity in twisted-pair line drivers and receivers than in RS-232-C, reflecting the growth and lack of standards in peripherals and other computer applications. The big push here is to party-line applications, including tri-state outputs that can be tied together to obtain an OR gate. A party-line connection is a parallel attachment of a number of units to a single bus line. For instance, a number of line receivers and transmitters may be connected in parallel to one line so that each one could talk with the others. An alternative is a switching system that permits any circuit to choose which other one to talk to. The Digital Equipment Corp. PDP-11 minicomputer uses this type of party-line circuit, which DEC calls Unibus. It's the coming thing.

Even in second sourcing TI's 75107 and 75108 receivers, Motorola has added diode-protected inputs to prevent damage to the receivers caused by circuit malfunctions or disconnected peripherals putting large common-mode voltages on party lines. Other attention to party-line operation is shown in the new TI 75150 dual-line receiver, with a low input current of under 100 microamperes, according to TI. This permits as many as 100 receivers to be used on a line in bus-operated systems.

Two new parts from TI and Motorola share type number 75113, but they are different. However, both are party-line-oriented. The TI SN75113 is a dual tri-state line driver with differential output for

The Big Sweep 100 kHz-18 GHz.



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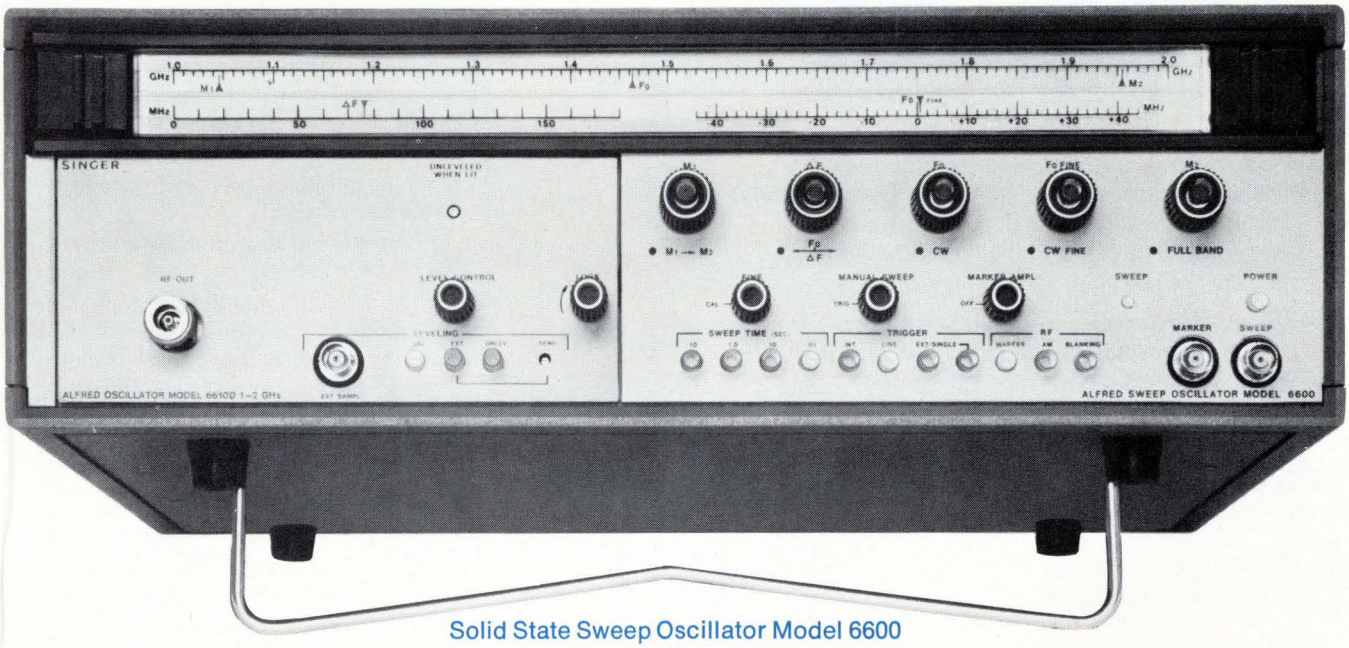

Solid State Sweep Oscillator Model 6600

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driving balanced lines. The Motorola MC 75113 is a single differential party-line driver that takes another approach to disconnecting the part from a bus. Unlike most drivers that have a single current source switched between the two output lines, the Motorola device has a matched current source on one line and a current sink on the other.

The currents are switched on and off in response to inputs, and all drivers connected to a line appear as open circuits unless they are on. Compared to the tri-state connection, this eliminates the need to disable the drivers when not needed to transmit. This also provides twice the differential signal for driving signals over transmission lines nearly four miles long. The balanced currents in the line also reduce crosstalk.

Another factor is reducing costs. Motorola's Campo says, "People are becoming much more cost-conscious." And Howard agrees, "Users want fewer packages—quads, not duals, for example. That's one reason we think our quad MC 1488 and MC 1489 RS-232-C line driver and receiver have become so popular with many second-sources."

Quads and duals account for part of the increased complexity in interface circuits, since these circuits reduce the number of parts and cut user costs. But even further integration is in the works. The leader here is probably TI with its new MSI TTL SN55329W eight-channel driver for core memories. This part, now available only in 24-lead flatpack with a $50.50 price in quantities of 100, is for military applications, as is its complex complement, the 55236 dual sense amplifier and data register, which TI claims is the first MSI sense amplifier produced. Like the driver, it's a military part.

Another way to cut system cost is with combination line-receiver/transmitter circuits. National Semiconductor, Santa Clara, Calif., has announced four such transceivers—all quads and tri-state—called the 7833, -4, -5 and -9. But this increased integration in one package likely foretells other developments, although cost problems with large packages and power dissipation may limit the trend. In fact, Dick Brunner, Motorola applications engineer, sees little need to integrate further.

Second-sourcing is active. Just as increased complexity can reduce prices, so can second-sourcing, with its increased competition. Typical of the second-sourcing in the industry is Motorola's recent introduction of a number of TI sense amplifiers, such as the SN7520 series, line driver/receivers in the SN75107 series, peripheral drivers in the SN75450 series, and memory drivers SN55325. TI, in turn, has introduced its version of National Semiconductor's DM 7820 dual differential line receiver (75782), DM7830 driver (75183), and TTL-to-MOS voltage translators DM7800 (75180). TI is also making the Fairchild 9614 driver and 9615 receiver as the 75114 and 75115. Motorola is planning to introduce its version of the National Semiconductor MH0026

MSI TTL memory driver. from TI comes a new interface circuit for use in high-speed military memory systems.

MOS clock driver in December.

One of the largest growth areas is the interface between MOS and TTL. Until recently, users depended on parts designed for other uses, such as line receivers and drivers. In fact, TI has recently introduced an improved version of its 75107 line receiver and calls it the 75207 sense amplifier, recommended for 1103-type memory circuits. The company has also introduced parts specifically designed to interface with the popular 6002 and 1103 MOS RAMs, neither of which is TTL-compatible. The 75361 drives the circuits, and the 75370 is a dual-bit driver/sense amplifier for the 6002. Motorola is also preparing parts for both the 1103 and 6002. The 1103 ideally requires current sensing, but the 6002 requires a special interface, since the output sits at about 7 volts.

Sense amps and sales. Ironically, although the new MOS-to-TTL parts may cut deeply into the market for traditional core sense amplifiers as semiconductor memories replace cores in many applications, the MOS translators themselves may have a relatively limited life span as MOS parts become low-threshold and TTL-compatible. For the present, however, sense amplifiers seem to be holding up.

Motorola's Campo, who says his company supplies about half the sense amplifiers commercially sold, finds sales up about 20% over the figure of last year. He expects sales to level off in another two or three years. One strength is, oddly enough, sense amplifiers for plated-wire memories. These sensitive amplifiers, with their tight specifications, are popular in Japan, and they are also finding applications in tape heads and disks, strain gages, and bubble memories. TI has just introduced a medium-scale integrated sense amp with sensitivity of 2 millivolts, half that of most core sense amplifiers.

Peripheral drivers have come in for their share of attention. Art Fury, linear product marketing manager at National, says, "Some interface devices don't last too long in these applications because electromechanical loads are destructive to ICs. But we have products in our line such as the LM309 and LM380 that are designed to work with these loads. At Motorola, Howard says that there have been problems operating monolithic peripheral drivers in the safe part of the voltage-current curve because output transistors are pushing IC voltage specifications.

He says that Motorola is working with output transistors having 60-V ratings. Fairchild Semiconductor, as a major supplier of light-emitting-diode displays, is pushing circuits to interface from MOS levels to LED voltages, usually 1.6 V. David Whetstone, computer marketing manager for linears, says that the need for this circuit has picked up as calculator business has grown. The firm will introduce a LED driver with brightness programable with a single resistor. □

Instruments

Manufacturers streamline sales pitch

Direct mailing to engineers and return-coupon advertisements are among new marketing methods seeking to cut costs on low-priced lines

by Michael J. Riezenman, Instrumentation Editor

Although the engineer may pay less for his instruments from now on as instrument makers continue the trend to lower-priced models, this economy is not without its price: The salesman can no longer afford to treat him in the style to which he has become accustomed. As manufacturers try new marketing approaches to cut the costs of sales as they have cut the costs of production, they must modify their customary applications help and repair service—at least for the lower-priced models.

The buyer must carefully evaluate the warranties offered, particularly with inexpensive instruments, because the prices that go with the new marketing approaches leave little margin for service costs. These include direct mail, free trial offers, advertisements containing order blanks, and more widespread use of distributors.

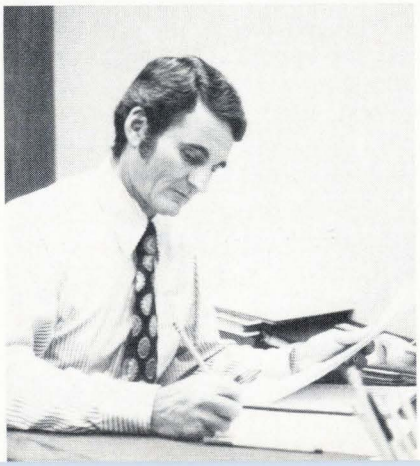
One of the most talked-about instrument success stories of the year is H-P's electronic slide rule, the HP35. That this shirt-pocket calculator in itself has been a success is undeniable; that the credit for its tremendous sales should go to the direct-mail campaign used to market it is not nearly so clear. An H-P spokesman asserts that the company is being flooded with orders for the $395 calculator. But he doesn't know how to compare the success of direct mail with that a sales staff would have had. "How do you compare what you might have gotten with what you've got?" he asks. The spokesman says that, although H-P is considering the mail-order approach for more products, the company will wait to see what success others achieve before proceeding. Then, he says, "if it looks good, we'll do it."

Getting sales costs down. While manufacturers hesitate to try new marketing techniques, the proponents of the direct-mail approach claim that it is one of the few sales methods that can get the cost per sale down to a reasonable level. Raymond Daniel Speer, president of Speer Marketing Services Corp., New York City, for example, says, "Direct-mail is a versatile, strong communications medium in which the timing is under the complete control of the manufacturer, and the freedom for creative expression is wide."

Don Kerr, manager of sales promotion at General Radio Co., Concord, Mass., seems to agree. His company, which has computerized its mailing list, includes qualifying data on each addressee. "Where before, the average mailing to customers interested in noise-measuring equipment might have reached 45,000 people, it now reaches about 30,000, and those 30,000 are more apt to be interested," Kerr points out. GR can program its computer to select addressees by plant size, industry, title, occupation, or other parameters.

Tektronix Inc., Beaverton, Ore., began a direct-mail program for its $800 J16 digital photometer-radiometer late in August, two months after the instrument was introduced. Bob Chamberlain, program supervisor, says that results of the sales program are not yet known. The J16 was chosen as the Tektronix guinea pig for the mail-order plan because, says Chamberlain, "it's simple enough, and it doesn't need a demonstration." Other instruments, he adds, "need a complete technical explanation so a guy can understand their full capabilities."

Although the J16 direct-mail pro-



Throwaway. Fred L. Katzmann (right) president of Ballantine Labs, feels that new warranty concepts are needed for low-cost instruments. James F. Helfrich (below), marketing manager at Dana Labs, speculates that throwaways may be the answer.

gram is the only new plan actually under way, Tektronix is looking into other "alternatives to reducing our field-engineering efforts," Chamberlain says. William Buecker, head of corporate advertising at Tektronix, says that that a sales force for low-priced instruments may be eliminated entirely. Most other manufacturers are more cautious when it comes to direct-mail advertising. Richard M. Haddad, Vice president of marketing at Krohn-Hite Corp., Cambridge, Mass., for example, notes that sales representatives start complaining about the cost of sales when the price of an instrument drops to about $300. "I frankly foresee problems in sales of low-cost instruments and have not come to a clear conclusion as to how they are going to be solved," Haddad says.

Confidence. "One partial solution," Haddad suggests, "could be increased dependence on the combination of advertising and direct-mail selling. This implies customer confidence—he must believe in you and your product before he'll fill out an order blank and send it off. Free trials also will be of some help here."

Some manufacturers are using advertisements that include order blanks, which the reader is asked to fill out and mail. The John Fluke Manufacturing Co., Seattle, Wash., is using this approach and others to market its new model 8000A digital multimeter. The $299 instrument is being offered on a 15-day free-trial basis, and can be paid for by check, company purchase order, or one of several credit cards.

But the new marketing approaches are not without problems. One problem that William R. Weir, marketing vice president for Weston Instruments Inc., Newark, N.J., notes for all direct-sales approaches is that above some fixed level—usually $250—buyers consider instruments capital equipment, not expense items. That means a lot of extra paper work for any engineer who'd like to submit a simple order blank to a manufacturer for fast delivery of an instrument. Therefore, while evaluating various new approaches, Weston is sticking with its distributors, at least for now.

Weir's attitude is shared by J.E. Niebuhr, instrument group marketing manager for Systron-Donner Corp., Concord, Calif., who has been giving a lot of thought lately to marketing low-cost instruments. Most of this company's products are sold through factory salesmen and representatives, but, he adds, "for a $200 sale, it's hard to convince a salesman to do it."

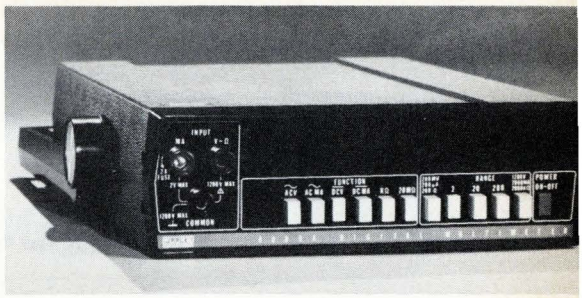
He admits that "more innovative marketing techniques are needed." In searching for these new techniques, Systron-Donner tried the mail-order approach, but, says Niebuhr, "it doesn't replace a distributor."

Will reliability suffer? Whether manufacturers choose direct-mail, order-soliciting ads, distributors, or something else, the thing the user must weigh carefully is the effect the new marketing methods will have on service—especially on warranties.

"Inexpensive doesn't mean unreliable," says Albert Oliverio, marketing manager for H-P's electronic product group in Palo Alto, and most other manufacturers agree. However, even the most reliable product will suffer a certain percentage of failures, and if the manufacturer must repair a faulty unit during its warranty period, his cost for doing so must be reflected in the instrument's price.

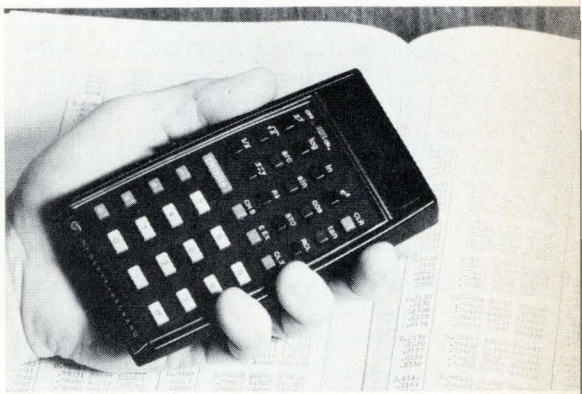
"In effect," says Fred L. Katzmann, president of Ballantine Laboratories Inc., Boonton, N. J., "putting a long warranty period on an instrument is equivalent to forcing the customer to take out an insurance policy on it—whether he wants one or not." On an expensive instrument, the price of this insurance premium is a small fraction of the total cost, but, Katzmann points out, the minimum cost of any service call associated with a malfunction is pretty much the same, regardless of the price of the instrument—about $50. Hence, the warranty costs of a low-priced instrument look big when considered as a fraction of the total selling price.

Katzmann points out that some manufacturers get around this problem by spreading the costs of in-warranty repairs over the pricing of their entire product line. This effectively makes the purchaser of expensive instruments pay for repairs on the cheapies, he says. Since this is patently unfair, and since the whole name of the low-cost game is to keep prices pared to the bone, Katzmann feels that the only solution is a different warranty concept for low-cost instruments.



Free trial. Fluke's 8000A digital multimeter is being offered on a no-obligation 15-day trial basis by ads that solicit orders directly.

To market. Whether the success of the HP35 calculator can be attributed to H-P's use of direct mail cannot yet be determined.



The warranty on his company's new $325 80-megahertz counter, for example, provides for free servicing for 90 days and a fixed-fee repair charge of $35 for the remainder of the first year. The $35 fee, coupled with a maintenance and calibration section in the operator's manual, provides an incentive for the user to undertake simple repairs himself.

A clue about the direction in which low-cost instruments may be heading can be gleaned from a comment by James F. Helfrich, marketing manager at Dana Laboratories, Irvine, Calif. Dana which has been offering low-cost instruments for three years, thus far has offered the same warranty and service on its low-cost line as it does on its more expensive products. "But," Helfrich says, "the way these low-priced instruments are going we may eventually get to the throwaway stage." □

Communications

AT&T moves to capture data market

The Bell System's entry into data communications seems likely to get FCC approval by April, when the plan is to start building a 96-city network

by Ray Connolly, Washington bureau chief

Success appears likely to bless the Bell System's effort to gain the Federal Communications Commission's approval of its entry into the data-communications business by April 1973. And if it does succeed by then, the American Telephone & Telegraph Co. New York City, plans to have a nationwide Digital Data System linking 96 cities in operation by 1976, say sources in the communications industry and the White House Office of Telecommunications Policy.

FCC approval is particularly likely in view of the Nixon Administration plans for creating a stronger business-oriented majority at the commission. Speculation is that a reoriented commission will approve in principle the AT&T application to interconnect Boston, New York, Philadelphia, Washington and Chicago as the beginning of its network using Bell's data-under-voice (DUV) technique [*Electronics*, Oct. 25, 1971, p. 34]. This will leave the resolution of the stickier issue of what represents "fair competition" and the related questions of cross-subsidization of services by AT&T to a more prolonged inquiry.

"There is about five years of work for lawyers in Washington in the chewing over of the whole subsidization issue," says John Sodolski, communications and industrial division vice president at the Electronic Industries Association, Washington, D.C. Nevertheless, he believes other specialized carriers like Microwave Communications Inc., who will be offering broader chunks of bandwidth than with DUV. "will be able to compete" with AT&T. "It will be like selling computers against IBM—it's hard, but it can be done."

However, James J. Lenehan, vice president of Collins' Microwave Div. does not believe AT&T will hamper the growth of specialized common carriers. "I would suspect that AT&T just wanted to show that it was aware of what was happening in the marketplace, and wanted to show its stockholders and the industry that it was going to take an aggressive posture," he says. "But I don't think that this will affect the viability of the MCIs and Datrans," Lenehan insists.

AT&T Long Lines officials say the company doesn't expect to file with a new tariff for the Digital Data System until market studies are complete and that this could take "about six months" after FCC approval of its entry into the private-line digital market. But their competitors are expected to challenge them on this point before the commission. Says one, "How can the commissioners judge the 'fair competition' issue if no one knows what it will cost?"

Speculation that AT&T may be asked to set up a separate corporate entity for its DDS is an issue AT&T says it has "under consideration." Still, the company makes clear it is not anxious to do so, noting it is "quite pleased with the way we are meeting the needs of data users" with the existing organizational structure.

There is also the possibility, according to Washington sources, that the FCC will grant AT&T approval of its data system, provided the communications giant agrees to chop off Western Electric, its manufacturing arm. But AT&T is expected to fight such a proposal, and "resolution of that point could take years," says an FCC source.

Technologies. Through the data-under-voice (DUV) technique, its initial approach to digital transmission, AT&T says it will use "a new

Equipment suppliers have other worries

The prospect of competition from AT&T is arousing surprisingly little concern among other U.S. communications-equipment manufacturers. They are presently much more worried by competition from foreign suppliers offering appealing credit terms on the microwave hardware needed by U.S. specialized carriers—terms that U.S. makers cannot match.

"We are concerned that large, foreign, government-supported electronics industries can come into this country and get a foothold that could affect our day-to-day business," says James J. Lenehan, Microwave division vice president of Collins Radio Co., Dallas. "We have to be very aggressive and come up with something to counter it," he says, noting that Collins' recent contract with MCI included some financing.

Nevertheless, General Electric of England recently became the third foreign vendor to supply MCI with hardware financing, following CitCom Systems of France and L. M. Ericsson of Sweden. Dallas-based University Computing Co.'s specialized carrier, Data Transmission Co. of Vienna, Va., says it is still negotiating with Nippon Electric Co. of Japan and other "vendors" for hardware in its proposed switched digital net [*Electronics*, May 22, p. 49].

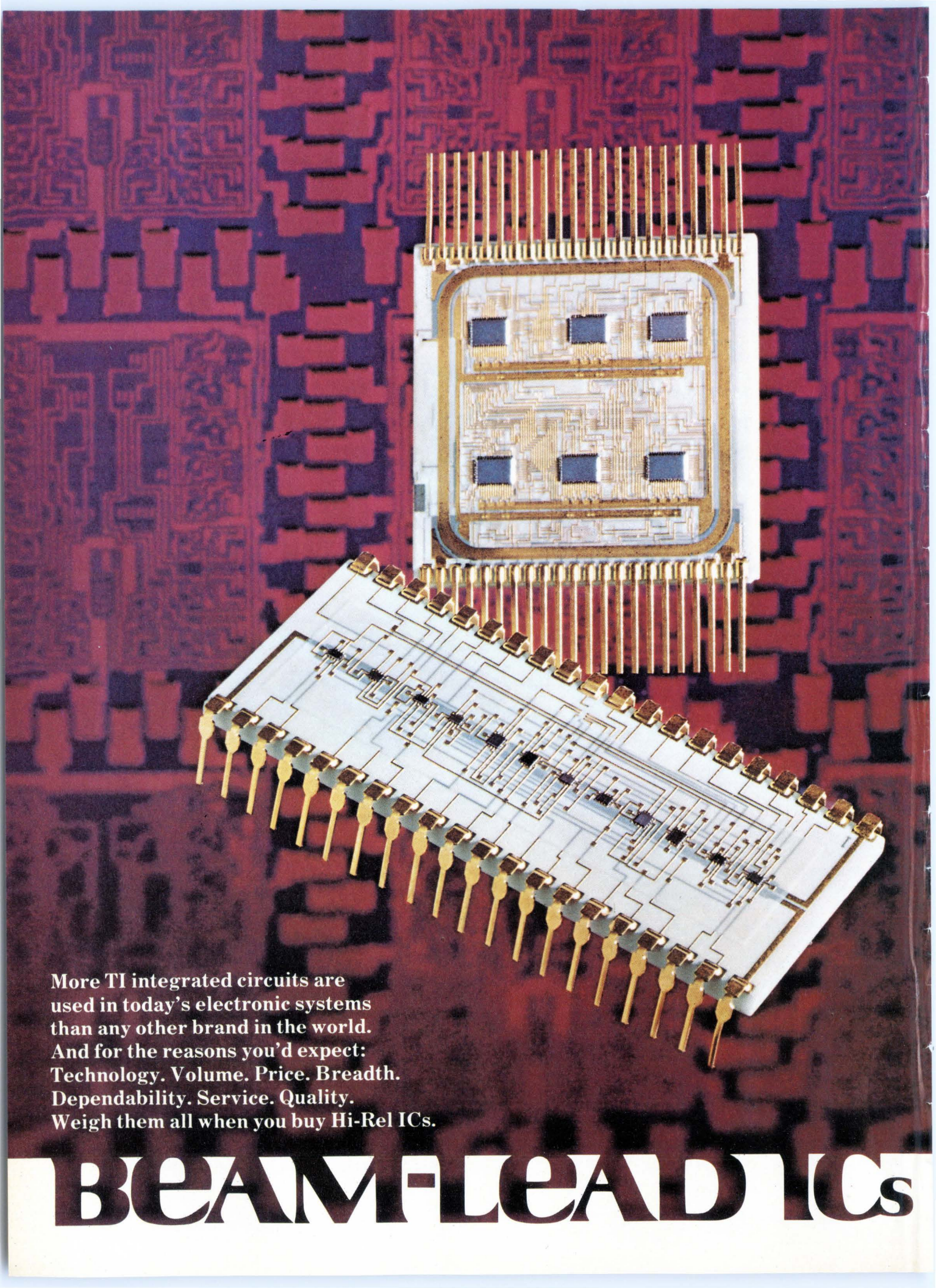
terminal developed to convert a digital bit stream into a form suitable for transmission in an otherwise unused portion of the bandwidth on existing 4-gigahertz and 6-GHz microwave radio channels." Without displacing any existing analog channels on existing microwave radio relay systems, a DUV digital channel group of 1.544 megabits per second could comprise as many as 460 data channels at the slow 2.4-kilobits-per-second transmission speed. The digital channel group, says AT&T, "is compressed into a 444-kilohertz bandwidth for transmission over each radio channel in a microwave route." In a fully developed microwave system of 18 radio channels, a data rate of 27 Mb/s can be transmitted.

Within one year of establishing its service between two adjacent points on the initial five-city net, AT&T says multipoint service would be offered. This would provide full duplex, synchronous end-to-end digital transmission.

Beyond DUV. Looking farther into the future, AT&T says it is considering up to six other transmission techniques for its DDS network beyond DUV. These are:

- 6.312-Mb/s digital lines for digital voice channels over repeated wire-pair cables on distances up to 500 miles.
- A 13.29-Mb/s coaxial master group digital system.
- A 20.2-Mb/s digital radio system.
- WT 4 digital transmission lines on coaxial cable.
- An 18 GHz digital radio link that would be "operational in the latter half of the decade."

Cost of DUV links between the initial pairs of five cities will run to about $1.3 million, says AT&T, a figure it contrasts with the $2.2 million that would be required to add an equivalent number of data channels without using the data-under-voice technique. The new facilities, including four outside repeater plants, will be capable of "economically and efficiently" handling such services as "series 8000 channels for transmission of 50-kb/s data, trunks for the Data-Phone 50 service, high-speed data channels such as 1.344-Mb/s or 1.544-Mb/s channels, and for other uses which may be developed in the future." □



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- Reduced system heating.
- Low power supply requirements.
- Lower system costs in production phase.

Choose from 13 standard MSI functions and a semi-custom random logic bar

Basic building blocks of the line are 13 standard MSI functions with average gate speeds of 10ns at less than 2mW power dissipation. TI's low-power Schottky TTL technology provides a speed/power product of 20 picojoules... MSI design permits high density and lower system costs... and beam-lead fabrication eliminates wire bonds for increased reliability. Hermeticity is accomplished at the chip level by a silicon nitride barrier layer in addition to standard hermetic packaging techniques.

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* Trademark of Texas Instruments Incorporated

Beam-lead chips off-the-shelf

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Description	BEAM-LEAD CHIPS	Typical Speed/Power	100-piece Chip Price
BL54LS95A	4-bit right shift register	30MHz/52mW	$15.50
BL54LS138	3-to-8 line decoder	20ns/30mW	13.20
BL54LS139	Dual 2-to-4 line decoder	20ns/35mW	13.20
BL54LS153	Dual 4-to-1 line data selector/multiplexer	15ns/35mW	9.90
BL54LS155	Dual 2-to-4 line decoder/ demultiplexer	20ns/30mW	15.50
BL54LS181	Arithmetic logic unit (ALU)	30ns/105mW	37.00
BL54LS193	Synchronous up/down 4-bit binary counter		24.50
BL54LS194	4-bit bi-directional universal shift register	30MHz/60mW	15.65
BL54LS195	4-bit parallel-access shift register	30MHz/52mW	15.65
BL54LS196	50-MHz divide-by-5 presettable decade and binary counter/latch	30MHz/55mW	21.30
BL54LS197	50-MHz divide-by-2 presettable decade and binary counter/latch	30MHz/55mW	21.30
BL54LS253	Dual 4-to-1 line data selector/ multiplexer with tri-state logic	20ns/45mW	11.90
BL54LS295	4-bit right/left shift register with tri-state logic	30MHz/60mW	18.55

Beam-lead IC technologies

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For more information

Call your local TI sales engineer for details on TI's custom beam-lead assembly capability. For product literature, including data sheets on standard catalog chips, circle 243 on Service Card. Or write Texas Instruments Incorporated, P.O. Box 5012, M/S 308, Dallas, Texas 75222.

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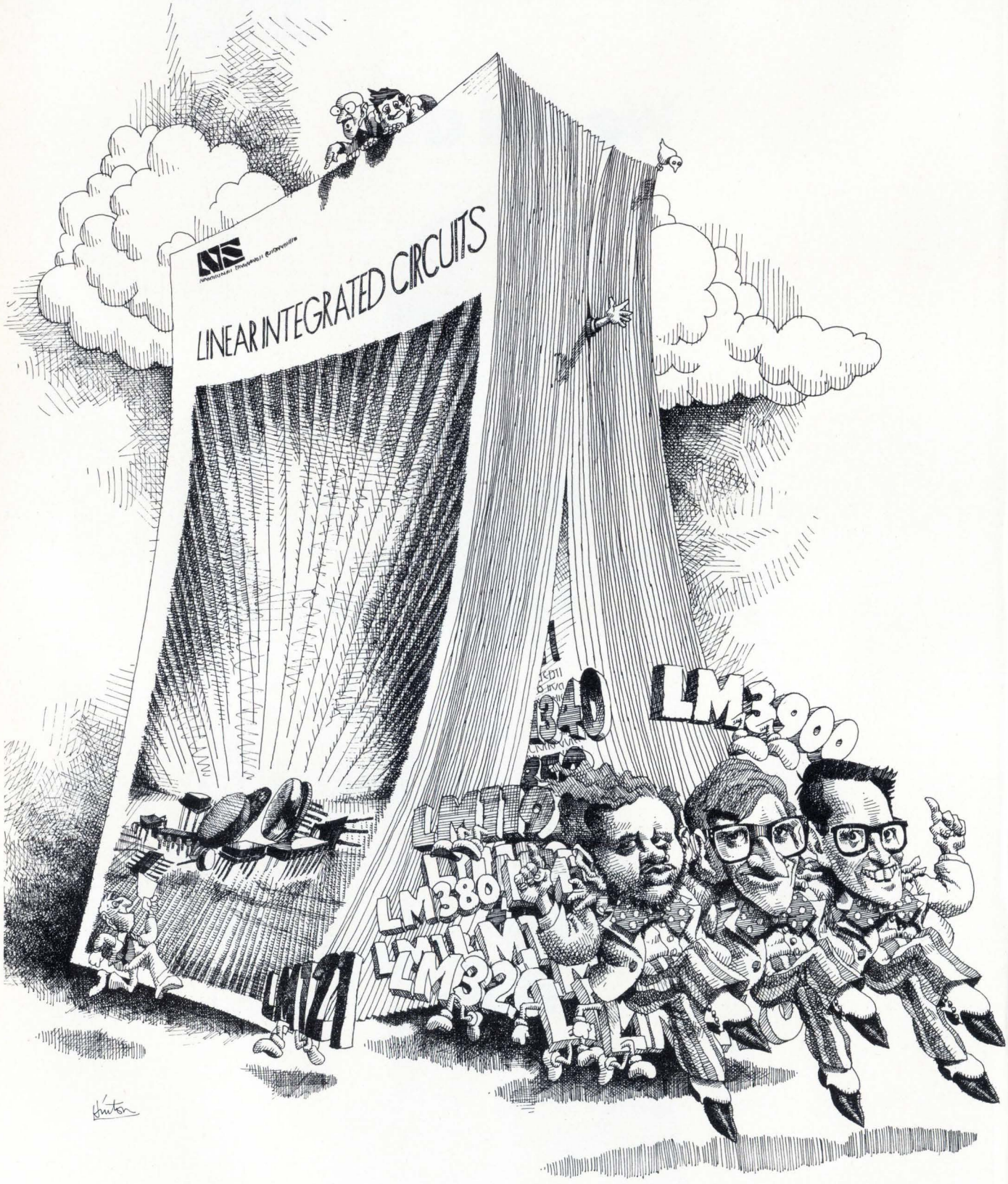

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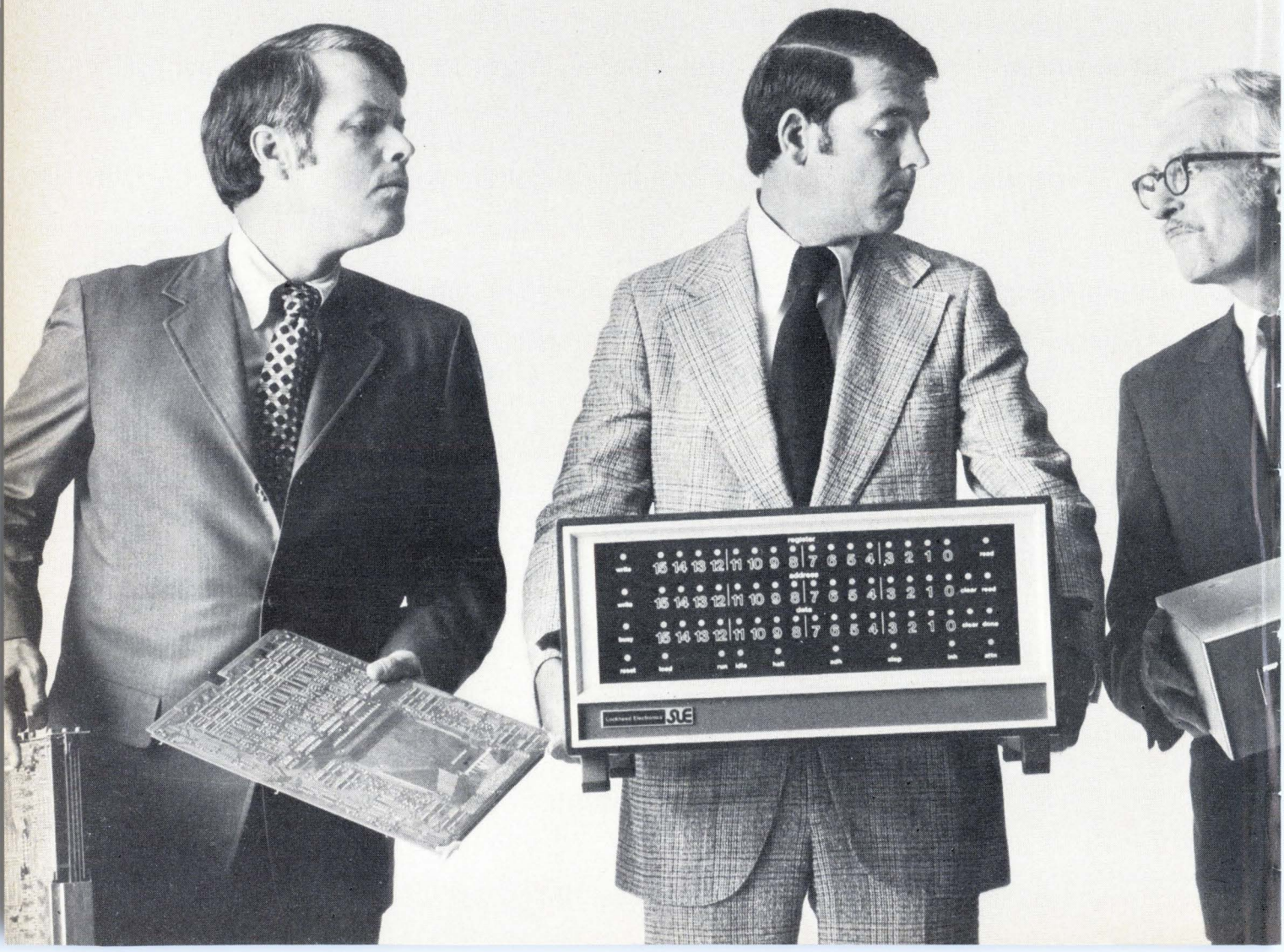

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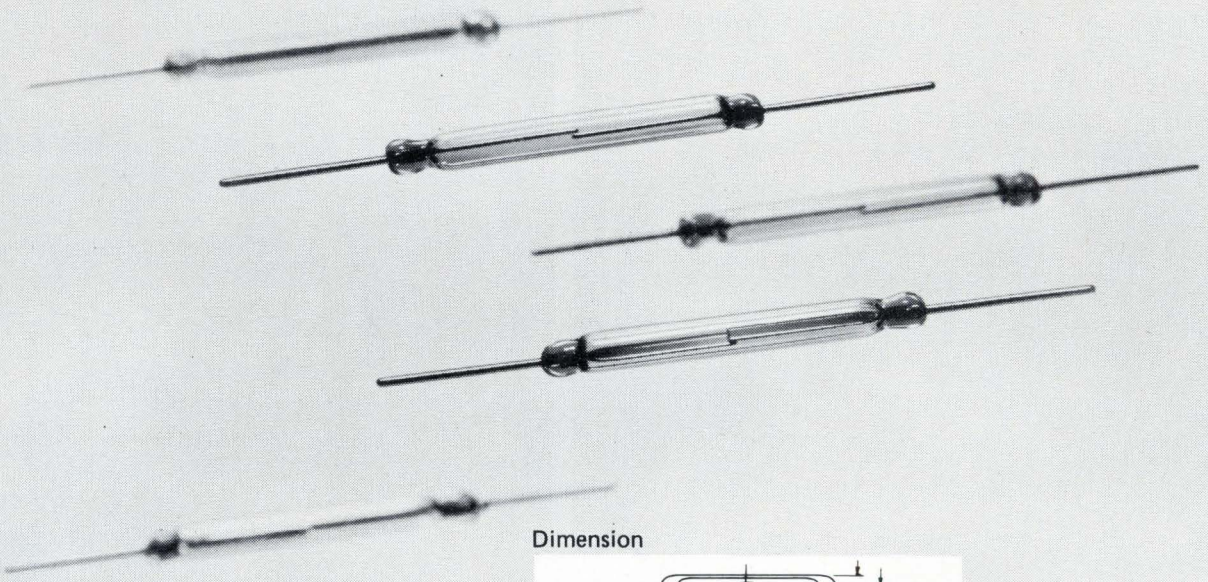
Dielectric Withstanding Voltage	600 VDC		



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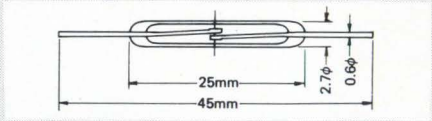

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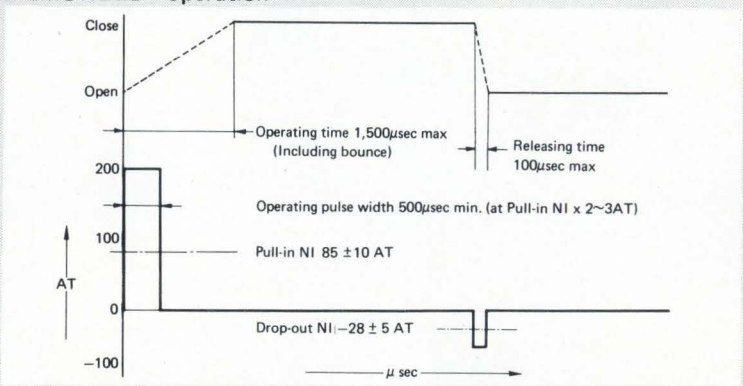

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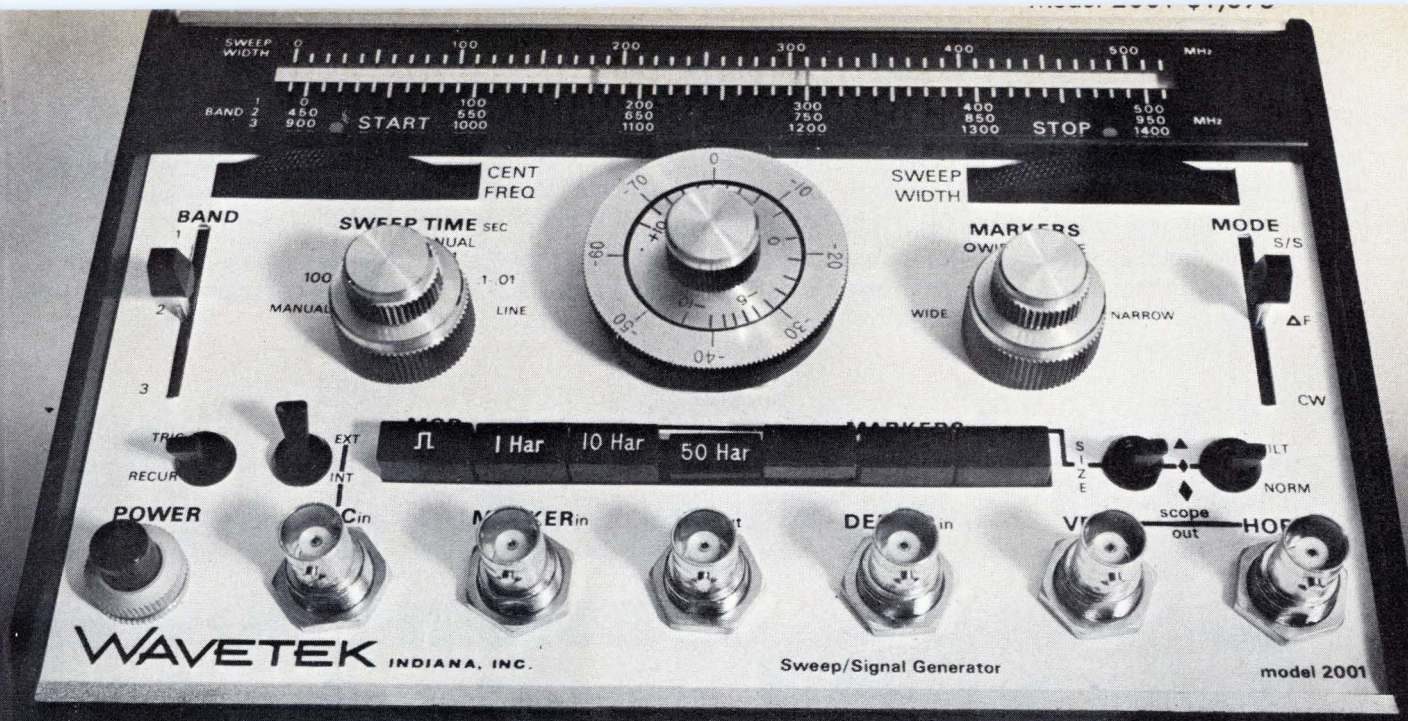

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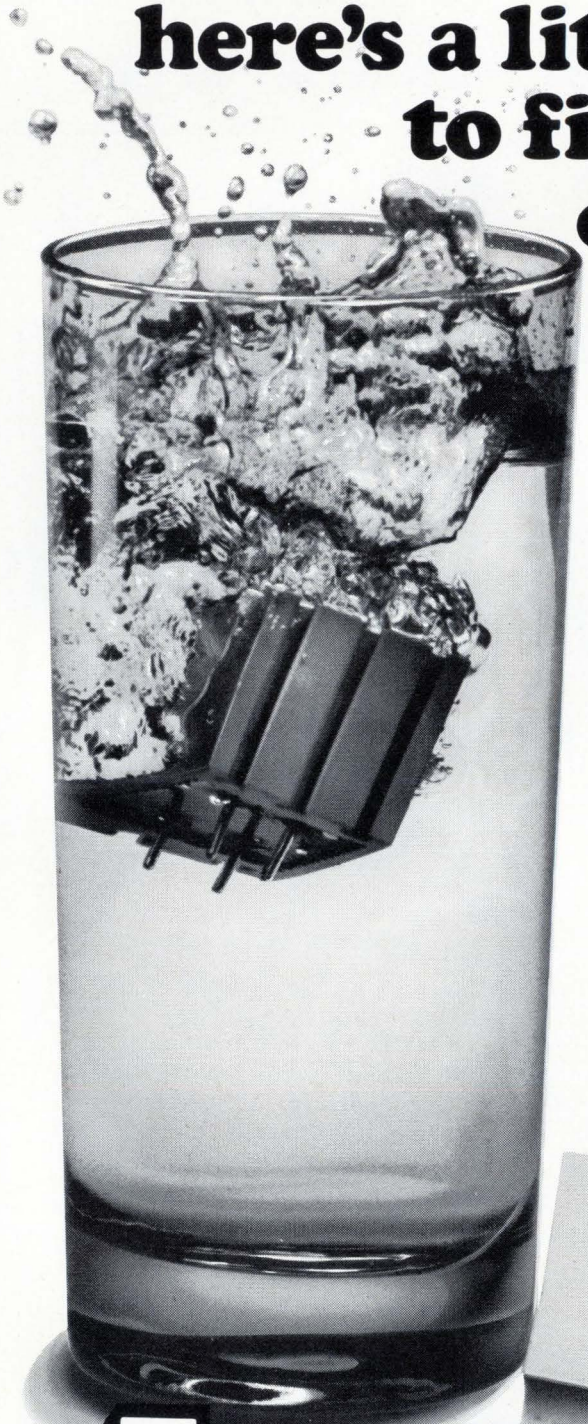
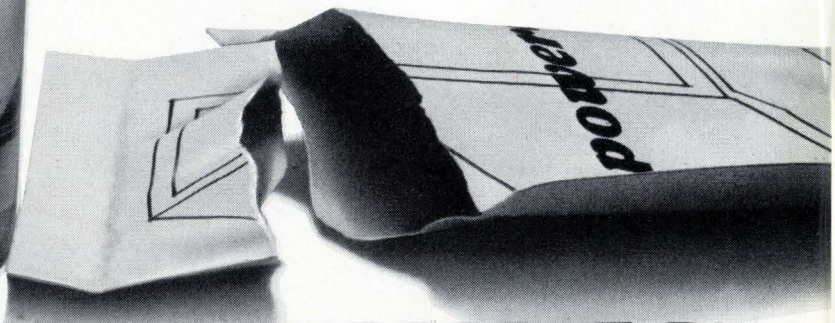


take one or two or three...



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Special report

Japanese electronics rebounds after two years of adversity

Industries predict that 1973 will mark resumption of solid growth after breaking about even this year; communications and computers have bright potential next year; 'post-color TV' worries consumer firms

by Gerald M. Walker, *Consumer Editor,* and Charles Cohen, *Tokyo bureau manager*

Special report

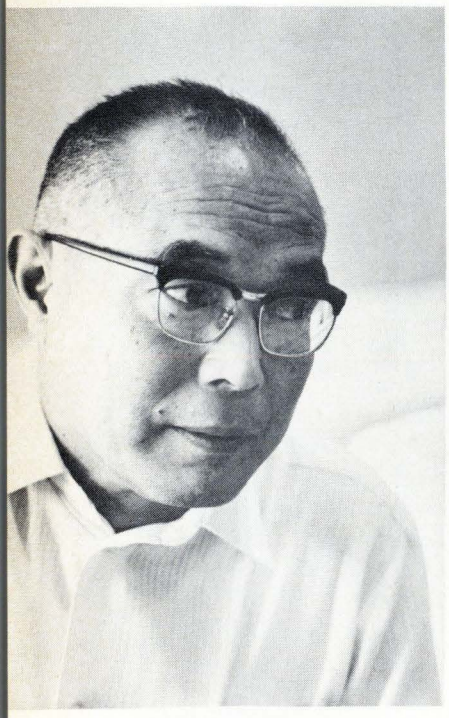
☐ The economic tremors that have rocked Japanese electronics industries for the past two years have subsided. The conscientious Japanese have turned 1972 into a recovery year, and they are confident that business will resume profitable growth in 1973, although the electronics industries may not match the remarkable expansion of the 1960s.

Revaluation of the yen, the culmination of the "Nixon shocks," rattled the domestic economy, which is accustomed to unhindered growth, at a time when it was depressed. And the revaluation made the nation's precious overseas markets difficult to hold as Japan's price advantage, particularly in consumer products, was narrowed. The nation's woes were compounded by the well-ordered society's emerging clamor for control of the pollution that has accompanied its industrialization binge.

As a result the electronics industries had been lost in a fog. But now that fog has lifted, says Tamefusa Onoye, executive director of the Electronic Industries Association of Japan. Although they have not been great, the past 12 months have not been as disastrous for electronics as many had feared a year earlier.

The economic consequences of the most important political event of the year—establishment of diplomatic relations with mainland China, and thus the end to formal recognition of Taiwan—are not yet clear. It appears that, despite Taiwan's howls, electronics business will continue as usual between the two nations. On the whole, Japan's electronics industries are not deeply enough imbedded in Taiwan to be crippled, should conditions deteriorate. One Japanese executive likened Taiwan operations to having a plant burn down—a problem, but not a disaster.

Mitsuo Kawasaki, (left) EIA-J chief of statistics, believes that "international division of labor" will mean more Japanese plants overseas.



Tamefusa Onoye, (right) EIA-J executive director, says that the fog over the industry is lifting, business was not as bad as feared.

China market limited

As for Red China, the electronics industries are not carried away by dreams of opening a vast new market. China has made it clear that its first interests are for industrial plants and heavy vehicles. If anything, electronics firms have cause for concern. "What happens," a consumer-firm executive muses, "when the Chinese begin to export cheap radios and TVs made with Japanese plant equipment? We may be cutting our own throats."

Soon after the yen revaluation, with the attendant decline of consumer-product exports to the U.S., outside observers predicted a Japanese push toward the less-saturated European markets. But that hasn't happened to any significant extent. Instead, Japanese executives are talking about international division of labor. It's an updated version of an old economic concept based on the premise that every country should produce only what is economically feasible—high-labor-content products in developing nations, high-technology products in advanced countries—and then market these products freely throughout the world.

The result is two parallel movements, observes Mitsuo Kawasaki, chief of statistics and research section of EIA-J. On the one hand, companies will continue to invest in offshore production facilities to shift labor-intensive products away from steadily rising Japanese labor costs. On the other, as overseas markets have grown, it becomes more efficient to build assembly plants within those markets, rather than shipping finished products. This trend will continue in the United States and Europe, particularly because another revaluation of the yen some time in 1973 is virtually certain.

Despite solemn declarations from the politicians and a new five-point plan to defend the yen at its present level, revaluation is so probable that companies have gone to a kind of double value in planning—what the yen is worth now, and what it may become next year. Japan's favorable trade balance is a real embarrassment because it increases the pressure to raise the value of the yen in relation to the U.S. dollar. Efforts to lessen the pressure by boosting imports of manufactured goods, such as a "buy-American" campaign, appear to be too little to stave off another currency change; however, it's clear that this time it won't be a shock.

R&D must continue

Confidence restored, Japan's electronics industries are not satisfied simply with recovery. The country is on the same technological bicycle that the U.S. is riding, and it can't afford to stop pedaling. So in 1973, expenditures for R&D will increase. No longer content to play catch-up with American technology, Japan's giant enterprises are gearing to take over leadership wherever they can. They plan to jump off the springboard in 1973.

However, the country's star performer, the consumer electronics sector, has been slow to recover. And next year's sales may also register a flat curve. Unfortu-

nately, a lag in exports has compounded the problem.

But there is cause for optimism in semiconductors and the computer industry. To stimulate growth, the Ministry of International Trade and Industry (MITI) has guided the reorganization of Japan's six major computer manufacturers into three joint efforts and sweetened the deal with a 34.1-billion yen ($113.67 million) subsidy, to be meted out over the next three fiscal years.

Japanese semiconductor manufacturers, who have been struggling to catch up to American producers, claim that they are over the hump in MOS LSI development. They boast that they will have a 50% share of domestic sales this year. Booming production of electronic calculators, together with the promise of big watch and auto semiconductor business in the near future, have stimulated the Japanese companies to produce integrated circuits that are in the same league with those of American competitors.

The industrial sector has had less reason for optimism because of a slow-down in plant expansion, particularly by the metal and petrochemical industries. Yet Japanese industry, smarting from rising labor costs, is automating by necessity. At the same time, there is a demand for pollution control, although the standards are still unclear. These trends offer a silver lining for industrial-control systems.

Communications firms, on the whole, probably prospered most during the depression, primarily because Nippon Telegraph and Telephone Public Corp. kept right on spending for telephone switching, microwave, and cable installations, while overseas demand from underdeveloped nations remained steady. With a healthy waiting list for telephones and plans for extensive data-communications networks, the telecommunications industry's main worry appears to be how fast it can fill orders.

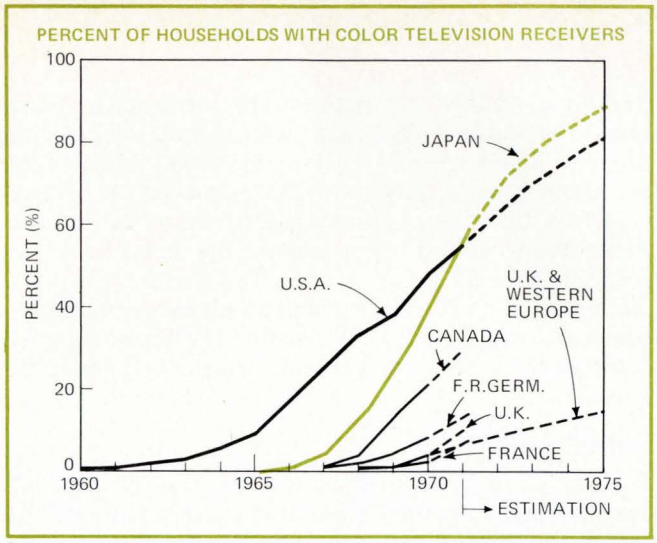
Sharing in the prosperity has been the National Space Development Agency of Japan (Nasda), which has enjoyed a skyrocketing budget in the few years it has been in operation. The latest budget calls for an 80% increase in funds up to 18.7 billion yen ($62.3 million), primarily to orbit weather and communications satellites.

On the other hand, Japan's defense agency, left hanging for a year, is still waiting final approval of a new and controversial five-year spending program, finally endorsed by Premier Kakuei Tanaka. Although the proposal would double defense spending over the next five years, many wonder if Tanaka has enough clout to ensure passage. Political rapprochement with mainland China has made defense spending unpopular among legislators, which could hold up approval for a time.

Consumer: After color TV, what?

"Color is forever!" confidently proclaims Noburu Yoshii, senior managing director for Sony Corp. This sweeping statement contradicts the evidence shown in this year's consumption chart [p. 106] that color television sales have leveled off at about $1.8 billion and the consensus that color TV sales will approach saturation by 1973.

Because color TV accounts for the bulk of consumer electronics sales, the industry may take heart from Yoshii's startling opinion. And despite the buffeting of prices, the U.S. continues to be Japan's favorite consumer export market.



Saturation. Statistics show the challenge presented to Japanese TV makers—Japan and the U.S. are approaching saturation, while the European markets are difficult to penetrate. Growth of two-set homes and replacement sales are expected to prop up profits in '73.

However, one of Yoshii's colleagues at Sony, Heitaro Nakajima, managing director for audio equipment development, asserts that the expected leveling off of color-TV sales provides an opportunity to turn attention to another important and fast-growing product line—audio equipment.

Whatever the status of color TV, Yoshii's reasoning deserves close analysis. First of all, he views the statistics as dangerously misleading because he predicts the color receiver soon will become a ubiquitous communications terminal, in addition to its role as an entertainment medium. The set, he contends, will provide several services, including those provided by the home video player. In addition, he points out that both monochrome TV and audio tape recorders continued to grow long after having supposedly reached saturation.

"In the end, the TV screen will be the final medium," Yoshii explains. "Every house, schoolroom, hotel room, and waiting room will have a set. Conventional market analysis considers the maximum number of households as the saturation point. Instead, think of the maximum number of rooms. We don't like the idea of 'post-color.' There will be two wheels of information exchange—the color monitor and the VTR together."

Nevertheless, stimulating color sales is a real problem until the home video player becomes a viable consumer product. Right now, manufacturers are counting on replacement sales and growth of two-set households to tide them over. But the problem is that, while unit sales may be up, value per set has dipped. In addition, home installation of color sets should be at 70% to 75% at year's end, and 80% by the end of 1973. Considerable effort is being expended to develop add-on features to increase the yen-value per unit and improve picture quality to speed up dissatisfaction with older models.

Remote tuning is one of the refinements that may be-

gin to pay off this year, thanks to performance improvements. Matsushita Electric Industrial Co., for example, has developed an infrared remote device slated to sell for about $50. An infrared signal is picked up by a receiver on the TV set. Although designed to be more reliable than other remote tuners, the hand-held unit must be "aimed" at the receiver. The General Corp. has started selling a 20-inch TV with an ultrasonic controller that has a telephone-like dial with 14 holes for channels 1 through 12, plus one each to increase and lower the volume.

Gadgets added

Sharp Corp. has introduced an electronic channel display to flash a channel number that covers almost half the screen for 1.2 seconds after tuning. This feature, which adds $17 to $27 to the price of the set, is available in three models, two of which have remote tuning. The display should help sell more remote tuning sets.

Tokyo Shibaura Electric Co. (Toshiba) has just announced an IC digital selection system in a 20-inch color set and plans to start sales in February. The 500-plus-element MSI device, a first in Japan, adds more than $30 to the selling price. Not to be outdone, Matsushita promises to have available "a revolutionary-type" digital tuner that a team from three separate R&D labs has taken two years to develop. Hayata Tokizane, managing director of Matsushita's Television division, promises that the tuner, to be available early next year, will perform an order of magnitude better than previous electronic tuners and will handle both vhf and uhf. The company has not priced it yet. The channel-selector portion of this design was revealed last June. It has a "binary" memory corresponding to channel numbers and a "decoder" circuit on MOS LSI devices.

The other major effort among TV manufacturers has been directed toward picture tubes. The 110° deflection tube has spread rapidly through all product lines. Sanyo Electric Co. plans for 90% of its 18-in. and 20-in. color sets to have 110° tubes by the end of this year, and some 14-in. models will join the ranks by mid-1973. Sony, meanwhile, has brought out a model with 114° deflection, scoring merchandising points by advertising "the plus 4°." Toshiba also has 110° tubes in nearly half of its large-screen sets. Space-saving offered by these tubes is a definite selling point for the typical small Japanese home.

Sony's stripe-format in-line-gun tube is being challenged. Toshiba says its "brick-wall" shadow-mask tube can be made with black matrix surround, and it is not limited in screen size. The Hitachi Consumer Products group is featuring tubes in which dots are baked on the faceplate with a multifacet correction lens for improved registration at the periphery. Mitsubishi Electric Corp. and Matsushita also use the black-matrix-surround tube. The next major push by the TV companies will most likely be toward flat-screen picture tubes.

Circuit integration continues

As for the application of integrated circuits, the consensus is that fewer or the same number of circuits in the next year's chassis will probably perform more functions. Color processing now accomplished by three separate ICs can be combined into one. Most sets already have six to 10 ICs of 40 to 50 elements each. Next, there will be six to 10 with 50 to 150 elements each. A larger scale of integration had been artificially stimulated by an anticipated tax break favoring sets with a certain percentage of ICs. However, when this reduction failed to materialize, manufacturers dropped some ICs that are not economical.

Not much can be said for black-and-white television these days. The decline in sales has continued as expected. Price cuts and way-out cabinet designs have superseded new features in the last significant years of monochrome. Developing countries still constitute a market, but they demand on-site plants and oppose im-

Keiichi Takeoka, Matsushita Radio & Stereo division, expects cassette/radio combinations to increase sales in '73.

Noboru Yoshii, Sony Corp. senior managing director, confidently predicts that "color is forever," despite the leveling of sales.

Heitaro Nakajima, Sony audio, has an 80-man research center striving for improvements in components, starting in '73.

ports, which doesn't help the situation much.

The word in home video players and player-recorders now is that it will be two to three years before popularly priced units reach consumers, and then significant growth will not proceed unless there is enough quality software available. All the major consumer manufacturers are working on VTRs and researching disk systems, but as Masao Matsumoto, head of Matsushita's Recording Instruments division, admits, every system has some drawback—in picture quality, ease of use, reliability, or economics. The simple fact is that reducing the price depends on quantity production, and that, in turn, depends on heavy demand. "An Olympics" may be necessary to stimulate sales of home video systems, Matsumoto jests. He is referring to the 1964 Tokyo Summer Olympics, which in one shot skyrocketed demand for color TV receivers in Japan. What form such a sales stimulus for VTRs could take is not clear at present.

This year, institutional-industrial users continued to be the only significant market for VTRs, in the same way as the audio tape business got its start in schools and offices before becoming consumer-oriented. And next year should be much the same, as the major companies jockey for a position with all their contending video-player types. After that, it will be up to the Japanese consumer which system will generate the greatest demand.

Four-channel sound moves

Unlike VTRs, four-channel sound—the new hope for the audio market—has begun to move. The contending disk techniques are Victor Co. of Japan's CD-4 discrete, CBS/Sony SQ (stereo-quadraphonics) matrix, and Regular Matrix, which is being marketed by a number of Japanese manufacturers under various trade names. As in the U.S., Japanese equipment manufacturers have had to design products capable of playing all three—or at least both matrix methods and CD-4 with an adapter. Promotion has been heavy in four-channel, and consumers packed the demonstration booths at the recent Japan Electronics Show in Tokyo. With more programing becoming available, hardware companies expect 1973 to begin paying off on the four-channel investment, with forecasts of up to 30% increase in sales over 1972 levels.

To help tip the balance toward choice of its CD-4, Matsushita is selling for $135 a demodulator and cartridge with stylus to convert from matrix to discrete four-channel operation. This combination with a turntable sells for $199.95, including two Victor records to get the buyer off and playing. Which of the contending techniques will come out on top is still anybody's guess. Once again it will be up to the pampered Japanese consumer to decide.

Individual hi-fi components, which have been the best sellers this year, have received most attention from manufacturers in the new lines. Hi-fi components sales should rise to 32.6 billion yen ($109 million) in 1973, an increase of a quarter over the 1972 level, according to the manufacturers' consensus. Although ensemble (console) sales are declining, the modular stereo radio/phonograph units should boost sales.

Super-research

The giant monolithic enterprises that make up the backbone of Japan's electronic industries are somewhat like Sumo wrestlers—sometimes cumbersome and unwieldy, but at other times surprisingly light on their feet. How to keep these companies growing through production and sales, and yet remain quick and strong in engineering advances, has been a problem besetting research managers for some time.

In American terms, it's the age-old problem of the left hand's not knowing what the right is doing. For a manufacturer as large and as diversified as Matsushita, the problem has become more difficult because of the rapid change in technology and the pressures of worldwide marketing.

Matsushita has all of 60 manufacturing departments in 17 divisions working on R&D that in some cases requires interface among three or more groups. To keep on top of the key programs requiring interaction, the company recently organized a Product Planning division, headed by Dr. Shunkichi Kisaka, one of its youngest top executives.

His job is to coordinate the interdivisional projects, and he now has 27 such programs going. He is empowered to shift resources and funds among the research groups to maximize the results; that is, speed to the market the products that will sell.

One successful multidivisional project was development of four-channel recording equipment. It involved the work of four or five different labs, together with Victor Co. of Japan, developer of the recording system. The Stereo department developed the cartridge, and the Wireless Research Laboratory and the Acoustic Research Laboratory worked on noise reduction. It ended as the Radio and Stereo division's product.

On the other hand, before the new organization was formed, Matsushita's industrial electronics subsidiary, Matsushita Communication Industrial Co. Ltd., was late in entering the fast-moving calculator business, Kisaka points out, because there was a lag in LSI development by the semiconductor subsidiary. This is where the super-research group comes into play.

There may be hundreds of projects under way that do not require outside help because the individual divisions have enough resources of their own. So the Product Planning division's job also involves knowing when to keep hands off.

Lower-priced versions of components have also reached the market to cash in on this popularity. A few companies, such as Sanyo, have added a microphone to allow users to sing along with recordings, a gimmick that should prove to be popular on the domestic market. (The Japanese love of singing is so strong that a Tokyo newspaper recently wrote an indignant editorial defending the non-singing minority's right not to warble at social outings.)

Audio development pushed

Sony's Nakajima is taking the leveling of color TV sales as an opportunity for further audio developments. In September, Sony launched an 80-man audio R&D lab to occupy a new six-story center in Tokyo. This group will work on everything from circuit designs to new ma-

terials to psychological studies of listening habits. Next fall, Nakajima promises, the lab will celebrate its first birthday with a number of new announcements, which will probably include a new type of speaker.

Compiling statistics for tape cassettes and radio sales is complicated more than ever by the raft of cassette-radio combinations on the market. As a result, manufacturers are not sure whether to report these sales as radios or tape cassette players. In some cases, both tape and radio divisions of the same company are making the combinations and reporting sales separately. In any case, these products have beefed up business for cassette players or radios, depending on how you slice the statistics.

This situation points up a basic trend in radio these days—unique packaging and price competition, rather than technical development, is the name of the game. Because Japan has been feeling the squeeze from Taiwan and Hong Kong for low-end models, companies are looking for new ways to attract buyers with, for example, a-m/fm/tape combinations or three-band, wireless-microphone units with fancy tuning controls, starting at about $50. The next burst, predicts Matsushita's Keiichi Takeoka, managing director of the Radio and Stereo division, will be four-channel radio.

Export caution exercised

Most of the conjecture concerning Japan's interest in Europe has centered on consumer products; however, company spokesmen are playing down its importance. Indeed, the obstacles are not to Japan's liking. France, which has the Secam color TV system, has legislated trade barriers. Italy has not yet decided whether to adopt Secam or the West German PAL system.

This leaves Great Britain and West Germany as the most likely openings. But here too, licensing of PAL has been tricky. Hitachi, which has a license, is selling PAL color sets in Hong Kong, as well as in some European countries, excluding West Germany. Matsushita is renegotiating with AEG-Telefunken, the cautious holder of the PAL licensing power. Other companies are waiting for resolution of these negotiations before proceeding. Sony, among others, has a PAL-like receiver that it claims does not infringe on Telefunken patents. The company has gone after sales there, even though Europe accounts for a minor percentage of business.

All hands are proceeding slowly for fear of frightening Europe into a more protectionist stance. Clearly, America continues to be the consumer industry's favorite export market, despite the price buffeting received in the yen revaluation and the countervailing tariff issue. With prices of its exports forced up, setting up plants in America is becoming both an economic and political benefit.

More to the U.S.

Matsushita has a TV assembly facility in Puerto Rico that has been supplied with Japanese-made parts. However, the company affirms that, eventually, practically all of the parts will be purchased in the U.S. Sony's San Diego plant, which went into operation at the end of July, is producing about 5,000 units a month. Early next year, this facility, located in an industrial park, should be turning out 20,000 color TV sets a month. In the first stage, 80% of the components will be shipped from Japan; in the second stage, it will be 50%; and, finally, 80% of the components will be American-made. Hitachi also recently announced plans to begin TV assembly on the West Coast.

Taking a different tack, Toshiba has ordered one line of 18-in. TV sets from Admiral Corp., to be delivered to New York in time for the Christmas-buying season. "One way of doing business in America," says Tatsuya Inamiya, general manager of Toshiba's Video Development department, "is to share production. We have had a long relationship with Admiral through selling them parts. We knew that Admiral could produce these sets to Toshiba's specifications and have delivery in New York by Christmas." Toshiba doesn't care where Admiral builds these receivers—just so they arrive on time.

Another strategy that may pay off in business and good will is Sony's program to help U.S. companies market products in Japan. As of September, some 1,000 prospects had expressed interest in the plan. While the bulk of the U.S. firms are in home appliances, 8% are marketing office equipment, 6% electronics and hi-fi, and 6% computers and measuring equipment.

Semiconductors: calculated boom

The wild pace of calculator growth has turned the Japanese semiconductor market into an uproar. In an all-out dash to keep up with the demands of calculator manufacturers, domestic MOS makers have developed MOS LSI devices, knocked the stuffing out of prices, and rearranged the market shares of domestic and foreign producers to a 50–50 split. In doing so, the shaky domestic semiconductor manufacturers have found solid and profitable footing. In contrast to the U.S. experience, some leading calculator manufacturers have even started producing their own integrated circuits.

Japanese producers were already ahead of their U.S. counterparts in the manufacture of linear ICs for color-television and audio equipment. And semiconductor makers are anticipating booms in the adaptation of ICs to watches and automotive equipment on a scale that will rival the calculator explosion.

The future also looks rosy for semiconductors in computer memories. Fujitsu Ltd. has already introduced a minicomputer with semiconductor memories. Moreover, Hitachi and Nippon Electric Co. agree that core memories probably won't be designed into computers after 1974.

On the negative side, semiconductor firms predict that heavy demand will continue to depress prices. The picture is grimmer for manufacturers of other components. Although they enjoyed a good year in 1972, components makers are facing rising labor costs, coupled with declining prices.

In 1972, domestic semiconductor houses have captured 50% of the MOS LSI market, previously dominated by Americans Texas Instruments, Mostek Corp., National Semiconductor Corp., and North American

Rockwell Microelectronics Corp. This remarkable catch-up by Hitachi, Toshiba, NEC, and Mitsubishi probably could not have been accomplished in such short time had it not been for the large-volume demand from the calculator manufacturers. This gave them the chance to produce in large numbers and improve yields, thus matching U.S. prices.

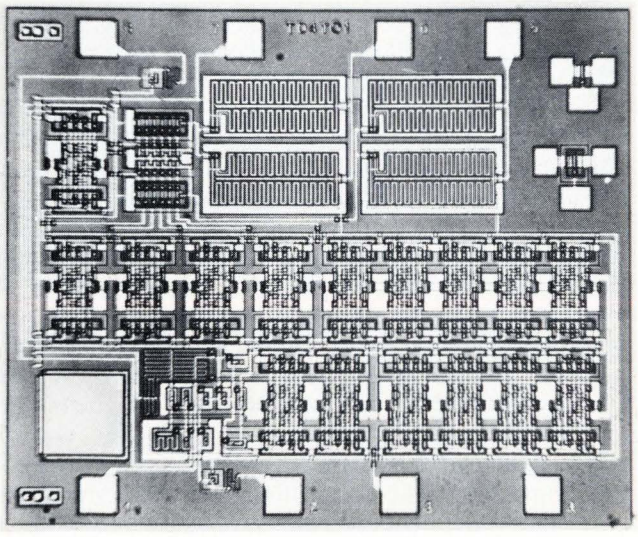
The technical edge enjoyed by U.S. companies has all but vanished—at least for the level of sophistication required in calculators—so the competition will center on those other semiconductor standbys—price and delivery. The situation may spell the end of the ability of U.S. companies to snag sales in Japan on the basis of a technical headstart. It's become much easier for Japanese competitors to close the gap. Convinced that this new game puts anyone without a joint venture on a greased pole, Motorola and Fairchild are setting up 50–50 joint ventures with Alps Electric Co. Ltd. and TDK Electronics Co. Ltd., respectively. Part of their reasoning is that a technical lead may gain orders early for the outsider, but it does not offer an opportunity for longer-term penetration of less exotic lines, such as TTL, bipolar, and linear ICs. (The TDK venture is actually Fairchild's second try to establish a foothold in Japan.)

TI challenged

TI's lead, created with resounding impact by the calculator-on-a-chip package, has been challenged, but the company is confident that its market share is intact. In fact, TI has started construction of a second plant in Japan, scheduled to go on line by the end of 1973. (TI gained a unique position when it won permission to set up its joint-venture with the understanding it could convert to full ownership after a three-year period.)

"By anticipating the learning curve of calculator chips, we were able to match production costs with the drop in calculator prices," comments William Sick, president of Texas Instruments Asia. "Not everybody saw this, and they were not ready with MOS LSI when the time came. This put a strain on producers trying to match our price."

Closing the gap. Products such as this C-MOS LSI chip announced by Hitachi have helped Japanese catch up to the U.S.



Toshio Inoue, Hitachi Electronic Devices, concludes that use of CAD and U.S. process equipment brought Japan even in MOS LSI.

Key to catching up by the Japanese, says Toshio Inoue, deputy general manager for Hitachi's Electronic Devices group, was closing the gap in computer-aided design and acquiring American processing equipment. Japan's big calculator business did the rest. Although Hitachi is supplying Casio with devices for the first under-$50 calculator in Japan, Inoue believes that the road to better profits is in the other direction—toward more complex functions on single chips designed for higher-priced machines.

The *Electronics* chart indicates the merit in this reappraisal, since quantities of calculators almost doubled from 1971 to 1972, while digital MOS LSI dollar value did not. LSI prices dipped by 10% in six months, Masao Adachi, deputy general manager for Hitachi Electronic Devices group, reports. Next year, MOS LSI consumption is estimated to reach 30.3 billion yen ($101 million), a gain of 28%.

Turnabout

In the U.S., the hand-held calculator designed around a single chip has tempted such LSI manufacturers as TI and NRMEC into the end-product business. The opposite has occured in Japan—calculator manufacturers have started making ICs. Sharp, with its policy of multiple suppliers, has been buying complementary MOS from Toshiba and p-channel from Hitachi, NEC, and Mitsubishi. Now, the company has started its own IC production line, although it will retain the original vendors. Sanyo will probably do the same. Hitachi, Toshiba, and, to a lesser extent, Matsushita, are already making both chips and calculators.

During 1972, calculators also created a shortage of LED displays, extending all the way to the raw material, gallium-arsenide wafers with the gallium-arsenide-phosphide epitaxial layer, from the U.S. NEC reports that it is selling 40,000 digits a month, Toshiba, 100,000 a month, and Hitachi, 200,000—and all three have demand for more than they can make. The bottleneck, says Hiroe Osafune, general manager for NEC's semiconductor division, is the supply of gallium-arsenide wafers. He expects the shortage to continue into next

year because demand will continue to use up capacity as fast as it's added.

The second strong demand for ICs is in linear devices for color television and audio equipment. In this segment of the market, domestic manufacturers have an edge because Japanese consumer electronics companies had been ahead of the U.S. in developing all-solid-state TV chassis and in applying ICs. In addition, the big TV manufacturers, Matsushita, Hitachi, and Toshiba, also have semiconductor divisions to design and custom build the circuits. The leveling of color-TV sales has not put a damper on IC makers because they expect to develop newer devices that combine in a one-chip package all the functions now performed by two or three separate ICs or discrete-component circuits.

The goal is to integrate all but the video power functions. Also, more action is anticipated in the audio sector, so that total linear IC consumption next year should jump to $75 million, 27% ahead of this year.

With 6 million cars and trucks rolling off the Japanese assembly lines every year, hardly a semiconductor company hasn't studied the potential for automotive electronics. But so far, the auto industry has put up more resistance than a bumper, primarily because electronics firms have to prove high reliability at low cost.

Most of Japan's semiconductor manufactures have been raised on reliability at low cost through their long relations with consumer-electronics firms. The hope is that in two or three years the untapped potential of cars and trucks will be open. Sumio Imaoka, of Toshiba, reveals that his company has top-secret projects with automobile manufacturers and predicts that by 1975 there will be as many as seven LSI devices in every Japanese car. Likely applications for ICs are fuel-injection, ignition systems, and exhaust-emission controls.

The all-solid-state wristwatch is another large-volume market standing in the wings. Here, low-power operation is mandatory, indicating that C-MOS is the way to go. Another must is a reliable display. The Japanese semiconductor firms are cautious about liquid-crystal displays, but concede that this is the way to go for a digital-display watch.

Hiroe Osafune, NEC Semiconductor division, expects Japanese firms to have 2- to 4-kilobit memory devices in one to two years.

Japanese manufacturers will be watching Motorola's movements in the watch business during the coming year. The U.S. firm, it is believed, will come on strong with its timepiece package, which includes the quartz crystal, the MOS circuits, and the power supply ready to be put into a case.

Matsushita officials have hinted that a consumer firm with a semiconductor division such as theirs might well make and market its own electronic watches in the coming year. If this happens, and other Japanese companies conform to their habit of following the leader into a market, other consumer-electronics firms with semiconductor divisions would sweep into the watch business, thereby creating another frenetic demand, similar to the calculator situation.

Computer demand

Semiconductor firms confirm the computer industry's interest in semiconductor memories. NEC's Osafune asserts that all computer systems under development will use semiconductor memories, utilizing either p-MOS technology, which holds the lead, n-MOS, which is backed by NEC, or bipolar. Although still behind the U.S. in this area, he adds, Japanese producers are expected to have 2- or 4-kilobit memory devices in one or two years.

Worry over other components

Other electronic components have also apparently weathered the economic tremors. But Taro Kuninobu, director of the Electronics Components division for Matsushita, warns that any components company that is not worried should be. He points out that business in the first half of 1972 was excellent, and that the situation should carry into the second half.

However, next year presents a question. First of all, manufacture of products that are no longer competitive in Japan—such as resistors, capacitors, coils, and speakers—will continue to go offshore. Matsushita, for example, has plants in Taiwan, the Philippines, Burma, Thailand, Malaysia, Iran, Venezuela, and Mexico. Only 15% of its Japan-produced products are exported, 60% are used by Matsushita divisions, and 25% are sold to other Japanese customers.

As the large components manufacturers set up offshore facilities, the small companies will find it more difficult to compete. Both large and small plants will end up with surplus capacity and know-how in Japan, which is now a matter of national concern. Matsushita, for one, is putting its resources into expansion of industrial sales.

On a larger scale, MITI is setting new goals for the languishing components companies. Some will be guided toward systems developments and others toward development of unique new components for new markets, similar to what Matsushita is doing on its own. MITI's assistance will include subsidies and loans for product development during the transition. A study to work out this national plan should take about a year.

Computers: an elaborate puzzle

Japanese computer manufactuers are confident of recovery in 1973 for all classes of data-processing equipment—large-scale, medium, and minicomputer systems—partly because MITI is playing a strong role in aiding development and partly because the economy is recovering from the recession. In addition, point-of-sale systems have appeared to spice the market's potential. And despite booming calculator production, which pessimists have predicted would over-extend demand, the market seems to be absorbing all that can be manufactured.

From large-scale computers down to shirt-pocket calculators, the Japanese computer industry is a labyrinth built up by the complex and touchy relations among domestic manufacturers, as well as between the domestics and foreign competitors—further complicated by the omnipresent MITI.

A good example of how the complex forces in the computer industry interact is the situation in the large-to-medium-scale end of the business. Under pressure from the U.S., MITI has promised that foreign producers—these include IBM's wholly owned Japanese subsidiary because ownership is over 50% foreign—will reach a 50–50 market without hindrance from the ministry. Since the present ratio is around 46% foreign to 54% domestic, this is not an earth-shaking concession, nor, it has been noted, did MITI guarantee the even-steven mark with a plan for accomplishing it. On the surface, the decision seems to favor IBM simply because IBM has the single biggest share of the market now.

When the computer business turned sour after years of heady growth, MITI took steps to bolster the six domestic manufacturers by forming three joint efforts and sealing the marriages with a 34.1 billion yen dowry. This move, though it did not make for particularly easy relations among the six former competitors, has been interpreted as a direct effort to strengthen these companies to compete with IBM when import liberalization comes.

It must be emphasized that it will be two or three years before the consolidation begins to make an impact on the market because of the long lead times in the industry. It will take some time to develop hardware and software to make the various system elements operate in unison. Furthermore, the companies don't want to impair sales of recently developed equipment.

In the year since the joint efforts began, a clearer picture of probable results has emerged. At the top in size is the Fujitsu-Hitachi combine. Their plan seems to be to develop the same hardware and software together—thus saving on R&D expenditures. Fujitsu will concentrate on small and ultra-large machines and Hitachi on medium and large ones. The second duo is Nippon Electric Co. and the smaller Toshiba. Their plan calls for each to develop and build a portion of each system, and then sell the total results. They will try to make different subsystems, but there is bound to be some overlap. As Yujiro Degawa, executive vice president and director of NEC, explains, "If Toshiba makes the teacup and NEC makes the saucer, we will buy the teacup from Toshiba to sell the system, and Toshiba will do the same."

The third combo, Oki Electric Industry Co. and Mitsubishi will angle away from general-purpose business computers toward process-control systems, where their strength lies. The goal is a fourth-generation line of computers in the large and medium range—Mitsubishi will build the mainframes, and Oki will handle the software and peripherals. This arrangement was a natural because in 1970 Mitsubishi concluded a three-way agreement with Oki Univac Kaisha Ltd., a computer manufacturing joint venture by Oki, Sperry Rand Univac, and computer sales firm Nippon Univac Kaisha Ltd., which includes the trading company Mitsui Ltd. and Sperry. This agreement included sales by Mitsubishi to the other two companies and appointment of Mitsubishi as sales representative for OUK systems. Neither Oki nor Mitsubishi are factors in general-purpose machines, thus the decision to steer clear of them.

Results will lag

Results are not expected from these efforts until 1975—perhaps later. For one thing, NEC last year brought out five up-dated models in its 2200 series that took three years to develop. Degawa estimates that this line should have two to six years of market life to pay back the development, and NEC is not willing to launch another series before that time.

Both Hitachi and Fujitsu expect to have a prototype line by 1975 or 1976. According to Hitachi, a simulator will probably be available to make the software programs compatible and to up-date machines already in the field.

This will have to be a gradual process, since the two companies are not building compatible machines now. "You can't change software overnight," comments Taiyo Kobayashi, executive director for Fujitsu. "It's like changing all of your blood at once. We will make the conversion in two stages, though there are no definite plans for the second stage now."

The response of U.S. firms operating in the Japanese market is naturally guarded. One American company executive describes the joint efforts as "neither a love match nor a marriage of convenience," meaning that

RATIO IN VALUE BETWEEN DOMESTIC AND FOREIGN COMPUTER INSTALLATIONS
(UNIT: $ MILLION)

Facilities	Domestic	Foreign	Total	Ratio of domestic computers (%)
Local public facilities	60.32	10.55	70.87	
Government	117.04	20.16	137.20	
Governmental organizations	280.18	8.36	288.54	
Subtotal (A)	457.54	39.07	496.61	92.13
Hospitals	3.08	.36	3.44	
Education	100.27	3.64	103.91	
Subtotal (B)	103.35	4.00	107.35	96.28
Electrical machinery firms (C)	358.50	146.79	505.29	70.95
Others	1155.99	1522.17	2678.16	43.16
(A) + (B) + (C)	919.39	189.86	1109.25	82.88
TOTAL	2075.38	1712.03	3787.41	54.80

Note: Yen converted at rate $1 = 300 yen.

the Japanese companies are incompatible in business philosophy and product line. Nevertheless, all agree that the government will not let the ventures fail. Despite the edge that the Japan Six have in government sales and the vigor they have shown in the non-government competition, U.S. companies feel that there is room for growth. "Our slice of the pie will stay about the same," says an IBM spokesman, "but since the pie is getting bigger, we will benefit."

Nippon Univac is more optimistic. Its large-scale computers are considered imports, but the medium-range machines sold by Oki Univac are counted as domestic, giving Univac a position in both camps. Kyoji Matsuda, managing director for Nippon Univac, expects an 11% increase in income in 1973. He claims a 35% market share in major real-time systems for financial applications and a 12% share in medium-scale computers. He does not expect the Japanese joint efforts to upset the market, though he concedes that Univac's large-scale machines will not have much chance for sales to government agencies, now that Japanese manufacturers are developing complete competitive lines.

Japanese lead in sales to institutions

This contention has its basis in statistics from Japan Electronic Computer Co. Japanese manufacturers have a lopsided lead in local public facilities, hospitals, education and electrical machinery firms in value, but foreign imports close the gap in the far more lucrative general-purpose business market, thus bringing the total to over 54% for domestic computers.

Of the Japanese manufacturers, Fujitsu has the largest commitment, for 60% of its business is in EDP. While competitors consider this position risky, Fujitsu disagrees. Says Kobayashi, "Some say Fujitsu is on a dangerous path. But, because the Japanese government is helping, it's a safe course. Fujitsu did not enter into any technical licenses with foreign companies; therefore, the government considers Fujitsu a special case and doesn't want to see it go down the drain."

Fujitsu recently startled the industry when it announced its use of semiconductor memories in a new minicomputer at lower prices than core. However, company officials reasoned that core-memory designs have reached their lowest cost point. But, since semiconductor versions have more potential for decline in price than core, eventually they will cost less. Both Hitachi and NEC agree that after 1974 there will probably be no new core-memory designs and that increased quantities of semiconductor memories will drive down prices.

Yujiro Degawa, NEC director, explains that it will be two or three years before the results of the joint computer efforts will be seen.

Nippon Telegraph and Telephone soon will cause two major impacts on the computer business. Within the next year, NTT will have converted its switching system to open up data communications among unrelated companies using time-sharing computers. Heretofore, users could only obtain leased-line connections for data communications. But the new NTT switching facilities should stimulate a significant increase in the market for data terminals and related data-communications equipment by 1974.

In addition, NTT expects to go on line next fall with the first of its expanded scientific and engineering computer services. This service will use a large-scale computer, called DIPS, developed by NTT and built by Fujitsu, Hitachi, and NEC. NTT also has a real-time sales and inventory management system (Dress) that will use DIPS computers.

If the schedule holds, the first expanded scientific and engineering series will go on line in Tokyo next fall. Osaka will get a DIPS computer with this system in March 1974. Both cities are scheduled to get the Dress systems by the fall of 1974. NEC will supply both scientific and engineering systems, and Fujitsu and Hitachi will each build a system for the Dress installations.

Oki stands to get some communications business too. Its latest model 4300C, a minicomputer used for terminal control of data communications and other control applications, had received 150 orders in the first month. The machine, which has 4,000 16-bit words of core memory, sells for 1.6 million yen ($5,333).

Minicomputer future is bright

The over-all minicomputer business potential looks good for Japan. The *Electronics* consensus puts this year's figure at $15.3 million—more than 27% higher than in 1971—and $20.5 million is projected for 1973. The lion's share of this business will go to domestic producers, including Nippon Mini-Computer Corp., a joint venture engineered by MITI that uses Data General Corp.'s technology. Other U.S. firms are shut out of significant OEM sales.

Banking on point-of-sale systems

Point-of-sale systems are just getting underway in Japan. Toshiba has started deliveries, Fujitsu has announced a system, and NCR Japan is marketing a system developed in America. Other companies are also moving into POS, but sales have not yet materialized.

Unlike the U.S., where large retail merchants are the prime potential customers, in Japan, the banks will probably be as important as the stores in initiating POS systems. Masanubu Watanabe, director of the Industrial, Financial & Commercial Systems division for NCR, explains that banks want to link the stores to their computers via point-of-sale terminals. The banks are mainly interested in verification of credit transactions,

while the stores are most interested in inventory control from the point of sale. To satisfy both demands will increase the price of a system.

Chaotic was the word for the calculator business a year ago. Today, the market may be just as wild and woolly, but experience appears to have injected a bit of method into the madness. Most of the flurry has been in the low end of the market. Availability of inexpensive LSI chips had caused an explosion in production, then a price tailspin for the six- and eight-digit nomemory units. The $100 hand-held calculator price barrier was cracked earlier this year. Casio Computer Corp. thrust the calculator firmly into the consumer market with a six-digit model that is now being sold in camera stores and other retail outlets throughout Japan for 12,800 yen ($42.67). That left competitors shaking their heads, until Busicom Corp. this fall squeezed a six-digit calculator down to 12,800 yen to match Casio.

By next year, $35 units will be available, and anything priced lower won't be a surprise. Calculators have spread to the public so quickly that educators have had to reevaluate school mathematics homework assignments because students with calculators have a great advantage over the others.

The feverish pace to beat down the price caused one American traveler to quip that he didn't buy a cheap calculator at Tokyo's airport because he was convinced that by the time his plane reached the U.S., another machine would be on the market at $10 less. Perhaps this is an exaggeration, but the image of a bottomless, profitless spiral has caused companies in the office machines business to reassess their situation.

Exploiting the consumer market

Dr. Tadashi Sasaki, executive director for the Industrial Instruments division of Sharp Corp., has concluded that most manufacturers should cut loose the low end and leave it to a handful of companies that will exploit the consumer market. Sasaki's view is that the best path for an office-machine manufacturer is to move upward to the more complex and more profitable machines, including the programables.

A general market for programable machines, now priced around the $1,000 level, has emerged. Under these are the standard machines and printer types ranging from about $150 to slightly less than $800. Finally, there are the low-priced types, ending with the line sold to grade-school students.

"Saturation is still a long way off," says Sasaki. "The river's gotten wider, and it is still rapidly expanding. In it, we have a low-cost eddy current, the six-digit calculator. It made lots of waves, but was not as serious as we thought. People will buy them and then switch to a better, higher-priced calculator."

Sasaki estimates that in 1972, worldwide production of calculators, including adding machines, will be about 4.3 million units. Of these, Japan will produce 3.1 million and the U.S., 1.1 million. The remainder will be European. Approximately 1 million of Japan's production will be sold domestically and the rest exported—in round figures, 1 million to the U.S. and 1 million to Europe. This means that the U.S. market in 1972 is split about 50–50, import and domestic.

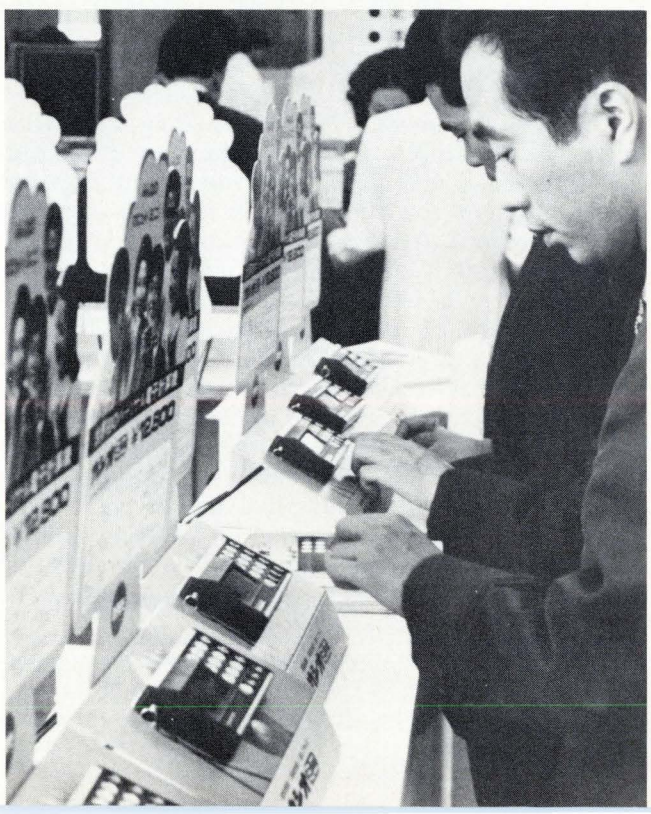
Sasaki further estimates that Sharp has 20% of the Japanese market in number of units sold, and 30% in value. Casio is second in number of units, thanks to its six-digit consumer model, and Canon Inc. ranks second in value. However, Canon leads Sharp in the number of units exported.

Perhaps symbolic evidence that the calculator river is getting wider was provided when Premier Tanaka took along on his visit to China some Sharp calculators as gifts. What if some day 700 to 800 million Chinese want to buy calculators?

Communications: line is busy

With solid spending plans set by Nippon Telegraph and Telephone, with a telephone-installation waiting list of over 2.3 million, and with the promise of more data communications coming on-stream, Japan's telecommunications industry once again has little to worry about, other than how fast these demands can be filled. Neither revaluation, nor Nixon shocks, nor the rapidly

Tadashi Sasaki, Sharp Industrial Instruments, estimates that some 3.1 million electronic calculators will be produced in Japan this year.



Calculating success. Casio (above) and Busicom have developed under-$50 calculators in Japan, and others are bound to follow.

filling electromagnetic spectrum can stay this industry from its usual round of steady profits.

Wireless communications, telephone switching, wire message equipment, and wire carrier equipment sales—all are increasing by 6% to as much as 45% this year. Next year holds much the same in store.

NTT budgeted 300 million yen ($1 million) for equipment in fiscal year 1972, ending next March, and another 350 million ($1.17 million) for fiscal 1973, ending March 1974. Top priority goes to preparations for data communications, followed by addition of electronic exchange centers and expanded microwave transmission systems. Almost every manufacturer stands to benefit, because NTT always spreads its procurement to all the competitors.

The data-communications conversion consists of combining 5,000 message areas in the country into 560 and changing the message and unit recording system in order to time, as well as count, local calls. The larger message areas, together with lower rates to neighboring areas, will keep average charge to subscribers the same, but will enable NTT to charge data communications subscribers for line use within a message area. According to NTT, the year-long changeover will cost about 70 to 80 billion yen ($233 to $267 million), mostly for labor.

By the beginning of April, NTT had started eight electronic exchange centers, each with a maximum capacity of about 40,000 subscribers. Between April and next March, 10 more will have been started, for a total of 18. There will be 20 in the year following. Each new exchange is expected to cost about 1 billion yen ($3.3 million) when fully equipped.

NTT has ordered from Nippon Electric transmitter-receivers for a 5-gigahertz microwave transmission system that will have 2,700 voice channels, a new high for Japan. NEC estimates that the main transmitter and receiver, plus auxiliary equipment for each installation, will cost 4 to 5 million yen ($13,000 to $17,000), but the final price has not been set.

Cable net being installed

For cable transmission, NTT is installing a 60-megahertz coaxial line from Tokyo to Nagoya to Osaka. This line will handle color television, which until now has been transmitted by microwave. It is also part of the preparation for TV telephones. While the market potential for video telephones is still in question, NTT intends to go ahead with a five-year plan, delayed until 1973, that is to have 3,000 subscriber lines completed by 1977.

The obvious target for video phones will be industry and government agencies. Yet even Fujitsu, one of the experimenters in this medium, is not sure how well it will be accepted. Says Kanji Yamamoto, a Fujitsu director, "A cheap method of transmitting pictures is the biggest need now." He adds that the advent of data transmission requiring a fraction of the bandwidth of the TV phone is more important now. There is a pent-up demand for data communications that will begin to be served as conversion is completed.

Thus, the near-term possibilities for facsimile are good. Yuichi Makino, director and general manager for the Telecommunications division of Toshiba, estimates that fax business was 3.8 billion yen ($12.7 million) last year, 6 billion yen ($20 million) in 1972, and will reach 8 billion yen ($27 million) next year. Then he forecasts a 10 to 12 billion yen ($40 million) market in 1974.

Toshiba, which is developing fax equipment to use the switched-dial network of NTT, bases its growth figures on the availability of inexpensive facsimile machines, probably nondevelopment types that use ink jets and inexpensive paper. Band-compression types that reduce transmission time will also be available.

While microwave equipment is the mainstay of NEC's wireless communications division, this category has matured, while others have picked up in growth rate, such as mobile radio and telemetry. Toshiba is also enthusiastic about telemetry. The company has a joint effort with NTT on remote meter-reading for utilities.

Telemetry forecasts rain

Another real-time telemetry program is underway with Japan's meteorological agency to warn against the sudden heavy rainfalls that cause havoc in concentrated areas. This plan will be tested the end of this year and could go into operation next year, Toshiba reports.

Telemetry and telecontrol equipment were the best performers for Mitsubishi this year, increasing by 10% to 20% more than 1971 sales. Utilities were the predominant buyers, but, Japan's space program and future pollution-control projects should aid continued expansion.

Overseas sales have also been steady, and they have not been restricted to the developing nations. NEC is selling its earth stations for satellite communications in 20 countries, including West Germany and France. The firm also supplied equipment to New York Telephone Co. during its expansion crisis. Fujitsu recently landed a 2 billion yen segment of a communications program for Nigeria. And Toshiba has microwave contracts in Latin America and India.

Back at home, NTT is experimenting with the possibility of widespread installation of telephones in automobiles. Looking at Japan's crowded highways as another source of business is enough to gladden the heart of any telecommunications company.

Yuichi Makino, Toshiba Telecommunications, is sure that facsimile sales will take off with liberalization of data communications.

Industrial: now it's systems

"Next year should be interesting," muses Masahiro Shimizu, president of Hokushin Electric Works. "It's the year that everything is going to happen." Companies in the industrial electronics sector might add, "and it's about time."

The potential for test and process-control systems is being stimulated by the demand for automation in public works, together with growing pressure for industrial automation—and further in the future—pollution control. However, the market for digital meters is so volatile that some company officials are fearful that a price war will develop.

Sales for 1971 were flat, but this year they are up slightly. The *Electronics* consensus figures the market at $584.9 million for total production-control and other industrial equipment. Next year, the one in which "everything is going to happen," they should be about $693 million. Sales of test instruments, not counting panel meters, should grow next year to $166.9 million, a 14% increase over this year's figures. An indication that the economy picked up steam slowly is the mere 4% increase in 1972 sales over 1971, which for most instruments companies was a bottoming-out year.

Next year, there will undoubtedly be a battle for sales in digital meters, the key being whether or not the prices hold. Using much the same LSI circuits as the soft-priced calculators, the hope in the industry is that the meters, including panel types, won't go down the same spiral. "I'd rather have the digital meters—like color TV—up in performance and price," comments Tsukasa Yoshizumi, product manager for Takeda Riken Industry Co., which together with Yokogawa Electric Works, holds 70% of the digital-voltmeter market.

Takeda's voltmeter business held about even in 1971, and sales of some $4 million in digital voltmeters showed a 20% increase this year. The company introduced two new models that use standard LSI chips for logic circuits. The next line will go to custom-designed C-MOS.

Price war feared

Yokogawa's Morio Ono, assistant manager for instrument marketing, is also concerned about a digital-meter price war. Digital voltmeters represent 15% of the company's test instrument business, or about 4% of total sales. However, it's a fast-moving line that should grow by 20% in 1973.

Fred Bode, director for Yokogawa-Hewlett-Packard, is also optimistic about both digital voltmeters and digital multimeters for next year and concerned about prices, especially if and when the yen is revalued again. While still priced higher than analog meters, prices of digital types are coming down close enough to tip the balance on the strength of their ease of use, he points out.

Iwatsu Electric Co. Ltd., which has entered the digital competition with low-priced multimeters, expects an annual 15% increase in sales. In one year, the price of digital multimeters has declined by 20,000 yen ($69) and will continue to drop, says Kozo Uchida, chief engineer. This downward price pressure will continue.

While the large-scale production of instruments and equipment is a familiar battle ground, the new and risky competition shaping up now is for test and control systems. In fact, Hokushins's president is "putting all the chips" on new process-control systems, due to be announced next February. "We have got to succeed in this, or we will no longer be a controls company," he states. Right now, he figures that Yokogawa, Hokushin, and Yamatake-Honeywell Co. hold 58% of the process-control market.

Systems promise competition

There are reasons to be optimistic about the new systems ventures, however. For one, public works are now taking up about 20% of the business, whereas this segment represented only 5% five years ago. Initiated by the government to boost the economy, these projects are for sewage-treatment plants and incinerator controls, which are part of Japan's drive on pollution.

Industrial-pollution control will also become a major source of sales, once local and national governments clarify standards. As in the U.S., there is lots of interest, but industry has hesitated to invest. More substantial for 1973 is the potential for automation.

Yokogawa's computer-based systems fall into two categories: supervisory and direct digital control. Its latest line, Yodic 100, can be used for either supervisory or extremely simple DDC. Priority interrupt and memory protection are standard features.

Yokogawa-H-P's entry into the data systems competition in Japan is relatively recent. The company has recently organized a design and software center of 50 people to handle measurement systems, computer systems other than testing, and calculators. The company plans to increase its data systems/calculators business to 30% of sales by the end of 1973.

Another newcomer to systems selling, Iwatsu, predicts that its automated test systems will grow from 5% at present to 10% of its business by next year. But as chief engineer Uchida explains, it requires a switch in outlook to go from producing 200 oscilloscopes of one model a month to 10 test systems a year.

Takeda's test systems, which already represent about 20% of the company's sales, include a memory tester for LSI circuits, a memory-board tester and data logger, and

Masahiro Shimizu, Hokushin president, says that this is the year everything is going to happen in the industrial-control systems arena.

a signal-analysis system. Producing about 10 systems a month, Takeda uses processors from Nippon Mini-Computer Corp. in almost 90% of its systems. Of 125 engineers, 70 are working on systems programs. Under a government subsidy, Takeda has developed and built a big tester, which generated know-how fallout that the company now uses in other equipment.

But the real competition in the test and control systems business, says Takeda's Yoshizumi, is in the software. That is why a disproportionate number of engineers is assigned to systems and why the matching of computer programs to test equipment is vital. It is largely on the software side that the competitive battle will take place next year.

Space: still looking up

The National Space Development Agency (Nasda) is on a crash program, Japanese style. Dedicated to practical applications of space technology, the young agency has been growing up, but concentrating on neat, small projects.

This year, Nasda received a jolt from NTT and NHK, Japan's public broadcasting system, in the form of a demand for a communications satellite to meet television and voice-transmission needs in the late 1970s. What's more, NTT and NHK want the 250- to 300-kilogram satellite up in the air by 1976.

Nasda's original long-range plan had called for launching an experimental 100-kg communications satellite in 1977. Now the space agency is up against a new and difficult set of demands. It does not yet have a rocket powerful enough to orbit a payload of 250–300 kg, nor does it have a design for a usable satellite.

In addition, Japan is committed to launching a meteorological satellite as part of a global atmospheric program involving coordination with space shots in the U.S. and Europe. In U.S. terms, these may seem like relatively simple problems, but Nasda must try to solve them with a budget of $60 million for the fiscal year ending next March. The agency has requested an 80% increase for the next year, and will probably get it.

The simplest solution to the time-and-money crunch is to get the rocket and satellite technology from the U.S.; however, there is internal pressure to make the space effort all-Japanese. And the final complication is that Nasda must deal with the ministers of Posts and Telecommunications, Science and Technology, and Transportation, as well as the University of Tokyo's Institute of Space and Aeronautical Science, which has a budget of its own and pioneered Japan's space effort.

If Nasda were to buy parts and knowhow from the U.S. for the satellites, and NASA were to launch them, the communications project could be completed in three years, estimates Dr. Yasuhiro Kuroda, director of systems planning department for Nasda. If not, it might take seven years before the satellites could be launched. By using nine boosters strapped on Japan's "N" rocket (same configuration as the Thor Delta first stage), it would be possible to launch a 250-kg satellite, he adds.

Specifications for the communications satellite have not been set; however, it's assumed that there will be transponders for multiple voice channels and TV. Also both broad-beam and narrow-beam broadcast capabilities will probably be required.

Besides the communication satellite, Nasda has ongoing plans for other projects of practical and scientific nature. Projects are scheduled to map the ionosphere and measure radio noise for data pertaining to communications use. Two others—both for scientific purposes—are to conduct plasma and positive-ion density and composition measurements.

Defense: more yen, but when?

All of the new spending plans set by Japan's Defense Agency under the fourth defense plan have been hanging fire, awaiting action by the government. By neglecting to obtain required final approval of the five-year plan by the National Defense Council, former Premier Eisaku Sato gave opposition parties an opportunity to freeze defense funds. The freeze was part of a compromise devised to pass the rest of the national budget.

The return of Okinawa to Japan then took precedence, and when that transfer was concluded, there was a change in leadership to Premier Tanaka. Soon thereafter, Tanaka began the long, careful plans to visit China and re-establish diplomatic relations. This effort has not only delayed approval of the new defense plan, but it took away the sense of urgency, since peace with China looked encouraging.

During the Tanaka visit, the pall of gloom hanging over Self-Defense headquarters was thicker than Tokyo smog. Since his return, however, the National Defense Council has belatedly approved the new plan, unfreezing funds for new aircraft, a tank, and a missile.

The delay has taken its toll. Although it was possible to continue programs previously established, no new efforts could be started. It's not clear whether or not research can proceed on an airborne early-warning system or anti-submarine patrol planes. A tactical computer project involving all of Japan's computer companies that was started under the third plan has continued. But there is no guarantee now that there will be enough funding to install the system.

Equally frustrating to the agency is the fact that delay of this year's spending has squeezed together next year's budget. It has been impossible to settle next year's budget without firming up this year's.

An artillery-shell-spotting radar will go to completion, but there also will be procurement of less costly mortar radar. Placement of Mitsubishi's three-dimensional radar systems is continuing too. The Defense Agency will say nothing about plans for backup mobile 3-d radar made by Nippon Electric, except that it will not buy as many portable sets as fixed units.

Since some form of the 90 billion yen ($300 million) fourth defense plan will eventually be adopted, the defense agency's next task will be to try to catch up the lost year, or at least minimize the delays it has caused. □

JAPANESE ELECTRONICS MARKETS 1971–1973

COMPONENTS

COMPONENTS	1971	1972	1973
Antennas	41.7	43.7	45.3
Capacitors, fixed and variable	327.5	328.4	369.7
Connectors, plugs, and sockets	48.0	53.3	60.0
Crystals and crystal filters	16.7	17.7	20.0
Delay lines	.7	.7	.7
Displays (except solid state devices)	17.0	20.3	23.3
Ferrite devices (except TV yokes and flybacks)	25.7	26.7	27.3
Loudspeakers (OEM type)	102.0	105.8	116.7
Magnetic tape	53.7	62.7	74.7
Microphones (OEM type)	23.3	26.7	28.3
Microwave components (except tubes and semiconductors)	21.7	26.0	31.7
Potentiometers, composition	83.3	95.8	100.0
Potentiometers, wire wound	17.7	19.7	21.7
Power supplies (OEM type)	19.2	25.7	29.7
Printed circuit boards	113.3	132.7	153.3
Relays	73.3	100.0	110.0
Resistors, fixed (including wire wound)	126.7	122.0	120.0
Semiconductors, discrete	444.9	494.1	491.0
Microwave diodes	7.7	9.7	11.0
Rectifiers and diodes (rated more than 100 mA)	98.7	103.3	109.0
Signal diodes (less than 100 mA)	45.0	53.3	46.7
Thyristors SCR's, four-layer diodes	26.7	29.0	30.7
Transistors, power	113.3	133.0	145.3
Transistors, small-signal	143.3	153.3	135.0
Zener diodes	10.2	12.5	13.3
Semiconductors, integrated circuits	251.2	294.6	360.2
Digital bipolar, small (less than 12 gates)	56.7	47.3	48.7
Digital bipolar, MSI (12 to 100 gates)	19.3	29.0	43.0
Digital bipolar, LSI (more than 100 gates)	6.0	10.0	13.8
Digital MOS, small and MSI	42.3	30.3	24.7
Digital MOS, LSI	64.0	78.7	101.0
Linear IC's (except operational amplifiers)	32.5	59.0	75.0
Operational amplifiers (monolithic only)	2.7	5.3	12.0
Hybrid IC's, all types	27.7	35.0	42.0
Semiconductor optoelectronic devices	7.7	11.7	16.7
Switches (for communications and electronics)	52.7	65.8	74.3
Transformers, chokes, and coils (includes TV yokes and flybacks)	315.0	325.0	331.7
Tubes, cathode ray (except for TV)	4.2	4.7	5.0
Tubes, receiving	27.3	20.0	12.2
Tubes, TV picture	416.7	400.0	353.3
Total	**2,631.2**	**2,823.8**	**2,976.8**

(millions of dollars)

Note: Estimates in these charts are market figures and were developed from inputs supplied by some 116 companies. They reflect the market outlook as of October 23, 1972, and are based on a conversion rate of $1 = 300 yen.

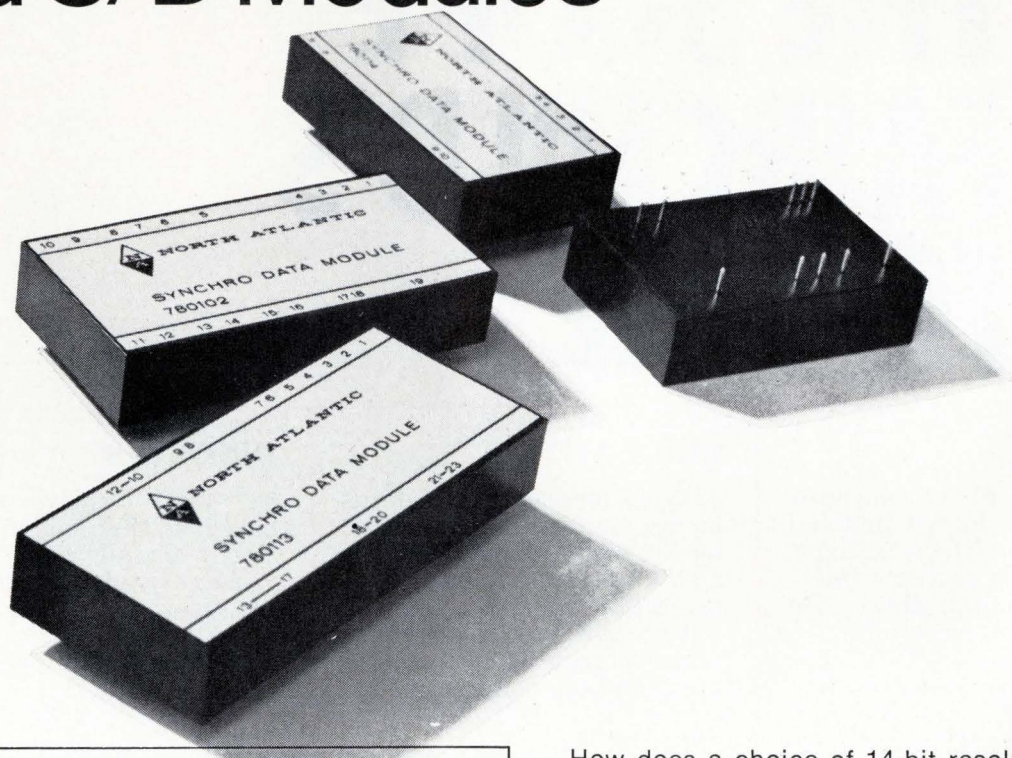
EQUIPMENT

	1971	1972	1973
CONSUMER PRODUCTS			
Audio tape recorders and players	212.3	250.0	291.7
Citizen band transceivers	7.0	7.3	7.7
Electronic ranges	69.0	89.0	108.3
Hi-fi component equipment	66.7	85.7	108.7
Musical instruments	43.3	45.0	45.0
Stereo phonograph and radio combinations	313.3	324.0	345.3
Radios (including car radios)	161.0	167.7	172.0
TV sets, black and white	112.5	93.3	85.5
TV sets, color	1,788.3	1,773.7	1,767.3
Video tape recorders (for consumer use)	21.7	51.7	71.3
Total	**2,795.1**	**2,887.4**	**3,002.8**
COMPUTERS AND RELATED HARDWARE*			
Analog and hybrid computers	6.3	7.0	7.8
Converters, a-d and d-a	85.0	110.7	144.0
Digital computers (except minicomputers)	461.7	583.3	733.3
Digital minicomputers (valued up to $10M)	11.7	15.3	20.5
Data storage devices	359.8	481.3	646.0
Data entry and output equipment	193.3	261.0	339.3
Remote terminal equipment	25.5	38.2	53.3
Electronic calculators	176.0	193.7	197.0
Total	**1,319.3**	**1,690.5**	**2,141.2**
COMMUNICATIONS EQUIPMENT			
Broadcast equipment	46.7	57.0	73.3
CATV	2.2	2.8	4.2
Closed circuit TV	14.3	16.3	19.0
Intercoms and intercom systems	14.0	15.3	16.7
Microwave relay systems	76.7	80.0	85.0
Navigation aids (except radar)	23.3	25.8	28.8
Radar (air, ground, and marine)	51.2	56.7	62.7
Radio communications (except public broadcast)	156.5	168.3	183.3
Telemetry and guidance systems (except industrial)	38.3	46.7	60.0
Telephone switching, electronic or semielectronic	26.2	36.7	53.3
Wire message equipment	156.3	178.3	203.3
Wire carrier equipment (includes FDM and PCM)	185.0	206.7	246.7
Total	**790.7**	**890.6**	**1,036.3**
INDUSTRIAL EQUIPMENT			
Machine tool controls	20.7	30.5	39.0
Motor speed controls	73.0	82.7	95.0
Power electronics equipment	91.3	113.9	126.7
Process controls and related equipment (includes computers)	326.7	333.3	400.0
Simulators, trainers, and teaching aids	13.3	16.7	23.3
Ultrasonic cleaning and inspection equipment	7.0	7.8	9.1
Total	**532.0**	**584.9**	**693.1**
TEST AND MEASURING INSTRUMENTS			
Amplifiers, laboratory type	13.3	14.2	15.0
Calibrators and standards, active and passive	9.2	9.2	10.3
Components testers	15.8	16.7	20.0
Counters and timers	9.3	8.8	10.0
Electronic meters, analog	7.5	7.5	7.5
Electronic meters, digital	5.3	5.5	5.8
Generators and synthesizers (to 1 GHz)	10.3	10.8	12.2
Lasers, all types	3.3	3.0	3.3
Microwave test and measuring instruments (above 1 GHz)	12.0	12.8	14.2
Oscillators	7.5	7.8	7.8
Oscilloscopes and accessories	30.5	31.7	35.8
Power supplies, laboratory type	5.0	5.0	8.3
Recorders (analog and digital)	11.7	13.3	16.7
Total	**140.7**	**146.3**	**166.9**
MEDICAL ELECTRONICS EQUIPMENT			
Diagnostic equipment, except X-ray	33.3	35.0	36.7
Patient monitoring equipment	6.7	8.3	10.0
Prosthetic equipment	10.7	11.3	13.0
Therapeutic equipment, except X-ray	8.8	9.3	10.0
X-ray equipment	83.3	90.0	96.7
Total	**142.8**	**153.8**	**166.4**
TOTAL EQUIPMENT CONSUMPTION	**5,720.6**	**6,353.5**	**7,206.7**

(factory prices in millions of dollars)

* Not including navigation, radar, process control, and similar systems

OUR ANGLE:
Low Cost D/S and S/D Modules



TYPICAL S/D MODULE SETS		
FUNCTION	LINE-LINE	FREQUENCY
S/D or R/D	11.8V	400Hz
R/D	26V	400Hz
S/D or R/D	90V	400Hz
S/D	90V	60Hz

TYPICAL D/S MODULE SETS		
FUNCTION	LINE-LINE	FREQUENCY
D/S or D/R	11.8V	400Hz
D/R	26V	400Hz
D/S or D/R	90V	400Hz
D/S	90V	60Hz

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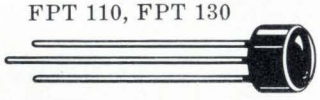
Standard — Dome Lens Phototransistor

FPT 100, FPT 120

Standard — Flat Lens Precision Package Phototransistor

FPT 110, FPT 130

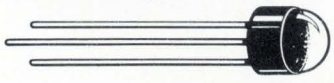


Metal Package — Phototransistor

FPT 101, FPT 102

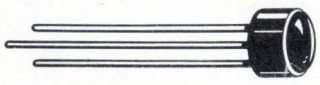
Matched Sensitivity Dome Lens Phototransistor

FPT 220, FPT 320
FPT 100 A, 100 B



Matched Sensitivity Flat Lens Precision Package Phototransistor

FPT 110 A, FPT 110 B
FPT 230, FPT 330

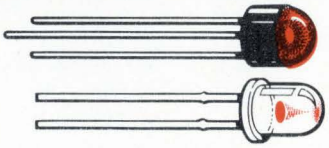


LED LAMPS

22 types for use as panel status lamps, malfunction indicators, backlighting of push buttons and keys, and narrow beam projection sources. Available with clear, white and red lenses, large light emitting areas and pin point sources.

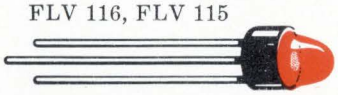
Point Sources

FLV 100, FLV 111, FLV 118



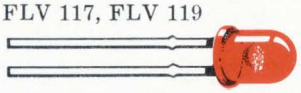
Wide Angle Panel Indicators

FLV 102, FLV 108
FLV 116, FLV 115



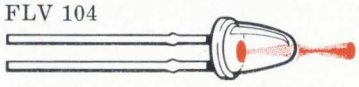
Panel Indicators

FLV 110, FLV 112
FLV 117, FLV 119



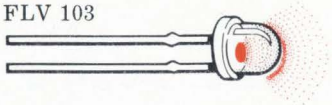
Narrow Beam Emitters

FLV 104



Backlighting Illuminator

FLV 103



Subminiature Lamps

FLV 107

DISPLAYS

⅛″ LED displays with the bold font that looks twice the size it actually is... ¼″ LED displays made by the industry's most advanced process... *standard* calculator displays with or without drivers and scanners built-in.

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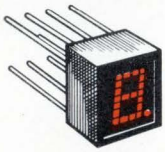
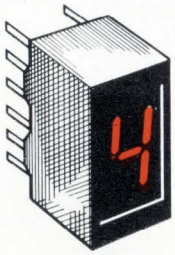
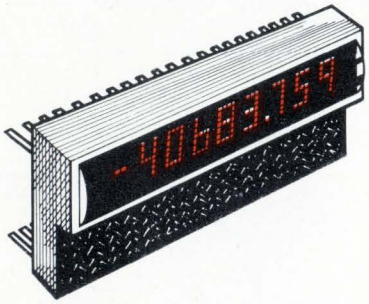


FND 70 ¼″



FNA 45 9-Digit DISPLAY with drivers

FNA 25 9-Digit DISPLAY without drivers



Circle 210 on reader service card

Circle 211 on reader service card

Circle 212 on reader service card

Its Many Unique Products Offer New Problem Solving Capabilities

Chances are that Fairchild's Applications-Oriented opto line contains many products you did not know existed. These special products were developed to save you design time and expense by permitting you to design around a product line that offers functional as well as package variations.

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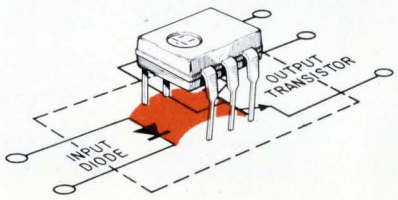


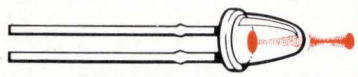
Circle 213 on reader service card

IR EMITTERS

INFRARED LIGHT

FPE 100

FPE 104

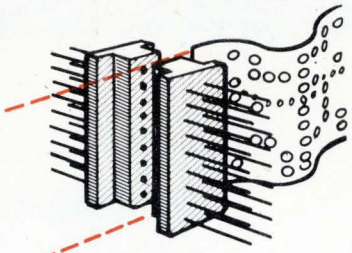


Circle 214 on reader service card

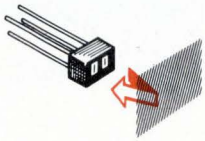
ARRAYS

Fairchild arrays, such as those shown here, serve specific information-reading needs and also provide broad capabilities for applications requiring edge-, angle-, and position-sensing, counting and controlling as well as specific information reading units.

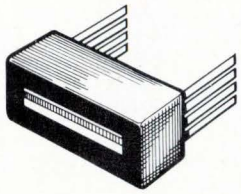
FPA 100 9-Element Source-Sensor Tape Reader Array



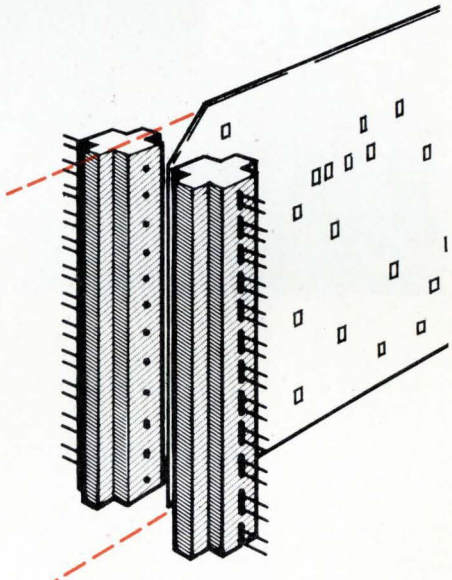
FPA 103 Reflection-type Source-Sensor Array



FPA 602 128-Element Linear Self-Scanned Array



FPA 101 12-Element Source-Sensor Card Reader Array



Circle **216** on reader service card

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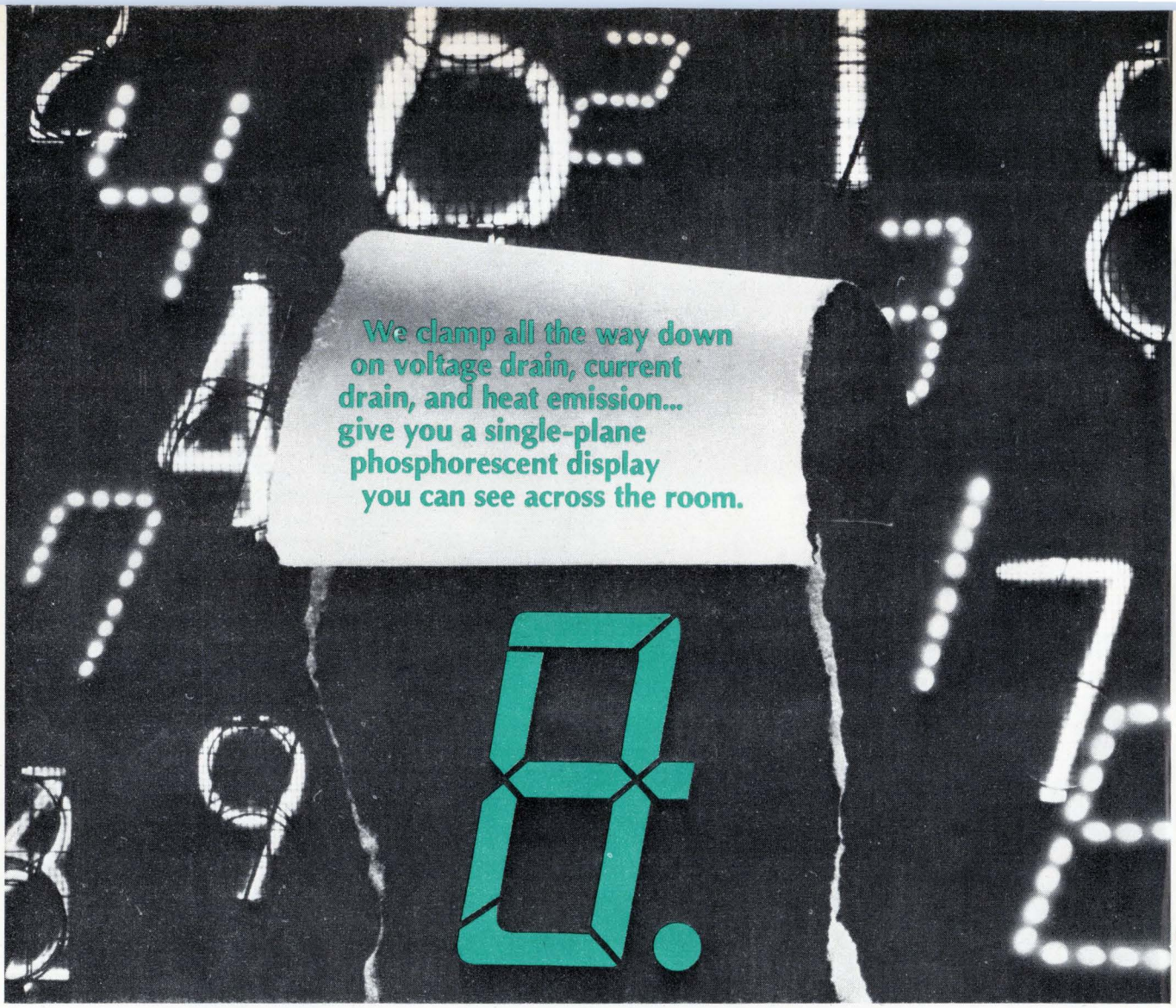

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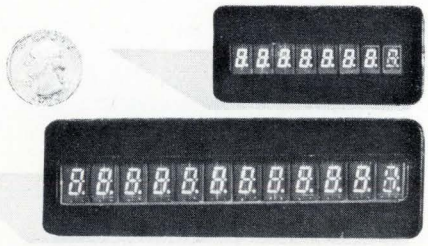

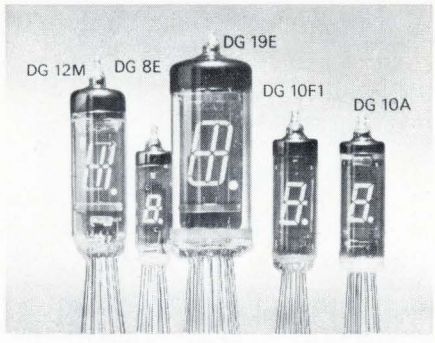

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Long-range infrared intruder alarm resists fault triggering

Ferroelectric bolometer with room-temperature Curie point "looks" through reticle without signaling its own presence, and, since it responds only to moving infrared sources, minimizes false alarms

by W. E. Osborne, *Infrared Laboratories Inc., Anaheim, Calif.*

☐ The recent increase in the number of burglaries has intensified the demand for intruder alarms. In response to this demand, a passive infrared detector with a maximum range of 1,000 feet has been designed. And because it responds only to infrared sources that move, the device won't generate false alarms easily.

Because the new detector is passive, it is superior to many presently available active alarms, which transmit ultrasonic or infrared signals to be intercepted or reflected by intruders. Sophisticated burglars can detect such signals and circumvent the alarms.

The device's long range and resistance to false tripping are superior to those of some other passive detectors—capacitive units, for example, have a maximum range of about six feet, while seismic units can be set off by passing trucks. Finally, because the unit detects only moving targets, it is an improvement over infrared devices that can be triggered by sudden changes in ambient temperature, as when an air conditioner turns on.

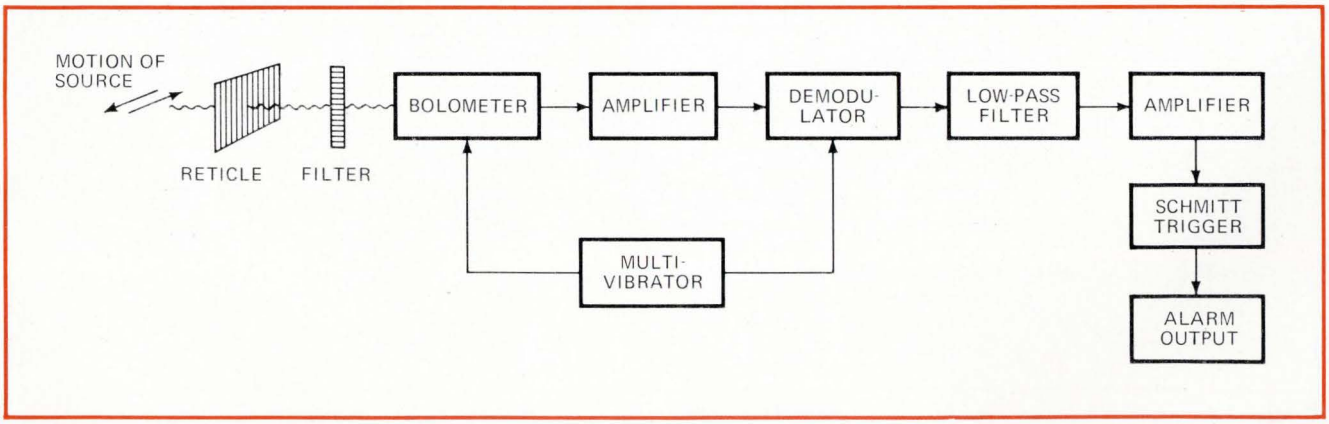
In the past two years, five prototypes, installed overseas, as well as in the United States, have signaled the presence and made possible the capture of many unauthorized intruders. None of these devices is known to have been discovered or disarmed.

The prototypes built to date have weighed an average of 2½ pounds each, including internal nickel-cadmium batteries and a charger. Two 12-volt batteries in series can provide 8 milliamperes for about 26 hours before requiring a recharge, and a 45-volt bias battery provides 0.5 mA to the bolometer. In the charging mode, a microammeter monitors the rate at which the batteries are being charged. It can also test the condition of either battery at any time.

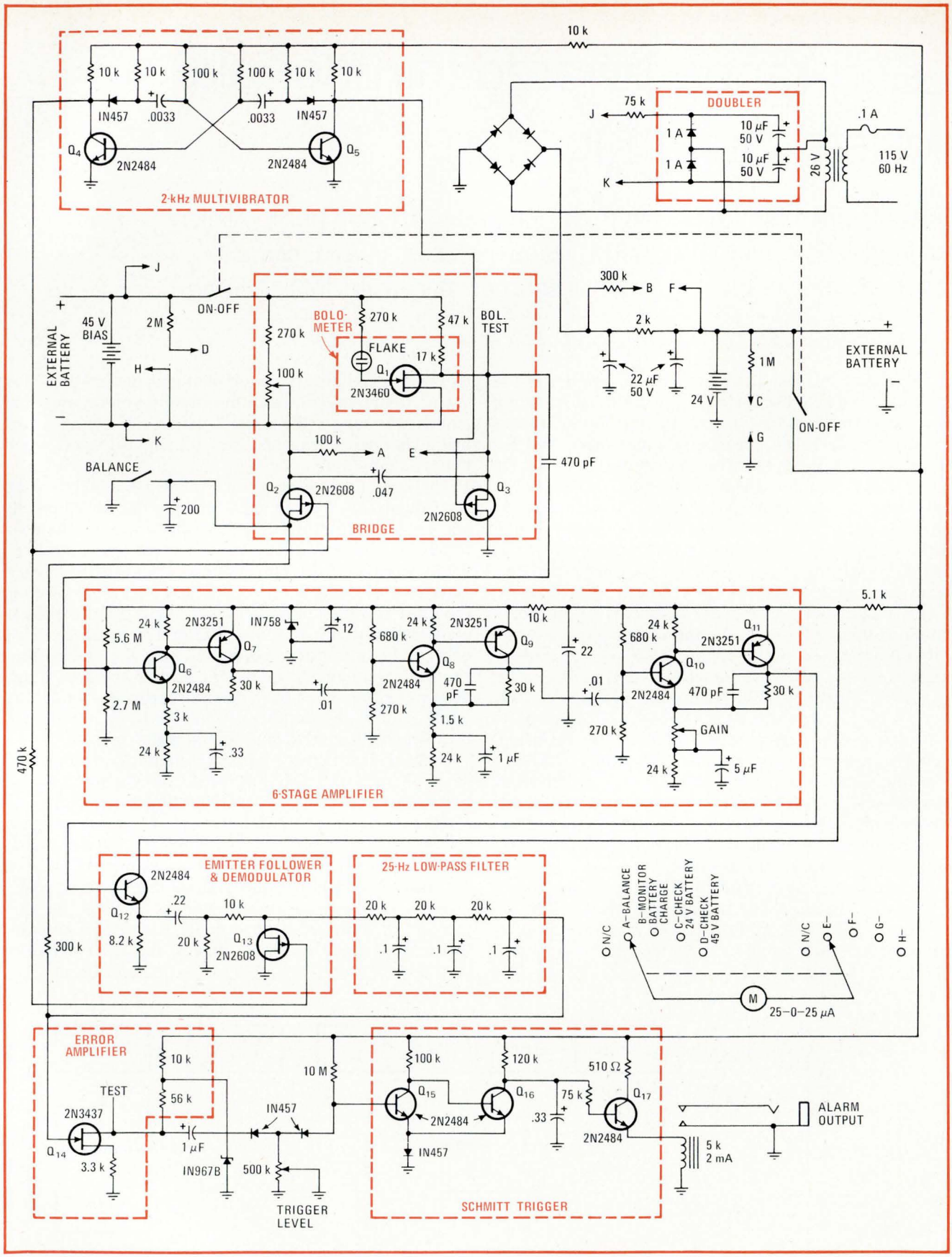
The new detector responds to infrared radiation at wavelengths of 2 to 15 micrometers, the intermediate and far-infrared portions of the spectrum. A reticle in front of the infrared sensor provides sensitivity to movement. When an intruder—a source of infrared—moves across the field of view, the reticle chops the incoming radiation and thus modulates a 2-kilohertz square-wave carrier, produced by a multivibrator and a pair of field-effect transistors; the modulation trips the alarm. The chopping frequency is between 0 and 25 Hz, depending on the angular speed of the source across the field; it is established by the number of lines in the reticle and by the distances from reticle to sensor and to target.

In the detector (Fig. 1), infrared radiation from a target is focused through the reticle onto a ferroelectric bolometer; the radiation changes the bolometer's dielectric constant and thus generates a minute current. As the target moves, the reticle chops the radiation falling on the bolometer, producing current pulses.

When the detector is idling, the 2-kHz carrier is symmetrical; but with an infrared source in view, the bolometer current causes the carrier to become unsymmetrical, and as the source moves, the current pulses



1. Detector. Reticle chops infrared radiation from source, modulating bolometer current and therefore multivibrator symmetry. Demodulated filtered signal trips Schmitt trigger and sounds the alarm.



2. Bridge unbalancer. Bolometer is part of bridge circuit that becomes unbalanced when illuminated by infrared radiation. Six-stage amplifier is conventional circuit with small negative feedback. Main power source is 24-volt nickel-cadmium battery; 45-V NiCad battery biases the bolometer. Alternatively, an external battery or standard 120-V ac source may be used.

create a pulse-width modulated carrier signal. This modulated carrier is then amplified, demodulated, and filtered; the filter's response is flat to 15 Hz and down 6 dB at 25 Hz. The filter's output is an alarm signal that is amplified, rectified, and presented to a Schmitt trigger that actuates the external alarm signal. Although discrete components are shown in the schematic diagram (Fig. 2), integrated circuits can be used instead.

The ferroelectric bolometer, which picks up the infrared radiation from the source, is made from a mixture of 75% barium titanate and 25% strontium titanate. This mixture is ground to particles about 1 μm in diameter, die-pressed into flakes, each having an area between ½ and 2 square millimeters, and sintered. The sintering causes some strontium atoms to migrate into spaces in the barium-titanate crystal structure, lowering the Curie temperature of the mixture to about 25°C, or room temperature. After sintering, each flake is coated with a conductive material, so that it becomes a small capacitor of 5 to 25 picofarads.

Ferroelectric materials, such as the titanates in the bolometer, have a spontaneous polarization at temperatures below their Curie points. But at the Curie temperature, the crystal structure changes, causing polarization to vanish and the dielectric constant to change rapidly. For the particular mixture used here, the dielectric constant increases 5%/°C in the vicinity of the Curie temperature, giving a high sensitivity; in addition, the bolometer can respond to incoming radiation chopped at frequencies up to 3 kHz.

Since the actual chopping never exceeds 25 Hz, this fast response assures that the changes in pulse width of the carrier are sharp and well-defined. The bolometer housing also contains a preamplifier, consisting of a low-noise field-effect transistor, Q_1, and a 17-kilohm resistor. This amplifier provides a gain of 8 to 10, but its primary purpose is to present a very high input impedance to the bolometer and to match this to the next stage's much lower input impedance.

Infrared radiation from the area in front of the detector is focused on the bolometer by a lens. Both a germanium lens 2 inches in diameter, with aperture of f:1, and a commercially available zinc-sulfide lens have been used; the germanium intrinsically filters out all radiation with a wavelength less than 2 μm, while the zinc-sulfide lens can be used with a separate 4.2-μm filter that excludes solar radiation. While the lens is not mandatory—the detector has a range of more than 100 feet without it—the filter, with a reticle incorporated in it, is necessary; if no lens is used, a small germanium window filter about an inch in diameter, with reticle included, is necessary. Such filters are quite inexpensive.

Detector operation

To operate the detector, it is turned on and switched into balance mode. The 2-kHz multivibrator drives the bridge circuit formed by the bolometer, two 270-kilohm resistors, the 100-kilohm potentiometer, and two J-FET transistors, Q_2 and Q_3 (see schematic diagram). In balance mode, the source terminals of both J-FETs are grounded, and the microammeter is connected across the bridge. The resistors control the current supply for the two J-FETs, the outputs of which are floating with respect to ground. With the detector running under normal ambient conditions and with no infrared target in view, the potentiometer is adjusted until the null of the microammeter indicates that the multivibrator's output is symmetrical.

Rear view. In balance mode (switch, right), microammeter is nulled by adjusting potentiometer (above knob at left). Phase control adjusts main amplifier gain. Function knob (bottom left) is at 1 for normal operation, 2 for balancing; other positions check batteries and monitor charging. Knob, bottom right, sets triggering level of alarm.

When balancing is complete, the detector is taken out of balance mode; this action inserts a 200-μf capacitor between the source of Q_2 and ground. This capacitor keeps the bridge balanced, even if the ambient temperature changes by ±10°F.

An infrared signal appearing in the field of view raises the temperature of the bolometer above its Curie point, thus unbalancing the bridge and the multivibrator. If the infrared source moves—even as little as 0.1 foot per second—the radiation flickers through the reticle, thus alternately balancing and unbalancing the bridge and modulating the multivibrator output. This modulated output is amplified in a six-stage amplifier in which a combination of npn and pnp transistors Q_6 through Q_{11} and small negative feedback provide both high gain and high stability. At the output of the amplifier, an emitter-follower, Q_2, feeds the signal to a demodulator, Q_{13}, which is synchronized with the multivibrator output to improve the signal-to-noise ratio.

The demodulator's output is a varying signal that represents the infrared source's motion across the reticle; this is passed through a low-pass filter with a 25-Hz cutoff to another amplifier stage, a rectifier, and a Schmitt trigger. The trigger closes a relay that activates an external rf transmitter, camera, lights, or bells.

Several prototypes have been built and tested, and production is now getting under way, using the bolometer, which has been a production item since June under a Government contract. □

Temperature-stable decoder for modulated pulse widths

by H.R. Beurrier
Bell Telephone Laboratories, Murray Hill, N.J.

Besides offering exceptional temperature stability, a pulse-width-modulation decoder for remote proportional radio control produces a presettable fail-safe analog output when the input control signal is interrupted. The circuit converts a time-modulated pulse input to an analog output.

Transistors Q_1 and Q_2 form a sawtooth generator with a ramp output that starts when the input control signal goes positive and that resets when the input goes negative. The control signal switches Q_2 alternately on and off.

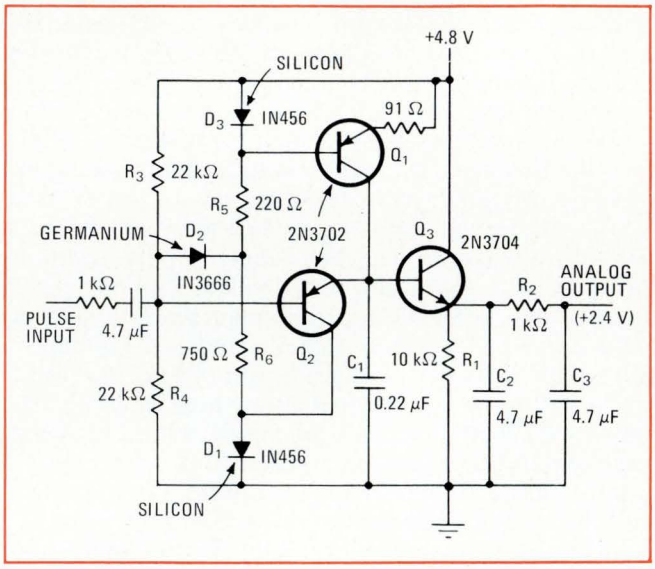
When the base of Q_2 is driven positive by the input, this transistor turns off and capacitor C_1 charges with the constant current supplied by transistor Q_1. (The longer the input pulse duration, the higher C_1's ramp voltage and the resulting output voltage.) When Q_2 is driven negative, it conducts, pulling its emitter voltage in the negative direction and partially discharging capacitor C_1.

Emitter-follower Q_3 acts as a peak-voltage detector that charges capacitor C_2 positively when its base is driven positive by the ramp voltage of capacitor C_1. If the voltage across C_1 is too negative to forward-bias the base-emitter junction of Q_3, capacitor C_2 discharges through resistor R_1. This portion of the circuit, therefore, acts as a diode peak detector with power gain. Resistor R_2 and capacitor C_3 are connected as a simple first-order output filter.

Once the input signal is terminated, the base voltage of transistor Q_2 settles to a level determined by the voltage divider of resistors R_3 and R_4. This voltage level is coupled to the output through transistors Q_2 and Q_3, which are connected as cascaded emitter-followers. The complementary arrangement of Q_2 and Q_3 causes any temperature-induced change in the base-emitter voltage of transistor Q_2 to be cancelled by an equal-in-magnitude, but opposite-in-polarity, change in the base-emitter voltage of transistor Q_3.

The circuit's output voltage is referenced to the lower point of capacitor C_1's charge/discharge cycle. When the input is negative, diode D_1 reverse-biases transistor Q_2's collector so that capacitor C_1 always discharges to the same level. Diode D_2 and resistors R_5 and R_6 clamp the capacitively coupled input control signal so that transistor Q_2's base is driven slightly negative. Diode D_3 simply fixes the base voltage of transistor Q_1.

With the component values shown, the circuit will convert a pulse width of 1.25 ±0.63 milliseconds to an analog output of 2.4 ±0.6 volts dc. The 1-kilohm input resistor simply reduces the loading on the driving source. □



PWM decoder. Circuit detects pulse-width-modulated signals, supplying dc analog output over wide operating temperature range. If input control signal is interrupted, decoder output goes to preset fail-safe level. Transistors Q_1 and Q_2 and capacitor C_1 make up sawtooth generator that drives transistor Q_3, which acts as peak-voltage detector. Q_2 and Q_3 are cascaded complementary emitter-followers.

C-MOS sums up tones for electronic organ

by Robert Woody
Hercules Inc., Radford, Va.

An electronic organ that produces a wide variety of voices, either singly or in combination, can be built with relatively simple circuitry if complementary-MOS logic circuits and linear diode gates are used. The organ, which requires only one gate for each frequency, adds tones to derive the harmonic content of each voice. Sound reproduction varies smoothly, too, so that there are no unpleasing key clicks.

The circuit shown generates the eight frequencies of note A. Adjacent frequencies of the same note have 2:1 ratios and are separated by an octave. Similar circuit arrangements generate frequencies for notes B through G and five sharps, for a total of 12 notes. These 12 notes, each having eight frequencies, comprise the 96 frequencies in the organ. Individual frequencies are spaced

at 6% intervals, from 32.7 to 7,902 hertz.

The eight square-wave outputs of the Hartley oscillator and the binary divider have precise frequencies, but are not musical because square waves contain only the fundamental frequency and odd (not even) harmonics. Furthermore, if these square-wave frequencies are turned on and off directly by key switches, the sounds begin and end too abruptly to be musically pleasing, and key clicks will be heard.

A diode gating circuit, like the one consisting of diode D_1, resistor R_1, and capacitor C_1, is used to convert each square wave to a sawtooth. This supplies the even harmonics and helps to turn the tones on and off gradually without clicks.

The square wave alternates between the supply voltage and ground. While the square wave is at ground, D_1 is forward-biased by current flowing through R_1, and the gate output is also at ground. When the square wave goes to the supply voltage level, D_1 is back-biased so that current through R_1 charges C_1, causing the gate output to have a rising slope. The capacitor discharges quickly through the diode when the square wave returns to ground, and the cycle repeats.

Resistor R_2 and capacitor C_2 slow the application of current to resistor R_1, permitting the gate to turn on and off gradually without clicks. Since C_1 charges for half the cycle of square-wave frequency f, time constant R_1C_1 is half the period of f, or:

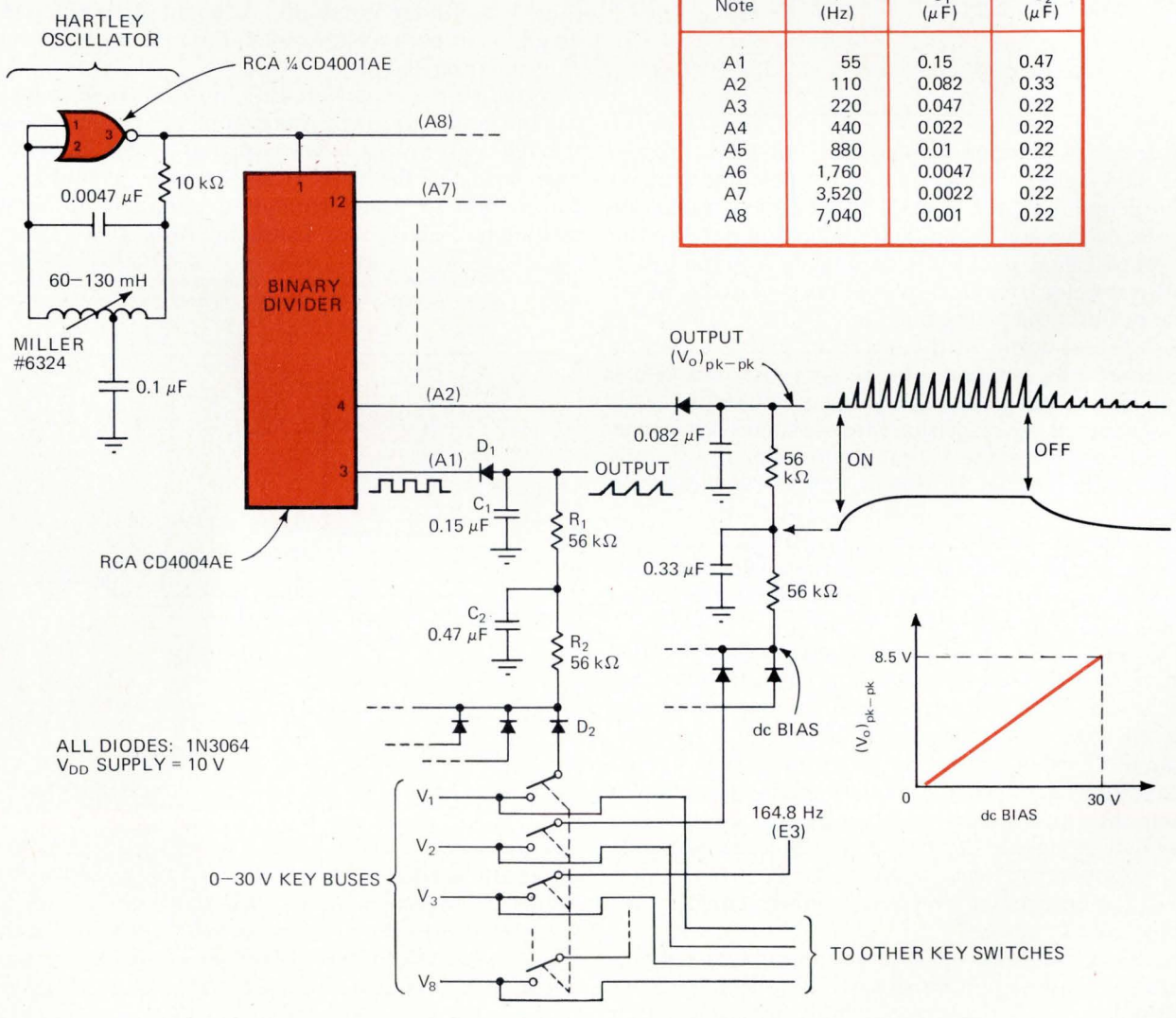
$$C_1 = \tfrac{1}{2}fR_1$$

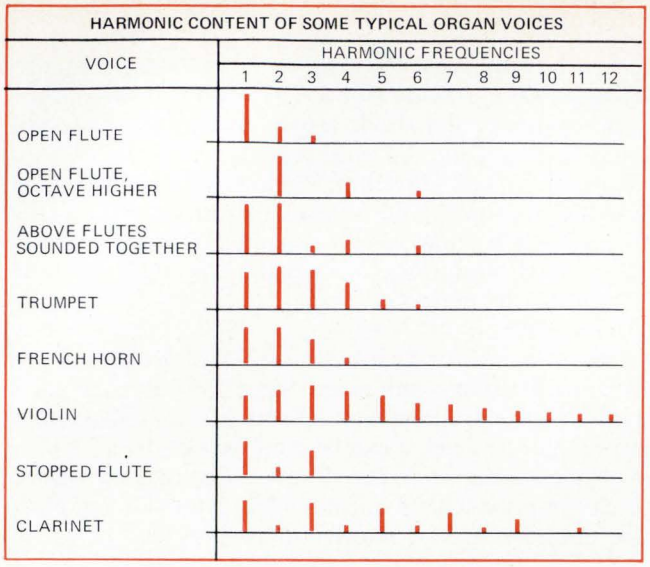
Values for capacitor C_2 are selected to approximate the switching times of organ pipes. Since the output of each gate is linearly proportional to its dc biasing voltage, the tone amplitude needed can be metered out precisely.

To sum tones to create the desired organ voices, which comprise several harmonically related tones, each gate output must be filtered to reduce its harmonics

C-MOS makes organ music. Complementary-MOS ICs add tones to produce eight frequencies that make up note A. Each of the remaining six notes, B through G, plus five sharps, requires its own Hartley oscillator and binary divider network to generate all 96 organ frequencies. Diode gate at each divider output converts that square wave to a sawtooth to get the necessary even harmonics.

Note	f (Hz)	C_1 (μF)	C_2 (μF)
A1	55	0.15	0.47
A2	110	0.082	0.33
A3	220	0.047	0.22
A4	440	0.022	0.22
A5	880	0.01	0.22
A6	1,760	0.0047	0.22
A7	3,520	0.0022	0.22
A8	7,040	0.001	0.22





down to the simplest voice produced in the organ, namely the flute. Since the eight frequencies of a note are multiples or submultiples of each other, they can be handled by one low-pass filter. This means that only 12 low-pass filters are needed for all 96 frequencies.

The diodes between the gates and the key switches—diode D_2, for instance—allow a given tone to be sounded by a number of different key switches. All of the key switches indicated are operated by the key for note A1. The voltages (V_1, V_2, V_3, . . .) on the key buses determine the amplitude at which the tones are sounded (V_1 controls the fundamental frequency tone, V_2 the second harmonic, V_3 the third, . . .). The key bus voltages set the harmonic content and, therefore, the voice of all the keys on the keyboard.

To conserve circuitry, the third harmonic, note A3, borrows a tone from the gate (not shown) used for note E3. The resulting 0.2-Hz frequency error cannot be heard. □

Transistor gating circuit cuts signal delay to 100 ps

by Arthur J. Metz
Tektronix Inc., Beaverton, Ore.

Frequently in emitter-coupled-logic design, a high-speed data signal must be gated by a dc control signal that is generated by a contact closure or a transistor-transistor-logic gate. When the propagation delay in the high-speed signal path must be held to a minimum, a simple transistor circuit can probably provide the fastest way to perform the gating function.

Propagation delay for the transistor gate is as low as 100 picoseconds, compared to the 1-nanosecond delays of the fastest integrated-circuit gates presently available. Moreover, the transistor gate consumes less power and costs less than the IC gate, especially if an additional IC gate package is needed to perform the gating function.

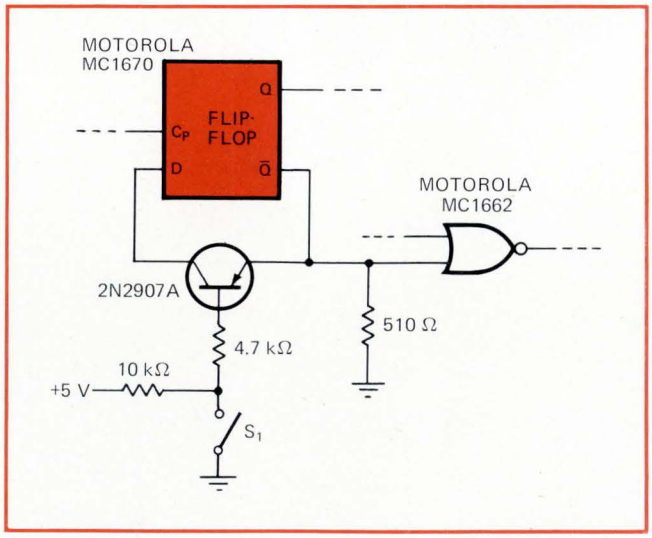
A typical application for the transistor gate is shown in the figure. Here, signal delay between the flip-flop's $\overline{Q}$ output and its D input must be minimized to realize the fastest possible toggle rate.

With switch S_1 open, the transistor's base-emitter junction is reverse-biased. An internal pull-down resistor of about 50 kilohms at the flip-flop's D input holds all data inputs near ground potential, reverse-biasing the flip-flop's input stage (by more than 3 volts) and assuring the rejection of any signal that passes through the internal capacitance of the transistor. When the switch is closed, the transistor saturates and provides a low-impedance signal path. For TTL applications, the function of switch S_1 is implemented by the appropriate TTL device.

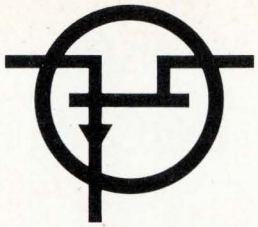
The noise immunity of the gating circuit is maintained by keeping the transistor's collector-emitter voltage drop low. (With the type 2N2907A transistor, which has excellent saturation characteristics, the V_{CE} drop can be held to approximately 10 millivolts by using a forced beta of 0.1.) Driving several high-impedance inputs or perhaps one low-impedance input will cause some loss of noise immunity. Although driving a terminated line is not recommended, the gate may be driven from a terminated line.

As with any ECL design, care must be taken in laying out the circuit to realize maximum performance. Since the full logic-voltage swing appears at the transistor's base terminal, the base biasing resistor should be located close to that terminal to eliminate the transmission line effects of an interconnecting lead. □

Designer's casebook is a regular feature in Electronics. We invite readers to submit original and unpublished circuit ideas and solutions to design problems. Explain briefly but thoroughly the circuit's operating principle and purpose. We'll pay $50 for each item published.



Gating ECL signals. Bipolar transistor gate can transfer logic signals with propagation delay of as little as 100 picoseconds. With switch closed, transistor saturates and gates signals from flip-flop's $\overline{Q}$ output to its D input. When switch is open, transistor is cut off, and strong reverse bias at D input rejects all unwanted stray signals. The switch can be a pair of contacts or a TTL device.



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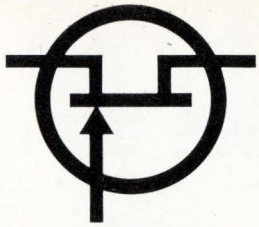

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Automatic control of speaker output compensates for noisy background

Output level of speaker system is increased by more than 30 dB to automatically compensate for changing background noises; the system is suited for such environments as those encountered by mobile radios

by David B. Hoisington, *Naval Postgraduate School, Monterey, Calif.*, and Andrew F. Hobson, *U. S. Coast Guard, Washington, D. C.*

☐ Noise in the surrounding environment can mask information coming from audio speakers. Mobile communications receivers in cars and trucks, for example, frequently have to compete with varying levels of audible background noise.

If the level of background noise were constant, it would be relatively easy for a listener to adjust the signal to an optimum level. However, in most situations, the audible noise is constantly changing.

To continuously adjust for optimum signal level in the presence of changing noise, then, an automatic volume control is highly desirable. In an automatic control system that was designed and tested at the Naval Postgraduate School, a balancing arrangement prevents the circuit from interpreting the received audio signal as noise. To further refine the control's ability to sort wanted from unwanted signals, a frequency-weighting technique was incorporated to approximately match the peculiar characteristics of the human ear.

By applying integrated-circuit technology to implement the design, the system should provide operator comfort and listening convenience, not only in mobile communications systems, but in such applications as public-address systems and home-entertainment radios, where mass-production methods are required.

The system design

Any noise-compensation system must be able to measure the background-noise level in the presence of the speaker signal, but independently of it, and then rapidly adjust the speaker volume accordingly. Independent measurement of the signal level is necessary for system stability because if the control circuit interprets the speaker signal as noise, a runaway increase in signal volume results.

Since the noise-measuring system must be subjected as nearly as possible to the same ambient noise as the listener, the detector will usually pick up both the speaker output and the background noise. The compensation system must then be able to separate the noise from the intelligence.

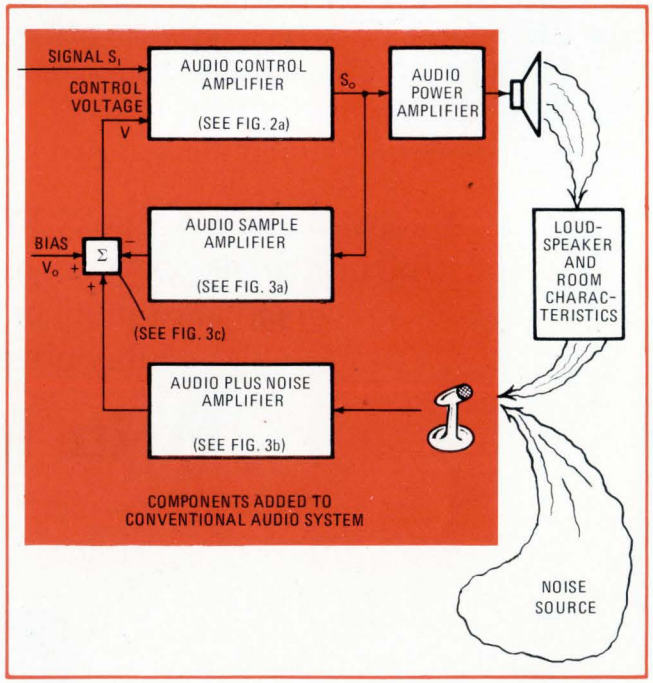
In the system design chosen (Fig. 1), a microphone is placed near the listener, where it picks up both signal and noise. The microphone output is amplified, rectified, and filtered. At the same time, a sample of the audio control-amplifier output is rectified and filtered, and then it is subtracted from the rectified microphone output, which consists of signal plus noise. The resulting voltage level, which is approximately proportional to the noise level, then adjusts the gain of the control amplifier to maintain the desired relationship between signal and noise level.

Ideal control characteristics

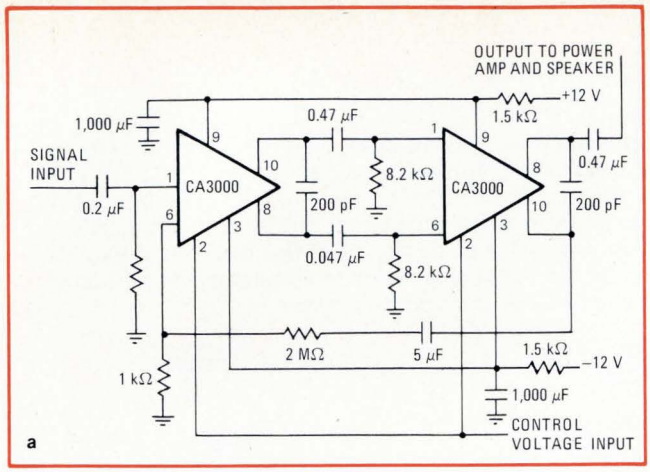
This discussion assumes that the signal-level input to the audio-control amplifier remains constant. The audio-control amplifier has a power gain that is proportional to the control voltage, V, or

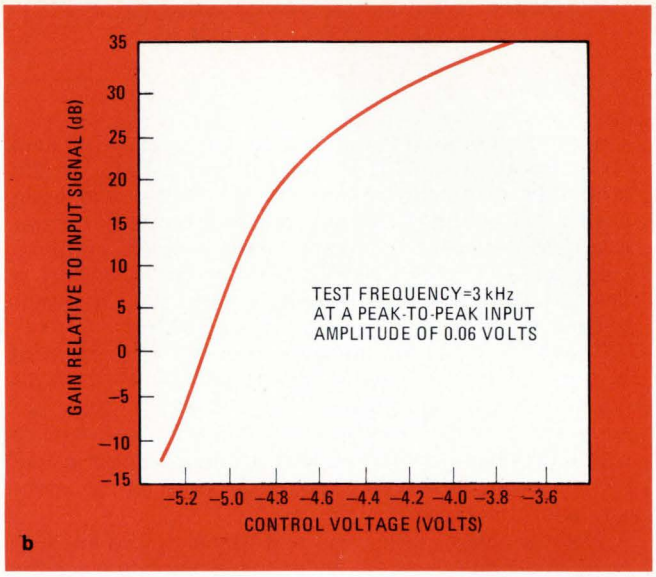
$$S_O = kVS_I \qquad (1)$$

where S_O and S_I are the amplifier-signal output and input powers, respectively. The control voltage consists of the sum of a fixed component, V_O, plus a component proportional to the total sound power picked up by the microphone, $A_N(N + \alpha S_O)$, less a component proportional to the output of the audio control amplifier, $A_S S_O$. Here, α represents the signal loss from audio-con-



1. Battle with noise. Feedback system compares sampled signal output to ambient signal plus noise to generate a control voltage proportional to background-noise levels. The resulting speaker output is thus automatically adjusted to changing background noise.





2. Control amp. Integrated circuits reduce power consumption and size of the audio-control amplifier (a). Gain is linear over a 30-dB range (b), controlled by a variable dc level of −5.2 to −4.8 volts.

trol amplifier output through the speaker, room coupling, and microphone; N is the noise power at the microphone output, and A_S and A_N are the ratios of the dc output voltage to the amplifier power input for the two channels, as indicated in Fig. 1. It follows that

$$V = V_O + A_N N + kVS_I A_N - A_S kVS_I \quad (2)$$

Substituting for V in Eq. 1,

$$S_O = \frac{kS_I(V_O + A_N N)}{1 - kS_I(\alpha A_N - A_S)} \quad (3)$$

Now if the gains are adjusted so that $\alpha A_N = A_S$, Eq. 3 becomes

$$S_O + kS_I(V_O + A_N N) \quad (4)$$

Under this condition, audio control-amplifier output is constant (for constant input) when the noise level is low ($A_N N$ is less than V_O), and the output-to-noise ratio is constant and equal to $kS_I A_N$ when the noise level is high ($A_N N$ is greater than V_O).

Practical considerations

The ideal system cannot be realized exactly for several reasons. It has been assumed that the frequency-response characteristics of the two bias-producing circuits are identical. In practice, while the frequency response from audio-control amplifier output through the audio-sampling amplifier can be made quite smooth, the frequency-response characteristics of the speaker, room, and microphone will be extremely variable, particularly if the room acoustics are not highly damped. Thus, it is not possible to obtain exact cancellation of the second term in the denominator of Eq. 3.

However, since voice signals generally consist of a broad spectrum, it is possible in practice to obtain satisfactory cancellation. Cancellation is less critical if the microphone is placed so that a minimum signal is picked up from the loudspeaker. But it is generally desirable for the microphone to be exposed to the same noise as is the operator, which requires that the microphone be placed near the operator and hence coupled to the speaker. In situations where the noise is not localized, microphone-to-speaker coupling can be reduced.

Another design consideration relates to one of the peculiar characteristics of the ear. The presence of noise containing low-frequency components raises the minimum discernible level for audio signals of the same or higher frequency, but high-frequency noise has little masking effect on lower-frequency audio signals (see panel). For this reason, the microphone channel should have a flat response for the full range of signal components, and its frequency response should decrease beyond this range. Telephone communications systems usually have an upper frequency limit of about 3,300 Hz, while entertainment radios in vehicles generally go an octave higher in frequency.

Developmental system

Integrated circuits are used whenever possible in the Navy's test system to keep size and power consumption at a minimum. Because the system is intended to be placed between the detector and audio amplifier of existing communications systems, a separate audio power amplifier is not required.

Two cascaded RCA CA3000 dc amplifiers are employed in the audio-control amplifier (Fig. 2a). Since the 3-dB bandwidth of this amplifier is from dc to 22,000 Hz, the system audio bandwidth is not limited by the added control circuitry. The input signal must be scaled to a maximum 0.1 volt peak-to-peak to avoid excessive distortion, and this level is set by an input potentiometer. Total gain variation exceeds 45 dB as the control voltage is changed from −5.3 to −3.6 V (Fig. 2b). The gain is nearly a linear function of control voltage over a 34-dB range.

The audio sample amplifier (Fig. 3a) consists of a two-stage transistor amplifier, followed by a peak detector. An input potentiometer connected across the system speaker sets the sensitivity of this channel. The bandwidth of this amplifier is about 10 kHz.

The audio-plus-noise amplifier (Fig. 3b) consists of a dynamic microphone, followed by one stage of transistor amplification, an RCA CA3015A high-gain operational amplifier, and a diode peak detector. Frequency response is limited at the low end to 100 Hz (6 dB) by the microphone, and at the high end to 12 kHz by the amplifier. Response beyond 12 kHz is not required, since high-frequency noise does not appreciably mask

How the ear hears

The key to the design of a volume-compensating system for noisy environments is some understanding of the properties of human hearing. While the ear and brain have the ability to detect sound over a range of greater than 100 decibels, the human hearing system performs many other functions. Among other things, it provides a unique filter that weights differing frequencies and distinguishes between various characteristic sounds.

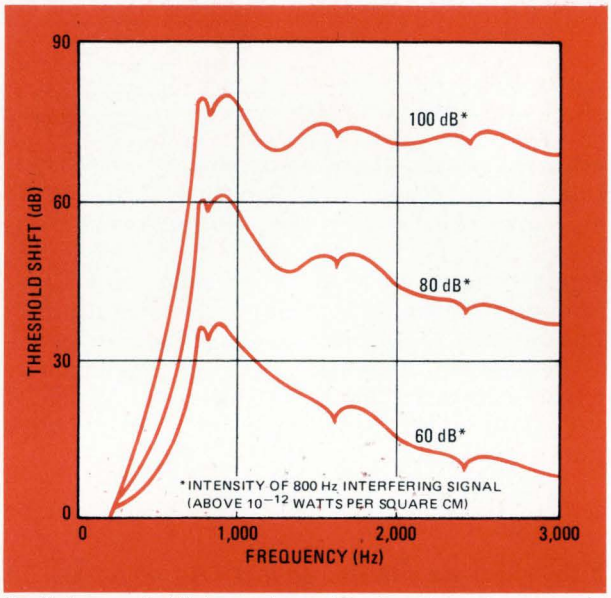
The response of the human ear for 10-dB increments of signal levels is shown in Fig. A. An intensity of 0 dB corresponds to a reference level of 10^{-12} watts per square centimeter. The 0-level contour is the average human's minimum level of detectable intensity. Notice that the response bandwidth becomes broader as the intensity level is increased.

Approximations of the levels of typical noises encountered in our daily lives are added to the graph to place the intensity-level contours in perspective. Also shown is the nominal range over which the automatic volume-compensation system operates.

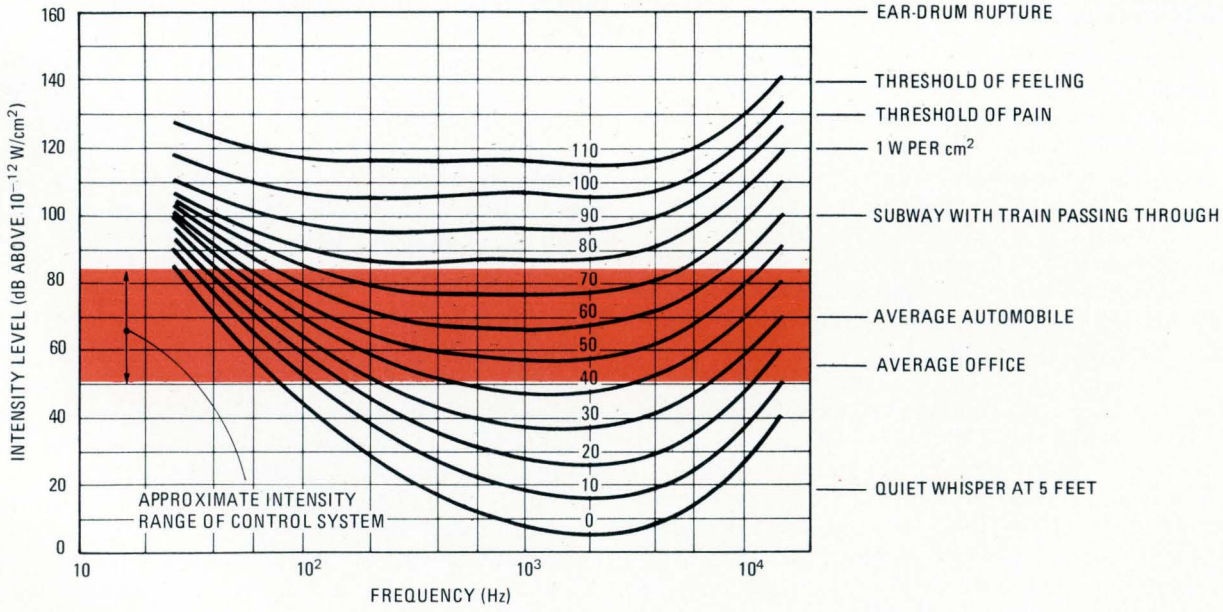
The contours in Fig. A were generated for single frequency components in an otherwise totally quiet environment. As might be expected, the minimum detectable intensity levels would increase in the presence of unwanted noise. To measure this effect, H. Fletcher, in "Speech and Hearing in Communications" (Van Nostrand Co., 1958), characterized the apparent shift in minimum detectable signals (MDS) as a function of the intensity of a single frequency-masking tone.

An example of this increase in MDS threshold in the presence of a masking tone of 800 Hz is shown in Fig. B. From these curves, it is apparent that the presence of pure tones increases the MDS threshold at frequencies above the masking tone.

The masking effect is not changed significantly in actual environments where multiple frequency components are encountered. In this case, the broadband noise tends to raise the MDS level for desired signals of the same or higher frequencies. On the other hand, higher-frequency noise has relatively little effect on the ear's detection of lower-frequency audio signals, a fact that fixes the upper filtering limits in the signal-plus-noise amplifier portion of the volume-compensation system.



B. Noise mask. Minimum detectable signal intensity rises at frequencies near and above an 800-hertz interference signal. The masking effect is less significant at frequencies below that of the interfering tone. Notice the faster fall-off in detectable signal threshold at frequencies above 800 Hz when the weaker interfering signal levels are used.

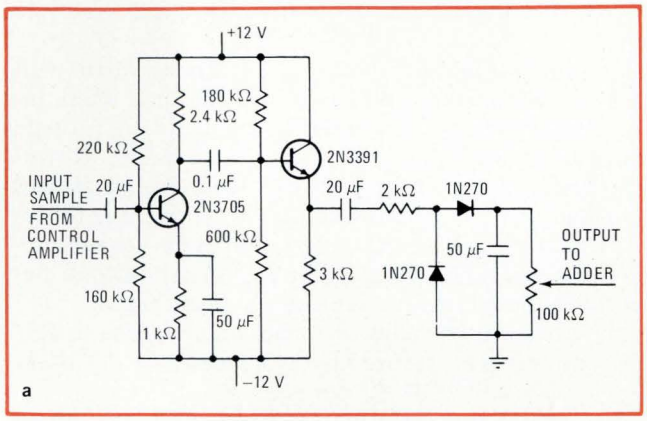


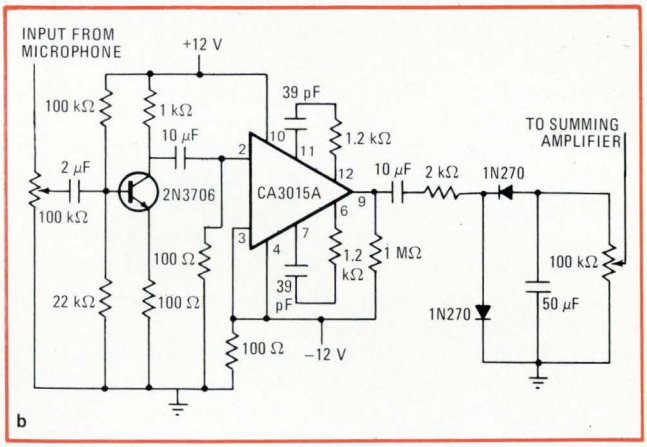
A. Human response. Human ears act as narrowband filters at very low signal intensities, but responses increase to a 3-dB bandwidth of several thousand hertz at an intensity of 1 watt per square centimeter.

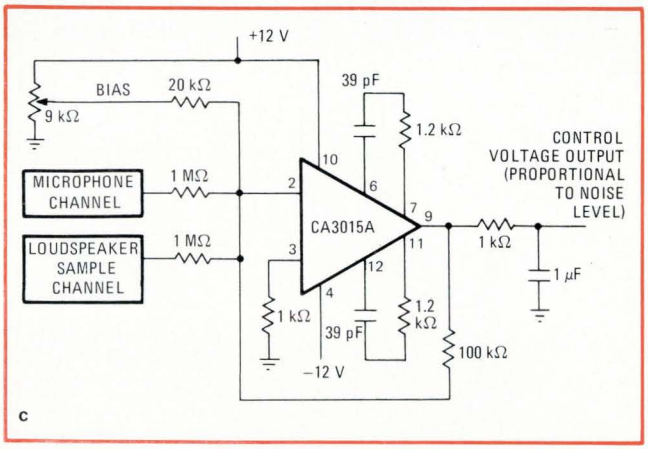
lower-frequency audio signals.

The attack-time constant for the detector filter in the audio-plus-noise amplifier is 0.1 second, and the release-time constant is 5 seconds. This provides for a rapid increase in system volume when noise appears suddenly. Gain remains high with fluctuating noise and then decays more slowly to compensate for the recovery time of the ear. The time constants in the filter of the audio-sampling amplifier are identical to make the control voltage as nearly as possible independent of signal variations.

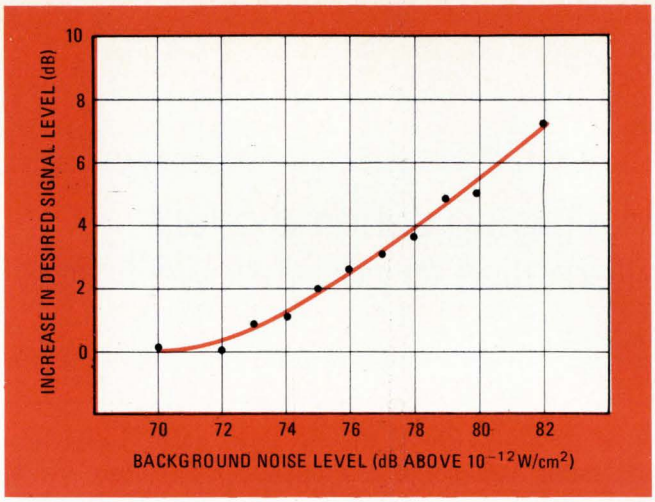
An integrated-circuit operational amplifier is used as an inverting scaling summer (Fig. 3c). The inputs consist of the direct-current-coupled outputs of the sample amplifier, the audio-plus-noise amplifier, and the fixed bias.







3. Feedback circuits. Outputs of signal sampling amplifier (a), and signal-plus-noise amplifier (b) are summed in amplifier (c) to produce control-voltage input to audio-control amplifier.



4. Highway test. With recorded freeway sounds as the noise source, prototype volume compensator responds to a 10-dB increase in background noise with a 7-dB increase in speaker volume.

To place the system in operation, several initial adjustments are required, but these have been found to be quite stable and not unduly critical. The input signal is adjusted to a level of 0.1 V_{pp}, which the system is designed to handle. The fixed bias is set to correspond with a minimum gain at the lower end of the linear portion of the gain-vs-bias curve (Fig. 2b). The sensitivity of the audio power amplifier is set to give the desired output level with no noise.

This control is the only one that must be made accessible to the listener, and in practice, it is rarely touched. The sensitivity of the noise-plus-signal channel is set to give the desired increase in gain of the control amplifier in the presence of noise, while the sensitivity of the audio sample amplifier is set so that changes in the signal level do not cause an appreciable change in control voltage.

Results and conclusions

In initial tests of the system, a General Radio sound-level meter measured speaker signals and background noise that had been recorded on a busy freeway. Signal level increased and decreased in approximately linear fashion with changes in background noise level (Fig. 4). Response time for a sudden noise increase corresponded to the 0.1-second attack-time constant of the bias rectifiers, and a decay-time constant of about 2 seconds was measured.

Subjective testing indicated that the system greatly improved reception. With changes in the noise level, the signal-to-audio noise ratio remains within comfortable bounds, so that readjustment of the audio-level control is not necessary. Time constants prove to be quite acceptable, either for slowly changing or rapidly fluctuating noise.

The useful dynamic range of the test system was limited to about 35 dB, but this could be increased by adding gain-controlled stages to the two in the audio-control amplifier and by using a larger power amplifier. □

Multiplying scheme offers alternative to count-down timers

by Elbert L. Cole
Westinghouse Systems Development division, Baltimore, Md.

Most timing networks, such as those used to synchronize radar and digital communications systems, use a clock oscillator at the highest timing rate needed, then divide down the clock frequency to synthesize all of the various gating pulses and waveforms required in the system. The clock thus generates the highest pulse rate in the system; all other waveforms have frequency components at clock rates or lower.

An alternative to this conventional timing system has been proved successful at Westinghouse. A lower clock frequency is used, and the waveforms required are generated by multiplying up from the clock frequency.

The frequency-multiplying, or count-up, technique is of particular advantage when used at frequencies higher than about 20 MHz, where inexpensive MSI count-down circuits are not available. The multiplying approach is also highly desirable when used in subsystems that get their fundamental timing from a low-frequency clock at some central location in the system.

Key to the count-up approach is a simple and inexpensive multiplying scheme, based on fundamental properties of the binary-numbering system. The basic frequency-doubling circuit (Fig. 1), consists of a delay line, followed by an exclusive-OR gate, which has the following truth table:

	0	1
0	0	1
1	1	0

The timing diagram (Fig. 2) for the multiplication circuit illustrates the circuit's operation. As can be seen, the delay line must be adjusted so that its propagation delay $\tau = 1/4f_o$, when f_o is the frequency of the waveform to be doubled.

Any number of frequencies can be generated by cascading the multipliers, limited only by the operating speed of the circuitry used. Thus, n multipliers will generate n + 1 frequencies, each of which is a 2^n multiple of f_o.

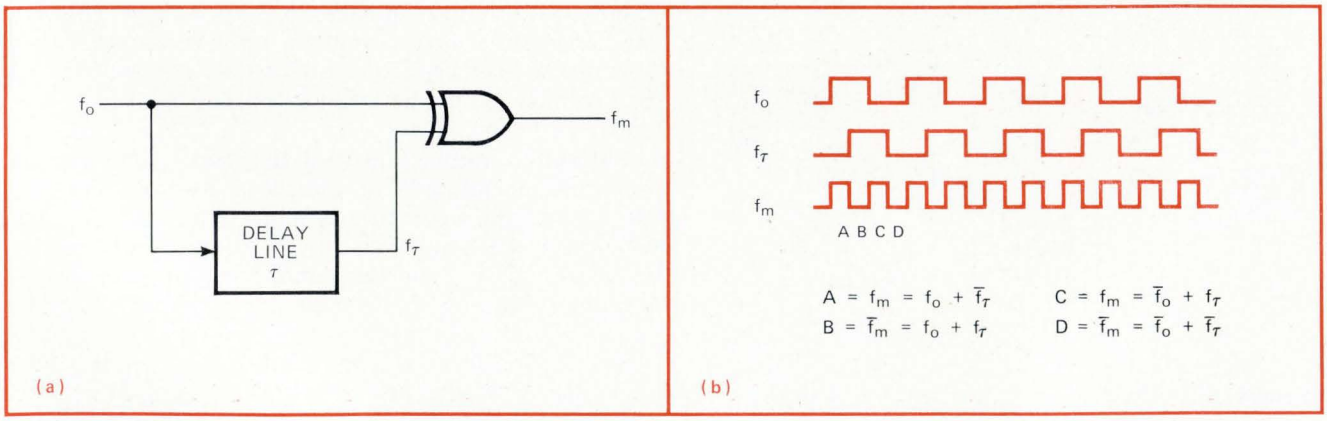
The amount of delay required, of course, varies with each cascaded stage. Screwdriver-adjustable dual in-line delay packages are readily available to provide variable delays from less than 1 millisecond (corresponding to a clock frequency of 1 kilohertz) to devices with delays of 0 to 2 nanoseconds (corresponding to frequencies higher than 100 MHz). Integrated-circuit delay-line costs range from about $2 for nanosecond delays to $8 for delays of as long as 1 millisecond.

TTL exclusive-OR gates that operate at speeds to several tens of megahertz are readily available in TTL packages at costs well under $1 per gate.

Two important performance parameters for timing circuitry are frequency stability, which is determined by the stability of the clock oscillator, and pulse-to-pulse jitter, a little of which is introduced in each multiplier stage. For a single multiplier stage, this jitter is typically 500 picoseconds peak-to-peak, and the jitter adds randomly as multiplier stages are cascaded.

The frequency-multiplying scheme has been used in several operating systems, including a ground station for the synchronous meteorological satellite network scheduled for launching early next year, and a drone-tracking radar for range instrumentation installed at White Sands Missile Range.

In the radar system, 22 cascaded frequency doublers are used to multiply a 23-Hz clock frequency up to 96 MHz. The wide range of frequencies generated is needed in tracking missiles of widely varying speeds. A target range resolution of less than 5 meters is maintained by keeping the over-all system-timing jitter below 30 ns. □



1. Frequency doubler. Basic multiplier circuit (a) consists of a delay line and a single exclusive-OR gate. Timing diagram (b) illustrates frequency-doubling operation. Any 2^n multiple of f_o is generated by cascading multiplier circuits.

Waveform generator chips help the circuit designer

by Bill O'Neil
Intersil Inc., Cupertino, Calif.

Ready-made monolithic waveform generators are versatile building-block components that can simplify many circuit-design tasks. For instance, they are easily inserted into phase-locked loops as voltage-controlled oscillators because of their inherent frequency and temperature stability and because they ease the job of matching loop elements.

At least two of these packaged generators-on-a-chip are now available—the model 8038 from Intersil, and the model XR-205 from Exar Integrated Systems Inc., Sunnyvale, Calif. [*Electronics*, Feb. 14, p. 127]. Both units can produce sine, square, and triangular wave outputs, as well as a sawtooth output and a pulse train. Additionally, both devices can accept modulation voltages, and they offer a broad operating frequency range from less than 1 hertz to 1 megahertz.

A block diagram of Intersil's model 8038 waveform generator is shown in Fig. 1. External capacitor C is charged and discharged by current source A, which is on continuously, and current source B, which is switched on and off by the flip-flop. While current source B is off, the capacitor charges with a current of magnitude I, causing its voltage to rise linearly with time. When this voltage reaches the switching level of comparator 1 (two-thirds of the supply voltage), the flip-flop triggers and switches on current source B.

Since this current source normally carries a current of magnitude 2I, the capacitor is discharged with a net current of magnitude I, and the voltage across it decreases linearly with time. When capacitor voltage reaches the switching level of comparator 2 (one-third of the supply voltage), the flip-flop is triggered into its original state, and the cycle can start again.

Both comparators are made from Darlington transistor pairs to raise input impedance to a high level, permitting the waveform generator to operate with small timing currents. Furthermore, the comparators only draw current at or near each switching threshold level so that any errors created by loading can be neglected.

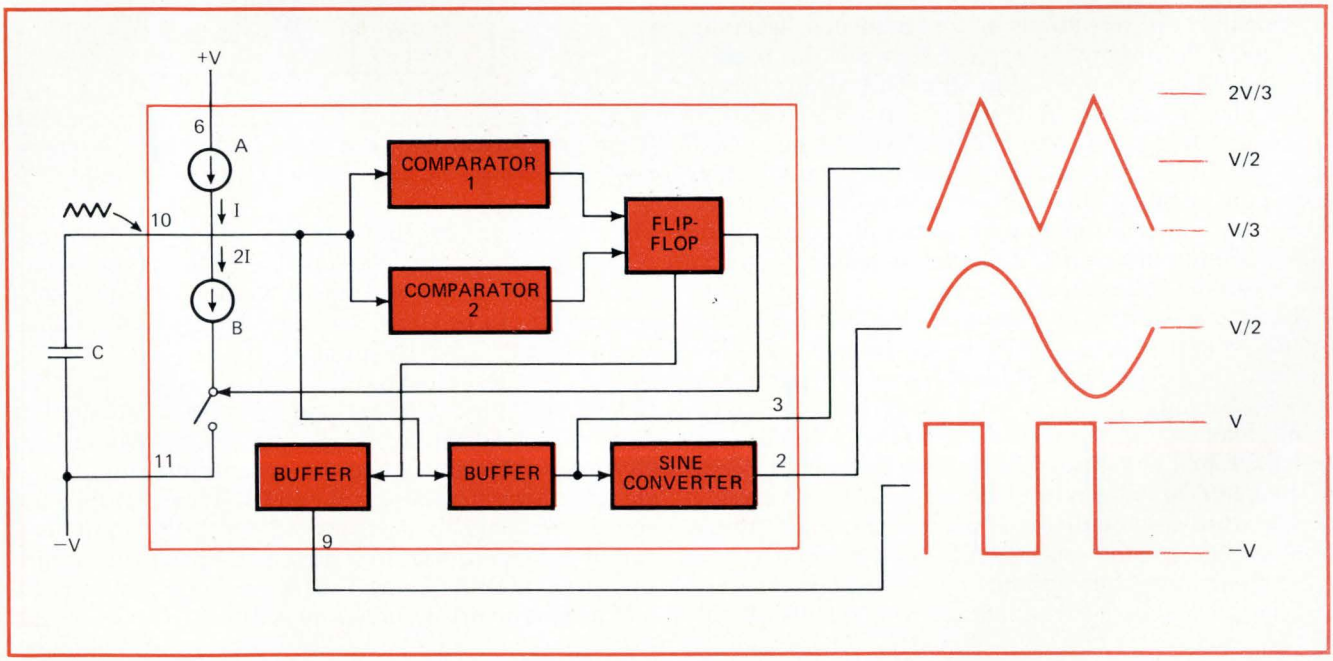
To achieve the highest possible operating speed, the flip-flop is built with transistors that are kept out of saturation by individual Schottky-barrier diodes. Also, the flip-flop is forced to change state before switching on current source B to avoid potentional false triggering or hang-up problems.

Four basic waveforms are readily obtainable from this fundamental generator circuit. With current sources A and B set at levels of I and 2I, respectively, capacitor charge and discharge times are equal, creating a triangular waveform across the capacitor and a square wave at the flip-flop output. Both waveforms are fed to buffer stages.

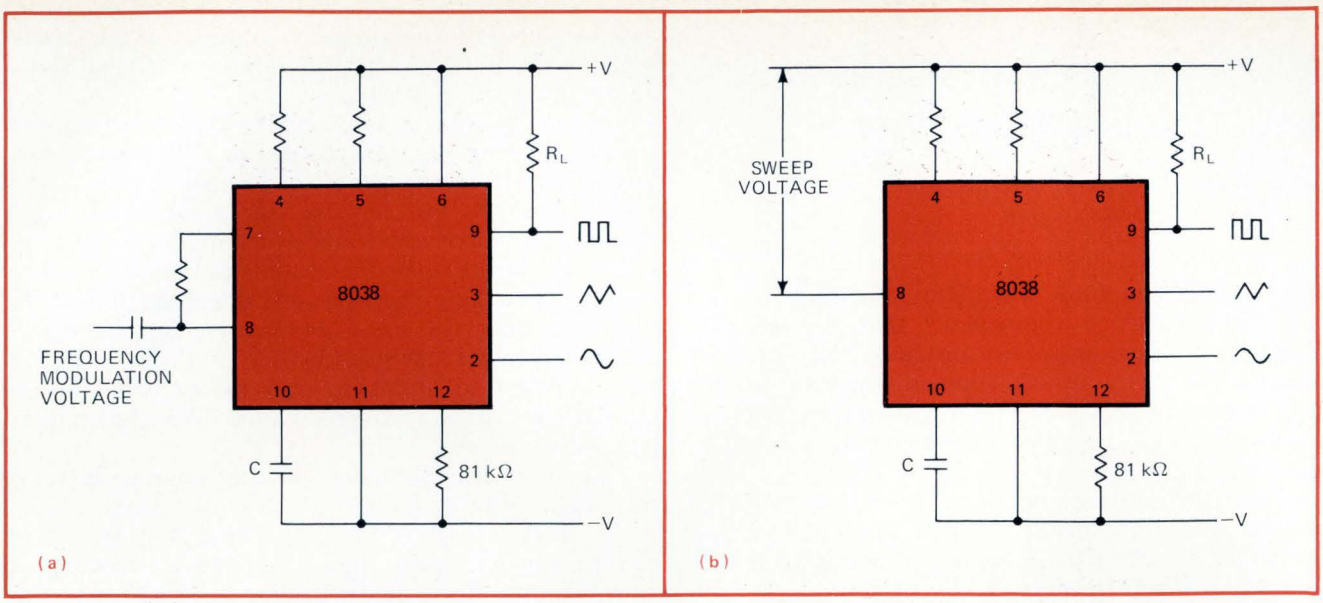
The levels of the current sources can be varied over a wide range of values with two external resistors. When these levels are set at values other than I and 2I, a linearly rising or falling sawtooth can be generated, along with a train of pulses having a duty cycle from less than 1% to greater than 99%. In addition, a sine-wave output is obtained by feeding the triangular wave into a conversion network.

Either a single power supply (10 to 30 volts) or a dual power supply (±5 to ±15 V) can be used to run the generator. With the single power supply, the average voltage levels of the triangular wave and the sine wave are exactly one-half the supply voltage, while the square wave alternates between the positive supply level and ground. The split power supply moves all waveforms symmetrically about ground.

What's more, the load resistor for the square-wave



1. Chip generator. Sine, square, triangular, and sawtooth outputs can be produced, in addition to pulses with a variable duty cycle.



2. Modulation schemes. Generator outputs can be frequency modulated or swept over 1,000:1 frequency ratio with dc control voltage.

output can be connected to a different power supply altogether, as long as that supply's voltage remains within the waveform generator's 30-v breakdown capability. This arrangement permits the square-wave output to be made compatible with TTL circuits by connecting the load resistor to a 5-v supply, while the waveform generator itself is powered from a much higher voltage.

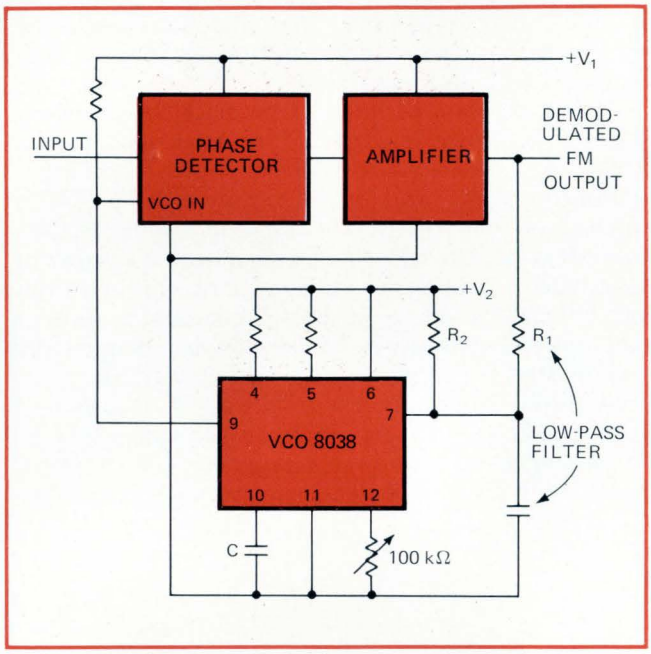
An external dc voltage (measured from the supply voltage), as well as the traditional external RC timing network, can be used to control the frequency at which these waveforms are generated. Altering this dc voltage produces either frequency modulation or sweeping.

For small (±10%) fm deviations, the modulating signal can be applied directly, as shown in Fig. 2a, with a capacitor to provide dc decoupling. The resistor inserted between package pins 7 and 8 increases device input impedance, which is nominally 8 kilohms when pins 7 and 8 are shorted together.

For larger fm deviations or for frequency sweeping, the modulating signal is applied between the positive supply voltage and pin 8 (Fig. 2b). This means that all of the bias voltage for the current sources is created by the modulating signal, permitting a sweep ratio as high as 1,000:1 to be obtained. However, the supply voltage must now be regulated, because capacitor charging current is no longer a function of the supply voltage, and the operating frequency becomes dependent on the power-supply voltage level.

Since the waveform generator exhibits good frequency stability, it can serve as the voltage-controlled oscillator in a phase-locked loop. Figure 3 illustrates an fm demodulator circuit, where, along with the waveform generator, a phase detector and an amplifier are the other building blocks in the loop. The circuit provides a free-running output frequency, offers very low temperature drift, and produces a large reconstituted sine wave having the same frequency as the input.

Naturally, the three building blocks must be matched to each other. For large-amplitude VCO signals, it may be necessary to use two different supply voltages and to return the square-wave output to the supply line of the



3. Fm demodulator. Employing monolithic generator in phase-locked loop simplifies the job of matching loop building blocks.

phase detector. This prevents the VCO signal from exceeding the input levels acceptable to the phase detector. To attenuate the VCO signal, a simple resistive voltage divider can be connected between the VCO's output and the phase-detector's input.

Also, the dc output level of the amplifier must be compatible with the dc level required at the modulation input of the waveform generator. A direct solution is to set up a voltage divider to the generator's supply (like the one shown for resistors R_1 and R_2) if the amplifier's output level is lower than desired. Or, if the amplifier's output is higher, place the divider between the supply and ground. One of the divider resistors can even be used as part of an output low-pass filter. □

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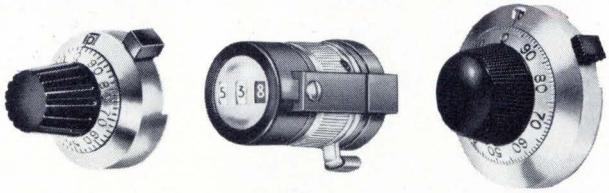

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Engineer's newsletter

Filter guide gets it all together

Most circuit designers find active filters a problem because virtually every application calls for a different design. Now, however, Kinetic Technology Inc. has come to the rescue with **a booklet that compares the performance of Butterworth, Chebyshev, Cauer, and other standard filter types, and provides easy-to-use nomographs for estimating filter complexity.** Also included are a data sheet listing various parameters that should be part of most active-filter specs and a standard-product-selection matrix that enables active-filter designers and users to select the universal active filter most suited to their needs.

While the information refers to KTI's line of standard active filters, the graphs, nomographs, and filter-response charts apply to all types of filters—passive as well as active—so they make a good standard reference for engineers interested in filtering problems. The booklet may be obtained by writing the company at 3393 De La Cruz Blvd., Santa Clara, Calif. 95050.

Register-transfer is route to small digital system

Do you have a small digital system to design, but aren't quite sure how to go about it? If so, you may benefit from a new book, *Designing Computers and Digital Systems*, by Gordon Bell, John Grason, and Allen Newell (Digital Press, 1972, $3.95, 447 pp.). **It's a sort of introductory text in logic design that uses the register-transfer method**—an old idea that has never caught on, partly because of the difficulty in implementing it with discretes or small ICs.

But register-transfer modules are now available commercially from Digital Equipment Corp. They were developed by the authors at Carnegie-Mellon University, and the design was picked up as the basis for a commercial line by DEC, where Bell is now a vice president. Nevertheless, the book is a fairly good basic text. The product can be ordered from DEC, 146 Main Street, Maynard, Mass. 01754.

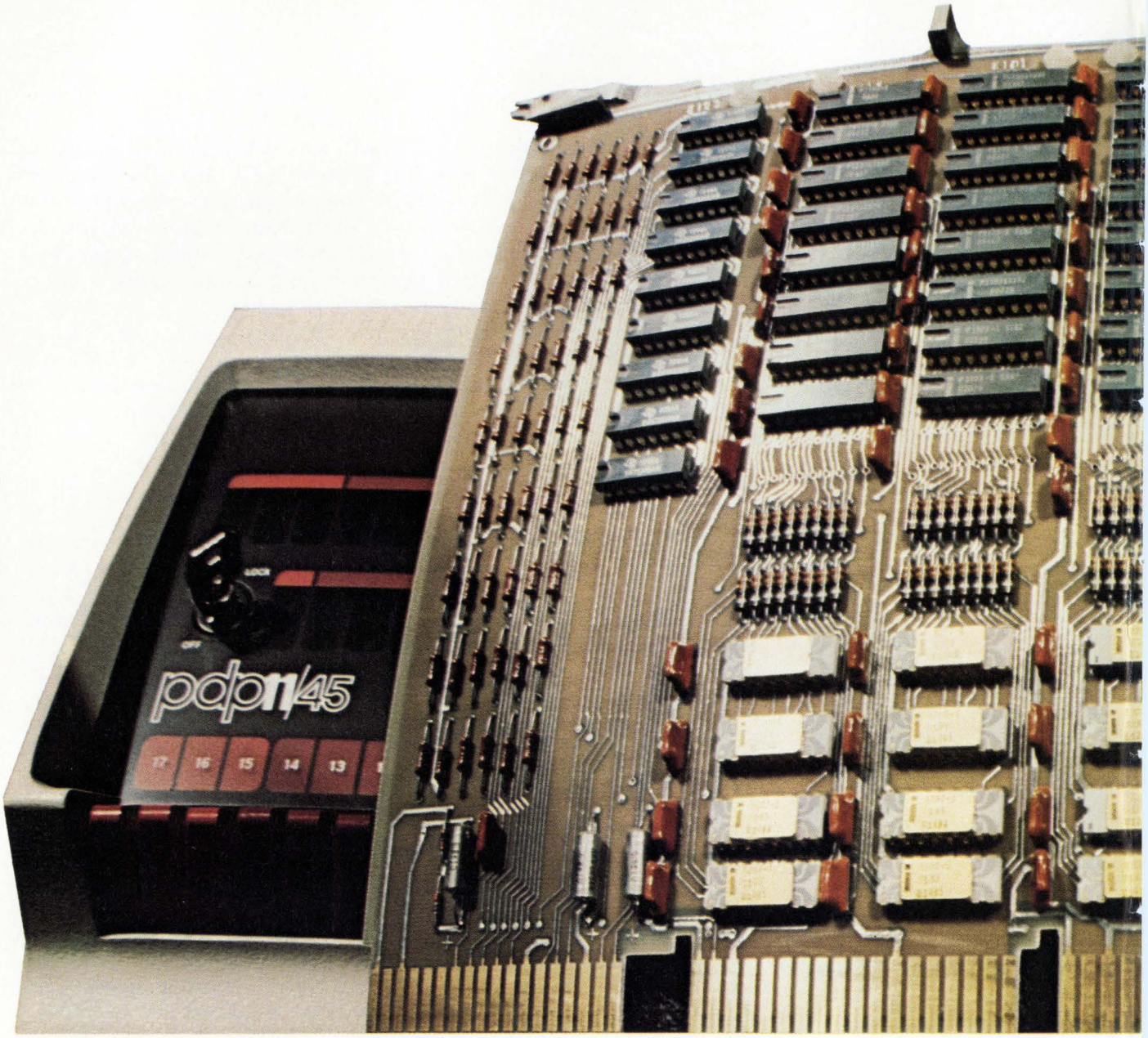
MIT offering self-study courses

If you've been getting the feeling lately that you'd like to go back to college—without leaving home—MIT may have the answer. **The college's Center for Advanced Engineering Study has put together a series of multimedia self-study courses for practicing engineers and scientists.**

Using filmed or taped lectures, a specially written study guide, and a text, the courses cover such fields as probability, random processes, and nonlinear vibrations. Detailed descriptions are available from the center at Room 9-225, MIT, 77 Massachusetts Ave., Cambridge, Mass. 02139.

GI to build 120 MOS FET line in plastic

If your rf tuner design is locked into the package style Motorola uses in its MPF-120 series of n-channel dual-gate MOS FETs, you will soon have a second source—General Instrument's Semiconductor Components division. **Next month, GI plans to introduce its vhf MEM-620 series in its Microfet 1 line, housed in the Motorola type of low-cost plastic package.** This availability could be important because of Motorola's desire to phase out its 120 package in favor of its MicroH style, which, according to the company, offers better isolation between input and output.



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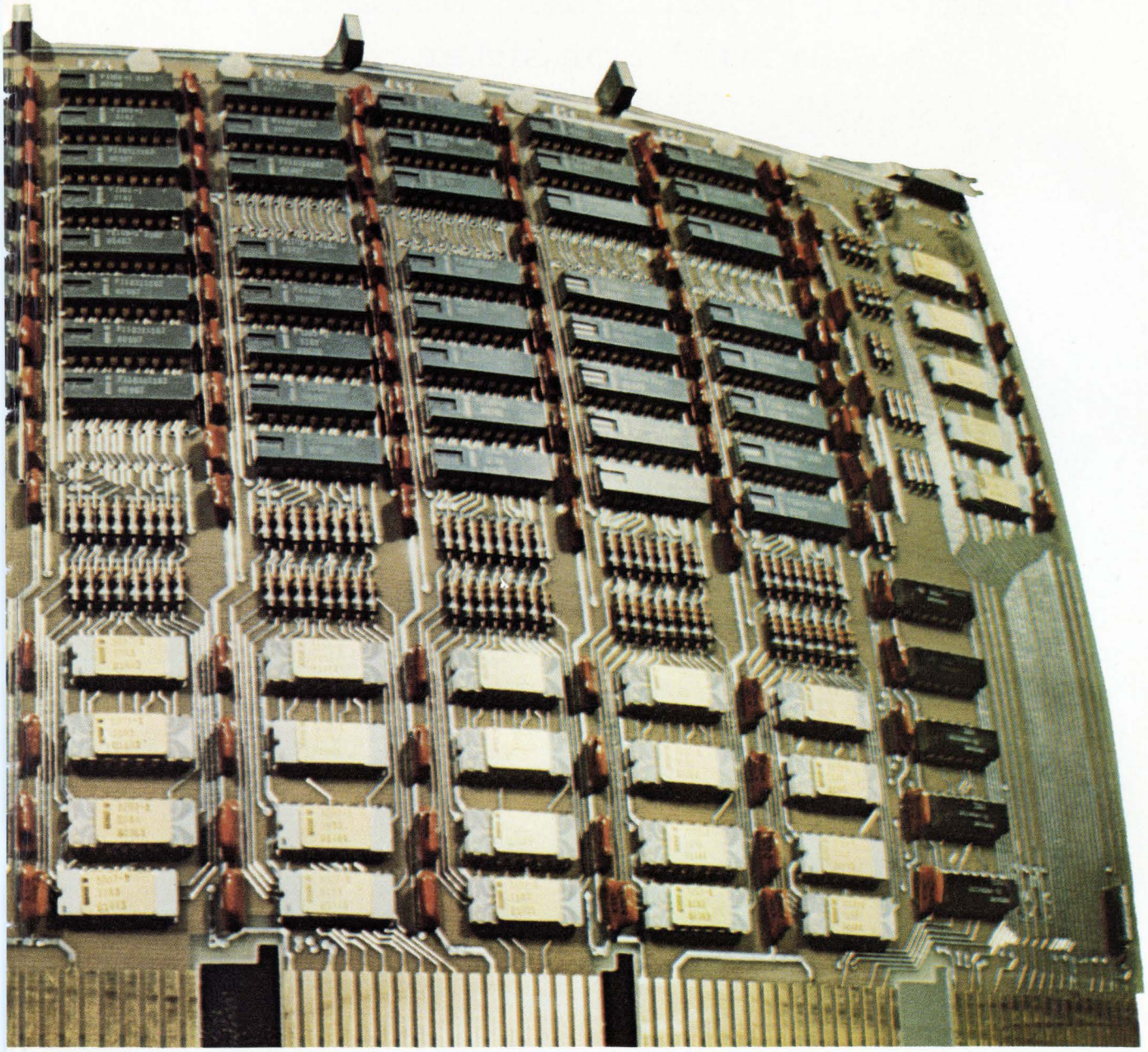

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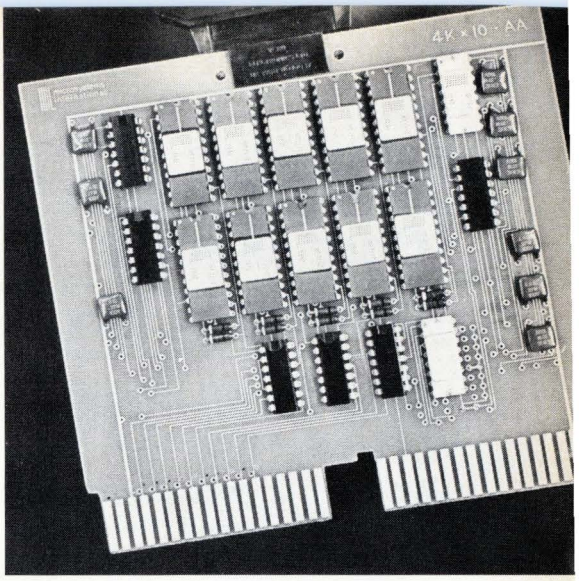
Circle 130 on reader service card

N-MOS boosts memory speed, cuts power drain

Expandable 4-kilobyte system offers read access time of 400 nanoseconds, uses 150 microwatts per bit

by Alfred Rosenblatt, New York bureau manager



Thrifty. N-channel MOS memory system can be built up from basic card that holds 10 of the 4,096-bit chips. The memory consumes only 150 microwatts per bit.

As a licensee of Intel, Microsystems International Ltd. built a reputation as a tough competitor in 1103-type p-channel MOS memory products. Now the Canadian company has posted a significant advance in n-channel technology—the first random-access memory system to use a 4,096-bit n-channel RAM chip as its basic building block. Moreover, the chip was designed and fabricated with proprietary technology "totally developed here," in the words of marketing manager Donald D. Winstead.

The new expandable RAM 4A system packs up to 262 kilobytes of memory in a card cage that fits into a standard 19-inch rack and measures 10½ in. high and 8 in. deep. And it's possible to parallel the card cages to form larger systems.

In addition to speeds comparable to those available in core designs, an n-channel system also requires considerably less power than core and other semiconductor designs.

The RAM 4A power consumption is only 150 microwatts per bit, compared with approximately 1 milliwatt per bit for equivalent core, Winstead claims. And this 150-μW figure is about half the power consumed by a semiconductor system employing an 1103-type p-channel silicon gate chip [see box]. Standby power is roughly 10% of the operating value.

Read access time of the RAM 4A is 400 nanoseconds, read cycle time is 500 ns, write cycle time is 600 ns, and read/modify/write cycle time is 600 ns, plus modify time.

And these times are expected to be pushed still lower. A design modification now under way should improve the access time of the n-channel chip to 300 ns in the 262-kilobyte system, Winstead says. However, a system built around this faster chip won't be ready until mid-1973.

A 4,096-bit chip, rather than the 1,024-bit chip that has been incorporated in existing systems [Electronics, July 31, p. 90] also offers other advantages. Reliability can be higher because, since fewer circuit packages and interconnections need be used, systems can be more compact. In addition, manufacturing costs are significantly lower for the larger chip.

The memory system is built from two printed-circuit-card modules. One is the interface-and-control (I&C) module that provides TTL interfacing, address and data-input registers, and timing. The other is the 4-kilobyte basic storage module (BSM) developed around the 4,096-by-1 RAM chip. As many as 16 BSMs may be driven by a single I&C card to form memory groups of 64 kilobytes. Furthermore, these memory groups can be stacked to increase word length, memory capacity, or both. It's also possible to interleave the memory groups to provide effective memory that's two or four times faster.

The 4-kilobyte card size, measuring 5½ inches square, "gives us better reliability, a more flexible building block and lower cost than would a bigger memory card," Winstead says. It also allows simpler, cheaper, and more reliable single-sided connectors, he adds. Another feature of the system is its multiplexing of addresses and data on one bus, with the logic included on each chip, which improves cost and reliability still further.

The company predicts a mean time between failures for its 4-kilobyte BSM (in nine-bit byte configuration) of 253,000 hours, calculated according to MIL-HDBK-217A and MIL-STD 876A standards.

Initially, the price of the RAM 4A will be less than 1 cent per bit, and price of less than ½ cent is projected within two years. Deliveries will begin before year's end, with volume production scheduled for the first quarter of 1973.

Microsystems International Ltd., Box 3529, Station C, Ottawa, Canada [338]

Meanwhile . . .

Microsystems International Ltd. also has introduced the RAM 1A, an expandable random-access memory built around its MF 1103 p-channel 1,024-by-1 MOS RAM chip. Access time of a system of 8,192 words of 12 bits is 350 nanoseconds; cycle time, 450 ns; and stand-by power dissipation is 4 watts. Up to four memory modules may be used with a single interface-and-control module to provide a total system of 32,768 12-bit words.

Data handling

Core memory challenges ICs

Ampex aims its 9100 core model at semiconductor's strong spot: small memories

As semiconductor memories get larger, they are increasingly attractive in areas where cores now reign supreme. But Ampex, a major core producer, is hitting back with an inexpensive core memory intended to compete with semiconductor memories where they've been strongest—in relatively small, fast memories.

Ampex' new 9100 core memory offers a better cost/performance combination than semiconductor memories in capacities under 4,096 words of nine bits each, asserts Eugene E. Prince, vice president and general manager of Ampex Computer Products division. The 9100, with access times under 400 nanoseconds, is priced below 1½ cents per bit, in large quantities, for a complete, packaged system ready to be plugged in and used. MOS memories, says Prince, offer similar speeds and prices, but require additional circuitry to store and protect data in case of power failure.

The OEM-oriented module is the first Ampex memory to use the 18-mil temperature-independent cores developed by the company. The cores eliminate the need for temperature compensation and forced-air cooling. The cores also require low drive current, allowing the use of IC drivers rather than more expensive discrete ones and thus contributing to the low cost.

Charles E. Priddy, national OEM sales manager at Ampex, finds requirements for a wide temperature range growing as the memories are used more often in locations other than temperature-controlled computer rooms. Priddy expects the new modules to find most use in applications where their nonvolatility gives them the edge over semiconductor memories with similar specifications: factory automation, communications control, data entry, and point-of-sale systems.

He also says that the unit, which measures 9.2 by 6.4 by 1 inch, is the smallest fully operating self-contained memory available. Capacity is 1,024, 2,048, or 4,096 9-bit words, or 1,024 or 2,048 18-bit words. The three-wire, 3d memory is sealed and no cooling is required, simplifying application to less-than-ideal environments.

The memory will be shown at the Fall Joint Computer Conference in Anaheim, Calif., Dec. 5-7.

Ampex Computer Products division, 401 Broadway, Redwood City, Calif. 94063 [361]

Plug-in modules turn digital printer into data system

Taking advantage of IC functions included in its digital panel meters, Newport Laboratories Inc. has designed a data-acquisition system that is based on adding plug-in modules to its digital printer.

The new modules are a $275 multiplex controller and $175 function programer module. They provide the capability to multiplex up to 16 Newport digital panel meters, sequence and identify readings, and correctly place decimal points and engineering units. By way of comparison, a more conventional type of data logging would require an analog scanner, analog-to-digital converters, and a data recorder.

The key to the Newport system is the use of the circuitry, especially the a-d circuitry, already in the panel meters. Any variable, such as frequency, voltage, and time also can be logged, since the output of the meter is binary-coded-decimal rather than analog signals.

In operation, the DPMs are connected in a party-line arrangement, with the controller calling on each in turn. The system is organized rather like a computer with a data bus, and each meter acts like a peripheral. The controller can sequence at the same rate as the printer advances: 2.8 seconds per black reading, 2.3 seconds for red.

The function programer allows predetermined engineering units and decimal points to be selected. It can form different limits for each channel to permit a single digital comparator to be used for overrange indication or other purposes. Sixteen single-line addresses enable 12 output lines via a programable discrete-diode matrix. Eight output lines drive two four-bit characters while four lines are available for driving decimal-point-enable circuits. The module can also program instrument functions and ranges with single line or BCD-coded addresses. Units and functions can be intermixed.

Both modules are options that plug into the Newport model 800 printer, which has 21 columns, including engineering units. They derive power from the printer and can be field-inserted with no additional hardware.

Newport Laboratories Inc., 630 East Young St., Santa Ana, Calif. 92705. [362]

Desktop CRT terminal uses standard keyboard

Designed to be completely interchangeable with the model 33 Teletype terminal, the Digi-Log model 33 is a portable desktop cathode-ray

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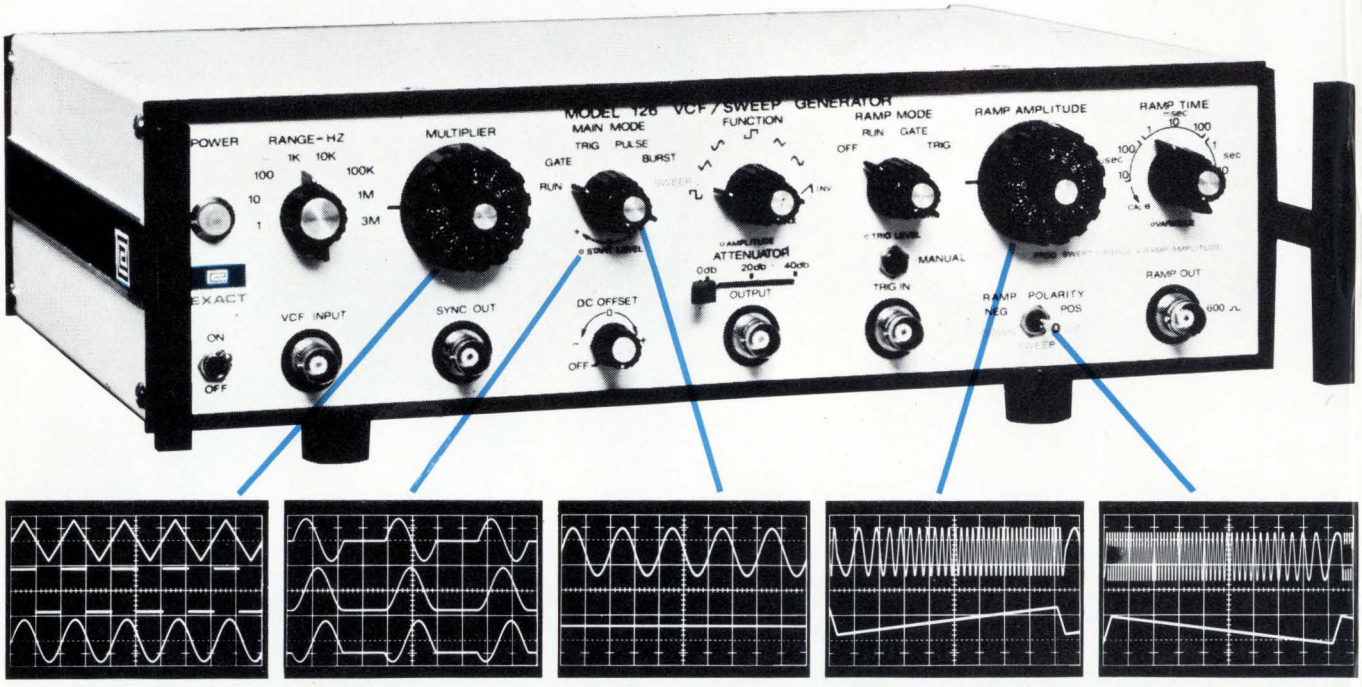

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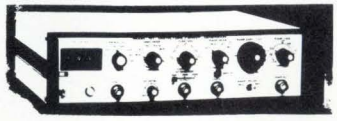

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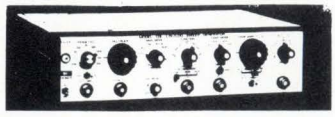

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cording to company officials.

The terminal has a display format of 80 characters by 16 lines. It uses a standard teletypewriter keyboard with all control functions, and can be used on- or off-line. Teletype current loop, TTL, or EIA RS-232 interfaces are provided.

Standard data rates are 110 and 300 baud when using the acoustic coupler or 9,600 baud when hardwired. A hard-copy printer is available as an option. Also available as options are a built-in coupler and a magnetic tape cassette.

The model 33, which weighs 10 pounds, is 4 inches high, 11 in. deep, and 11 in. long.

Digi-Log also produces a terminal displaying 40 characters by 16 lines that operates with a standard TV monitor.

Digi-Log Systems Inc., 666 Davisville Rd., Willow Grove, Pa. 19090 [339]

Line printer also functions as digital plotter

The Alphagraphic 1100 is a line printer that also functions as a digital plotter. As a line printer, the unit generates copy at 180 lines per minute on a 128-column line. As a plotter, it produces 768 resolution

elements at a rate of 75 per inch. The unit, which does not require ink toners, operates quietly. The 1100 can be linked to minicomputers and operates in both vertical and hori-

New products

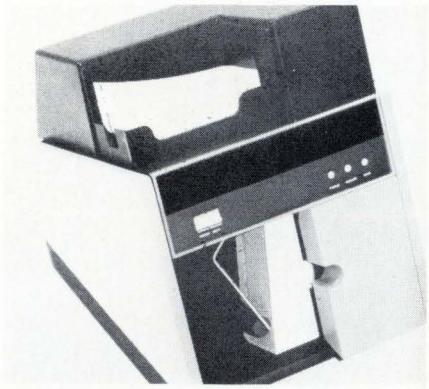
zontal positions. Applications include scientific and hospital systems.
Datalog, 1770 Walt Whitman Rd., Melville, N.Y. 11746 [363]

Cassette recorder meets international standards

The model 135 digital cassette recorder is compatible with international standards, including those of the European Computer Manufacturers Association, the American National Standards Institute and the International Standards Organization. Designed for the OEM market, the unit reads and writes phase-encoded data at 12.5 inches per second, providing a rate of 10,000 bits per second at a packing density of 800 bits per inch. Start and stop times are 20 and 25 milliseconds, respectively. Price is $525.
Sycor Inc., 100 Phoenix Dr., Ann Arbor, Mich. 48104 [364]

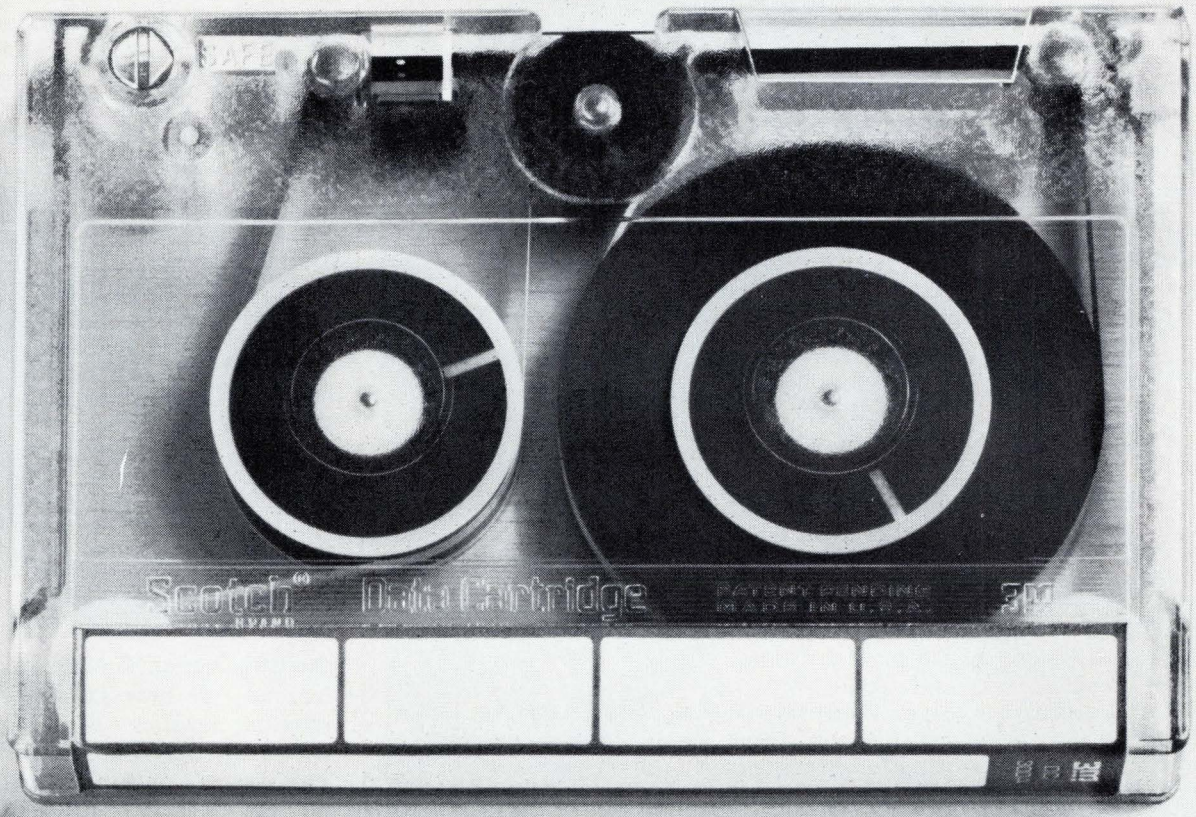
Card-input system is designed for minicomputers

The model 251X card-input system, designed for minicomputer applications, consists of a 600- or 1,000-card-per-minute card reader and interface equipment, including cables.



Documentation and supporting software are supplied with each unit. The system is compatible with the Data General Nova; Digital Equipment Corp. PDP 11 and PDP 8/E/L/I; Honeywell 316/516; Hewlett-Packard 2114, 2115, 2116 and 2100; and Digital Computer

This tape cartridge may be new to you.



It isn't to your competition.

Our new ¼ inch "Scotch" Brand Data Cartridge has done everything we said it would. Evaluation by some eighty major peripheral equipment manufacturers worldwide proved it.

They really put the cartridge through its paces. Backwards and forwards, at operating speeds to 90 ips and with start/stop accelerations to 2000 in/sec^2. They checked out its 1600 bpi packing density, and its expected lifetime of more than 5000 passes. They tested its single-point drive, with no external tape guidance, no pinch rollers, no capstans and no pressure pads. They found out that its tape handling is fast, precise and gentle at all times because the cartridge functions as its own transport. Their conclusion: the "Scotch" Brand Data Cartridge offers reel-to-reel tape deck performance, but with cassette convenience and price.

In fact, the cartridge tested out so well and was so easy to use that manufacturers are announcing complete low cost digital storage systems built around it. And others are building drives just for it.

If you haven't done so, isn't it time that you too evaluated the "Scotch" Brand Data Cartridge? Give us a week for delivery; we'll put the solution to your data handling problems in the palm of your hand. Data Products, 3M Company, 300 South Lewis Road, Camarillo, Ca. 93010. Telephone (805) 482-1911. Extension 371/385. TWX 910-336-1676.

Data Products

3M COMPANY

New products

Control Corp. D112 and D116. Price starts at $2,595
Media III, 2454 E. Fender Ave., Fullerton, Calif. 92631 [365]

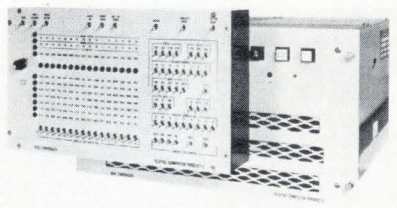
Cassette system operates at 600 characters a second

A cassette tape system conforms to the EIA standard RS-232 bit serial interface between data terminals and data communications equipment operating in the synchronous mode. Called the Mini-cette 2200,

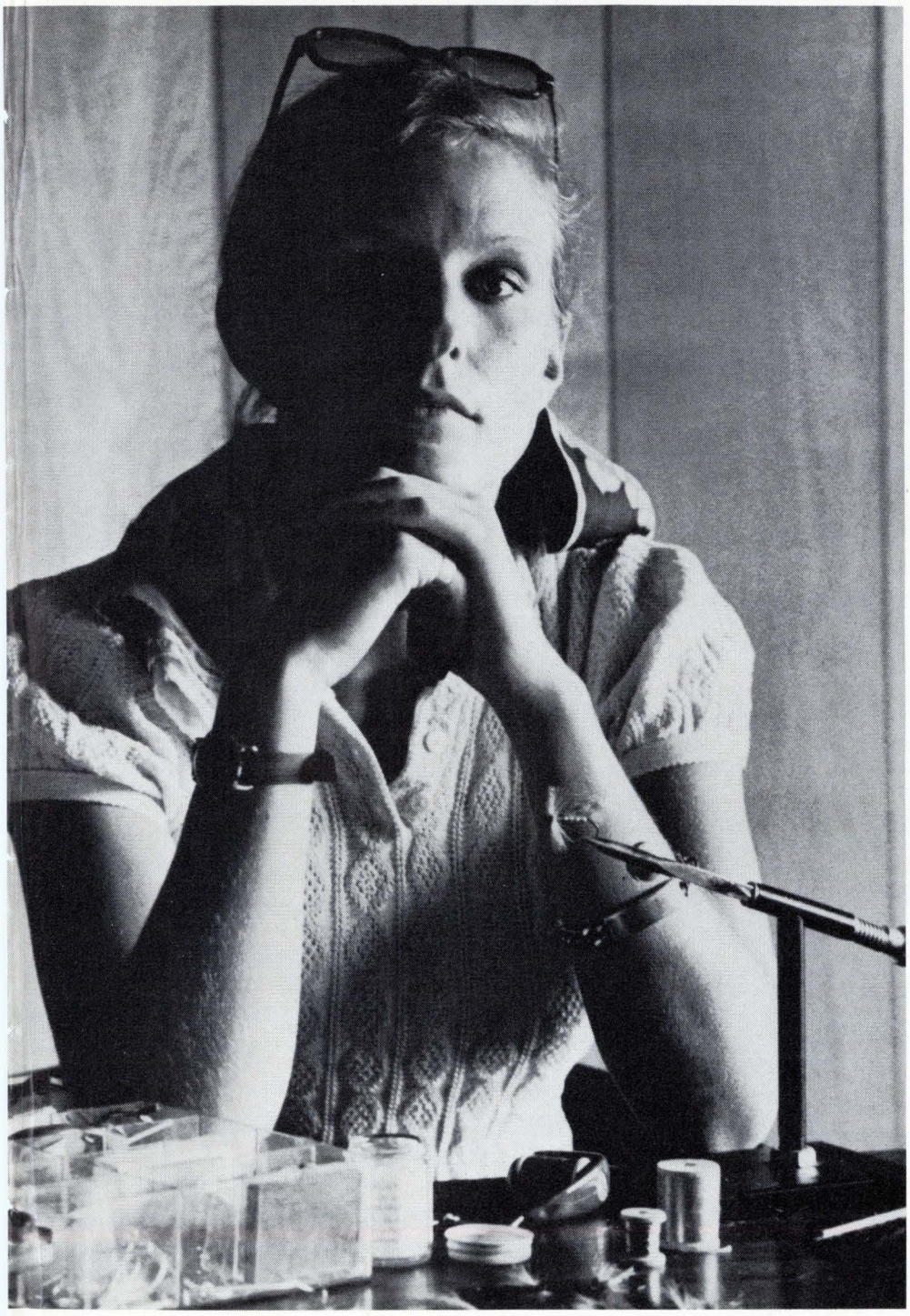
the drive system includes a controller and one bidirectional dual-differential capstan cassette transport with a speed of 6 inches per second. The system's packing density is 800 bits per inch with 8-bit characters. Read-write speed is 600 characters per second. Price is $2,450.
Cipher Data Products, 7655 Convoy Court, San Diego, Calif. 92111 [367]

Disk controller provides simultaneous seek operation

The model DC-36 disk controller is designed to link the IBM 2311, 2314 compatible disk drives to Univac 418 II computers. Features of the



I think these people have discovered software lib.



Why did it take so long for a computer maker to realize that software is every bit the equal of hardware, that it deserves a decent place to work and an equal opportunity to be great? Prime must have admitted this to themselves when they began the 200, because they defined the software completely before they built a home for it. The result is the most efficient small system I've ever seen.

DOS, RTOS, FORTRAN, macro assembler, editors, loaders – they're going out with first deliveries. The FORTRAN IV compiler is so efficient you can use FORTRAN as the systems programming language. Then you find that PRIME 200's logic is 100% microprogrammed with a 64-bit-wide microprogram word and you realize your programs are going to fly. It's refreshing to find a manufacturer who knows that memory cycle time doesn't mean much without software to make things happen.

One thing surprises me though – that they should use the phrase "small computer." That's nothing but chauvinistic hardware talk which deprecates the software and system performance. What they mean is, it doesn't weigh much.

The PRIME 200 16-bit computer raises a lot of interesting questions for which we have prepared detailed answers. Let us send them to you. Prime Computer, Inc., 17 Strathmore Road, Natick, Mass. 01760. (617) 655-6999.

Prime 200
small computer

Prime sales offices: Boston (617) 237-4565, New York (212) 896-6262, Washington D.C. (703) 533-9343, Philadelphia (215) 688-0396, Jacksonville (904) 396-5253, Chicago (312) 887-1845, Dayton (513) 435-1343, Detroit (313) 356-4840, Tulsa (918) 663-0518, Palo Alto (415) 968-6003, Los Angeles (213) 881-8433.

Authorized representatives: Phoenix (602) 957-9110, Albuquerque (505) 255-2330, Denver (303) 771-0140, Seattle (206) 454-9332.

Circle 139 on reader service card

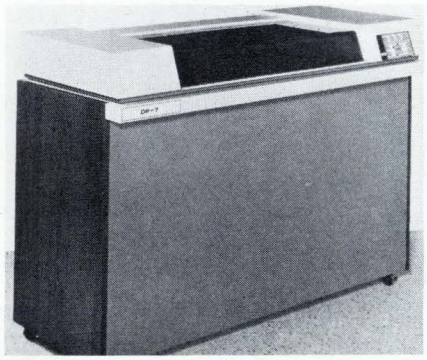
New products

DC-36 include simultaneous seek operations, programing requiring eight commands, verification of track location by hardware, error checking of all data transfers by hardware, and read or write multiple records with one command. The unit provides direct transfer to or from memory for data, thereby eliminating blocking I/O channels. Price starts at $17,000.

Telefile Computer Products oc., 17785 Sky Park Circle, Irvine, Calif. [368]

Plotter operates at 1,800 increments per second

Bidirectional paper movement is offered by the Complot DP-7 digital plotter, a 36-inch wide unit, which performs 1,800 increments per second, at a continuous speed of



0.0025-inch increment size. The unit is available with up to three pens, available in colors, and automatically selectable. The pens provide a rectilinear trace.

Houston Instrument Division, Bausch & Lomb, 4950 Terminal Ave., Bellaire, Texas 77401 [369]

Interconnection chassis forms a microcomputer

The model MCS-4 microcomputer system can be assembled without hand-wiring by using the MCB4-10 interconnection chassis that links the SIM4-01 prototyping board and the MP7-02 programable read-only memory programing board to form a PROM programing system, a PROM test system and a functioning micro-

The News is

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A 6″ tubeaxial fan that moves more air . . . at higher pressures . . . and costs less!

It's the kind of news you expect from Rotron. An air mover with the extras built in. The Major® fan will deliver 150 cfm at a static pressure of .35 inches of water. That's 12% more air than the closest competitor.

The Major stays cooler, too. Its multi-slot permanent split capacitor motor draws less power than a shaded pole, and withstands line voltage variations better. An aluminum venturi and motor housing dissipate heat. And ball bearings add still further to long motor life.

The Major fan mounts interchangeably with other 6″ fans. It can also be mounted on less than 6″ centers.

Price? About 10% less than you used to have to pay for less performance! Get all the facts on Rotron's new Major tubeaxial fan today by sending for Catalog E2855.

Why settle for less when the best costs no more.

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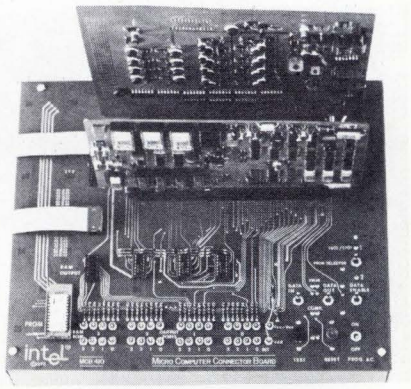
Pacific Div., Burbank, Cal. 91506, 213•849-7871 • Rotron B.V., Breda, Netherlands, Tel.: 49550, Telex: 844-54074

New products

computer. Each has a Teletype interface, control switches, and a binary LED display of data and addresses for PROMs and random-access memories. The chassis includes a zero-insertion-force socket



for the PROM being programed, a source of 50-V peak-to-peak programing voltages, and a 16-lead cable for direct connection to a teletypewriter, which is used to program the PROMs, test them and communicate with the microcomputer prototype. Price is $375.

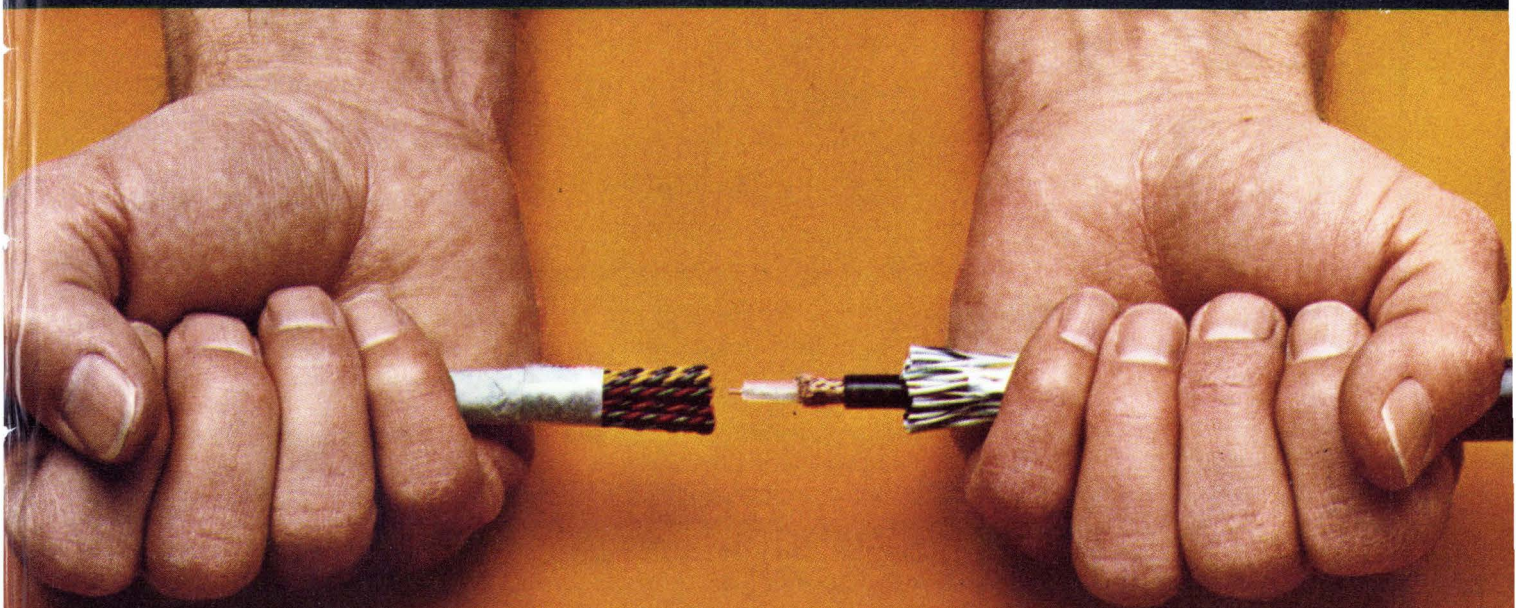
Intel Corp., 3065 Bowers Ave., Santa Clara, Calif. 95051 [366]

Computers expandable by adding memory, power units

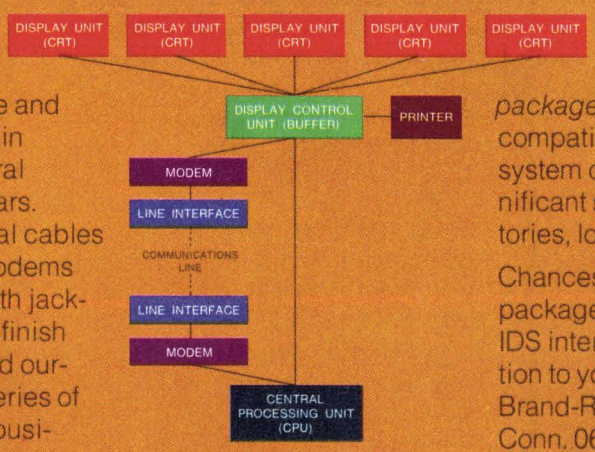
Two additions to the company's series 2000 family of computers are the model 2040A and 2050A that can be expanded on site by the addition of power modules or memory units. The power modules provide increases in cycle time or input/output capabilities, or both, and more main memory can be added in standard increments to provide a maximum of 524,288 characters. The model 2040A central processor is a small-to-medium programing computer with 65,536 characters of main memory. The model 2050A is a medium-scale multi-programing unit with 131,072 characters of main memory. The computers may not be leased, but purchase price for a basic 2050A is $595,000. For the 2040A it is $335,000.

Honeywell Information Systems, 200 Smith St., Waltham, Mass. 02154 [370]

PROBLEM:
establishing plug-to-plug compatibility within a multi-company Information Display System.



SOLUTION:
the most complete series of "standard" interconnecting cable constructions available.



Brand-Rex has been solving wire and cable problems for the major main frame and independent peripheral equipment manufacturers for years. Designing and producing special cables for CRT displays, buffer units, modems and teleprinters. All UL listed, with jackets color-matched to equipment finish where required. Suddenly we find ourselves with the most complete series of "standard constructions" in the business. Information Display System *packages* that provide plug-to-plug compatibility between multi-company system components. You realize significant savings through reduced inventories, longer lengths, faster deliveries.

Chances are Brand-Rex has the cable package you need for fully integrated IDS interconnections. Ask us for a solution to your particular problem. Write Brand-Rex Company, Willimantic, Conn. 06226. Or call 203/423-7771.

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Circle 143 on reader service card

BRAND-REX CO. A PART OF Akzona INC

New products

Instruments

Low-power DPM priced at $100

Aimed principally at the portable-instrument market, unit uses less than 0.75 W

Two distinct trends are becoming apparent in the market for digital panel meters. The first is a move toward lower prices; the second, and more recent, is the effort to decrease power consumption. The goal is to make prolonged battery operation possible, and so enable DPMs to compete with analog meters for the OEM portable-instrument market.

The latest low-power design is Weston's model 1220/1221. Built around the same custom p-MOS chip as the company's model 4440 multimeter, the 3½-digit panel meter uses less than 750 milliwatts with all display segments turned on. This gives the meter a minimum of 13 hours of continuous operation with four standard C cells.

Since the meter is intended principally for portable-instrument applications, special attention was given to minimizing size and weight and maximizing ruggedness. The package, which measures slightly less than 3 × 3 × 1.5 inches, is completely sealed. The meter's low power consumption makes venting louvres unnecessary. Weight is under 4 ounces. To better enable it to cope with the rigors of field use, its designers made the 1220/1221 tough enough to meet the MIL M10304 vibration specification.

Two mounting options are available: the standard rectangular mount with access from the front panel and a special recessed mount, through which only the LED display is visible. Since the p-MOS chip and the LED display were made pluggable for easy servicing, it is possible to mount the display at a location remote from the rest of the meter. This remote operation is not offered as an option by Weston, but the user can make the necessary modifications himself.

The meter is accurate to within ±(0.1% of reading + 1 digit) over a 20°C temperature range centered at 25°C. For prolonged operation at a temperature away from this standard, the unit can be calibrated at any temperature from 10° to 50°C, and it will then meet its accuracy spec over a 20°C span centered at that temperature. Operating temperature limits are 0°C to +60°C.

Price in single quantities is $175, but this drops to below $100 in lots of 100. Delivery is from stock.

Weston Instruments Inc., 614 Frelinghuysen Ave., Newark, N.J. 07114 [351]

Low-priced line monitor spots 0.5-microsecond pulse

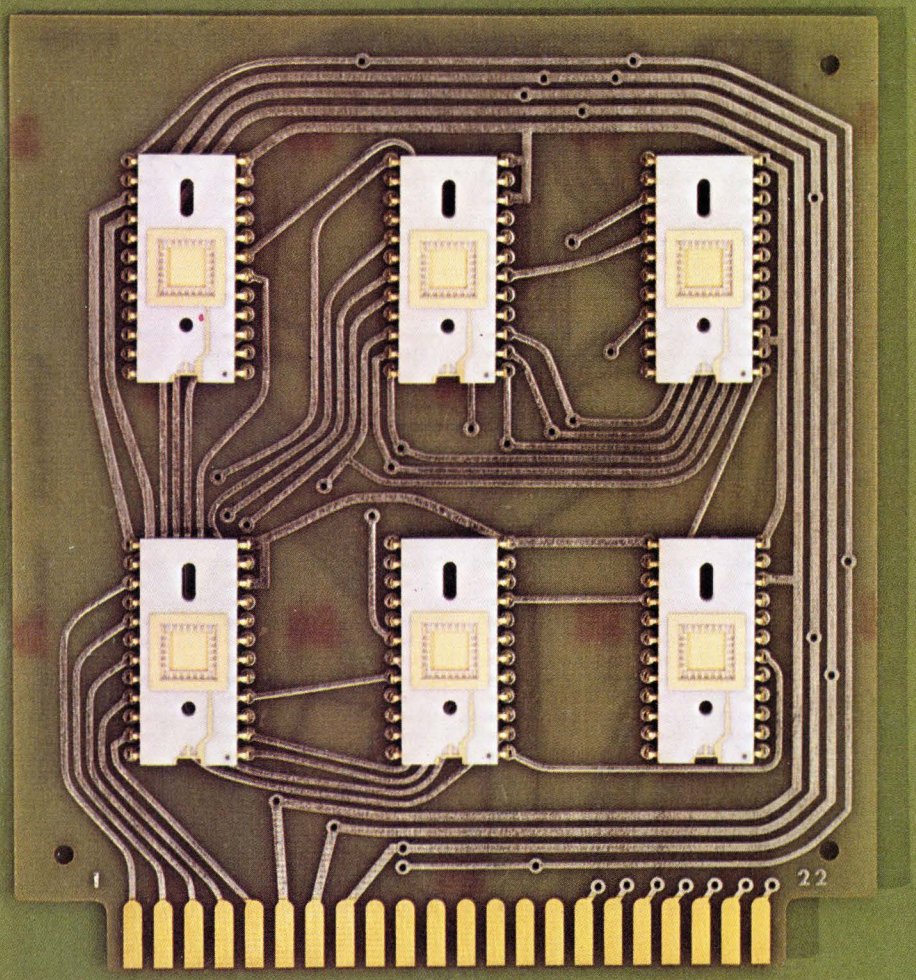
With brownout happening more frequently, the need to know exactly what's going on in the ac power line becomes increasingly important, especially in large data centers, where a single line transient can mean false data.

Power-line monitors that can spot such things as under- or over-voltage conditions, have been available, but these usually catch disturbances only if they repeat for several cycles. Equipment that can respond faster usually costs between $15,000 and $20,000.

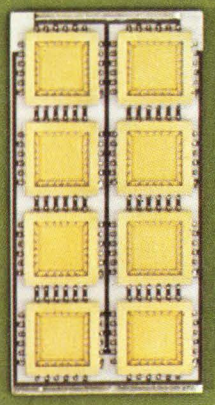
Now, however, Programmed Power Inc., Menlo Park, Calif., has developed a portable power-line-disturbance monitor that sells for $2,995. The model 3200 checks for under- and over-voltage conditions, under- and over-frequency conditions, and 50–600-volt positive or negative transients lasting 0.5 to 100 microseconds. The instrument can be set for either 50 or 60 hertz, can monitor either single-phase 90- to 140-V rms or three-phase 90- to 140-V rms input lines to neutral voltages, or 208/120 V in a four-wire Y configuration.

When a preset line condition is exceeded, the 3200 gives both an audio and visual alarm, records the event on the proper event register (a digital counter—one for each condi-

Looking for maximum circuit density and lower cost?



A typical printed circuit board with six standard 24 lead packages with .200" device area.



These eight AlSiPak® 24-lead hermetic chip carriers on AlSiBase® multilayer ceramic substrate give far greater circuit density.

This single AlSiPak® 24-lead hermetic chip carrier has .235" device area.

Illustrations approximately actual size.

Let American Lava help solve your space and cost problems with our Hi-Density Leadless Packages. This packaging concept lends itself to automation and permits convenient repair or replacement. Electrical testing after hermetic sealing allows storage of good devices in a less expensive package BEFORE committing to the circuit. The design permits conventional die attach, wire bonding and lid sealing operations . . . and re-flow solder attachment to a multilayer ceramic substrate, hybrid substrate or phenolic circuit board.

AlSiMag® BRAND CERAMICS

AMERICAN LAVA CORPORATION

CHATTANOOGA, TENN. 37405, U.S.A. • PHONE 615/265-3411

SUBSIDIARY OF 3M COMPANY

Circle 145 on reader service card

tion), and provides a hard-copy printout of the event, including the type of disturbance, the time of day, and the date it occurred.

Lee Cooper, president of Programmed Power, says, "We had planned for some time to produce an instrument like the 3200 as an aid in selling our uninterruptible power systems. We could use it to indicate what was happening on the power line and thus prove to a potential customer why he needs a backup system." But in the meantime, the Naval Civil Engineering Labs studied the monitors available and came up with specifications for a new one [*Electronics,* Sept. 11, p. 133]. This got Programmed Power rolling. As a result, the 3200 was developed and the Naval labs has purchased several units.

Cooper points out that the 3200 can be employed in applications other than data centers, such as in production-control equipment, electronic instruments, and synchronous communications equipment, which are also highly sensitive to line fluctuations.

Programmed Power Inc., 141 Jefferson Dr., Menlo Park, Calif. 94025 [352]

Linear thermometer offers resolution of 0.001°C

A four-digit readout, portable linear thermometer operates at 990 hertz. Sensor self-heating effect is less than 5×10^{-4}°C, and quadrature rejection is –20 dB. The unit offers a reso-

lution of 0.001°C, and long-term deviation from accuracy and stability is rated as ±0.01°C. The thermometer, designated model LD-1, provides a 60-hertz rejection ratio of 70

Ring up more savings on keyboard switches.

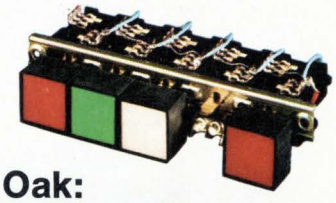
As much as 50% (savings per key)

The new Oak Series 400.

Get Oak-engineered quality in keyboard switches with the inherent reliability of electromechanical operation. Ideal for peripheral data-processing equipment. Contact bounce is less than 3 milliseconds. Long life, up to 20 million operations per key. Designed with self-cleaning crossbar-wiping contacts.

A feather touch.

We kept the operator in mind. Standard operating force is approximately 85 grams (3 oz.).



Also from Oak: Series 300 Lighted Pushbutton Switches.

Featuring Oak's exclusive twin-lamp lighting. If one lamp goes out, the other stays on. Double-wiping contact clips. Short stroke. Smooth, quiet operation. Unlimited combinations. Request our Series 300 brochure.

The configurations you want.

The Series 400 is available in limitless arrangements, including standard 10, 12, and 16-button keyboards. And you can specify any of six different contact circuitries. Choose snap-in or plug-in P.C. mounting. Compact—only ½″ x ½″ x 1″.

Write today for our Series 400 brochure.

Under 30¢ each.

For SPST/NO in production quantities. Other versions comparably priced. Keytop button and snap-in mounting extra.

OAK Industries Inc.
SWITCH DIVISION/CRYSTAL LAKE, ILLINOIS 60014
TELEPHONE: 815 • 459 • 5000 ■ TWX: 910 • 634•3353 ■ TELEX: 72 • 2447

New products

dB. Battery life is 1,200 hours. Price of the unit is $1,495.
Massey Engineering, 202 North Highland St., Arlington, Va. 22201 [353]

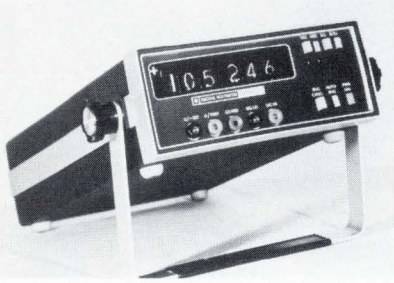
Bipolar digital panel meter is accurate to within 0.05%

The model 36 bipolar 3½-digit panel meter features a maximum error of ±0.05% of reading plus one count. Also featured is a stability of 50 parts per million/°C over a 0-to-50°C operating range. The unit has an instrumentation-type front end with floating differential input, which provides more than 1,000

megohms input impedance and more than 70 dB common-mode rejection ratio. The unit is available with either a seven-segment planar or Nixie display, and BCD outputs are provided. Price is $95.
Gralex Industries, 155 Marine St., Farmingdale, N.Y. 11735 [356]

Multimeter provides five ranges from 0.1 V to 1,000 V

A 5½-digit multimeter, the MX-1, measures five ranges of dc from 0.1 volt to 1,000 volts full scale. Also provided are automatic or manual ranging, a wide range ratio, a fast active filter, and a sixth digit for



This is no time for popcorn noise...

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

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

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

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

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

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

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

RCA Solid State

products that make products pay off

International: RCA, Sunbury-on-Thames, U.K., or Fuji Building, 7-4 Kasumigaseki, 3-Chome, Chiyoda-Ku, Tokyo, Japan, In Canada: RCA Limited, Ste Anne de Bellevue 810, Canada.

Circle 149 on reader service card

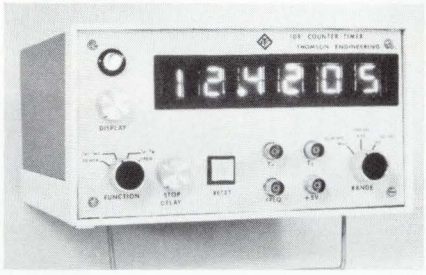
New products

20% overrange. Options include 10 kHz and 100 kHz ac in four ranges from 1 V to 1,000 V full scale, resistance in six ranges from 100 ohms to 10 megohms full scale, and isolated data outputs. Price of the model MX-1 is $1,000.

Non-Linear Systems Inc., P.O. Box N, Del Mar, Calif. 92014 [357]

Counter-timer features six-digit frequency readout

The model 109 counter-timer, designed as an OEM instrument, boasts a six-digit readout of elapsed time and frequency. Elapsed time can be measured with a resolution of 0.0001 second on the 100-second

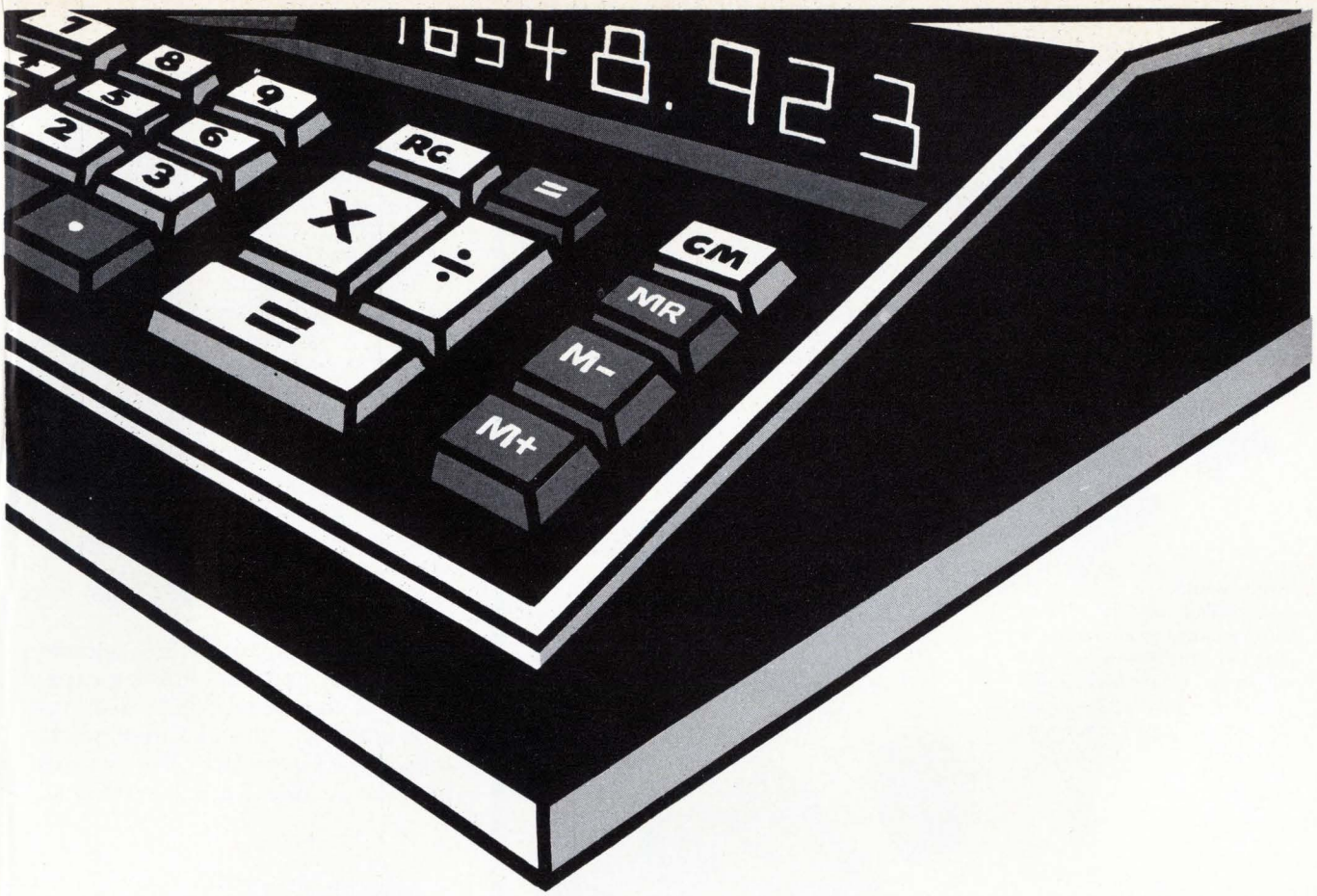


range and 0.01 second on the 1,000-second range. Frequency of any ac or positive dc pulse may be measured to 2.5 MHz in three ranges. Price is $400.

Thomson Engineering Co., 511 Old Lancaster Pike, Berwyn, Pa. 19312 [358]

Curve tracer checks ICs, discrete components

The model 577 curve tracer plots and displays parameters of linear ICs, transistors, FETs, tunnel diodes,



WE HELPED MAKE IT POSSIBLE!

Advances in electronics technology have brought about many changes in the things we use — like the business calculator.

Business calculators as a result of electronics technology now are smaller, lighter, more attractive and less expensive than was ever thought possible.

While Monsanto is not in the calculator business, we are in the business of making advancements like this possible through research and development of new electronic materials.

Take for example the silicon we produce for the semiconductor industry. For over 13 years we have been researching every avenue to improve our production capabilities and the final quality of our material. And even though we believe the material we produce is the best available, we will continue to look for other ways to make it better.

But it took more than Monsanto's silicon to make the business calculator the little gem it is now! Our gallium arsenide phosphide did its part too. Gallium arsenide phosphide emits light when a voltage is applied. This phenomenon enabled the calculator manufacturers to replace their tube displays with low-power consuming light-emitting diode displays.

Monsanto has the highest quality material available anywhere and our production is increasing every day.

Monsanto materials make it happen.

Monsanto

Advancements in Electronics through Materials Technology

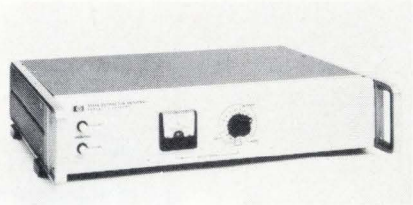
P. O. BOX 8 ST. PETERS, MISSOURI 63376 (314) 272-6281

New products

SCRs, zener diodes, and other electronic components. The 577 shows characteristics for entire ranges of operating conditions, instead of single points, for parameters that include random noise, popcorn noise, thermal feedback, and phase-shift effects. Storage display is also provided. Prices range from $1,850 to $3,200, depending on configuration.
Tektronix Inc., P.O. Box 500, Beaverton, Ore. 97005 [354]

Distribution amplifier handles signals, even if power fails

Distribution of up to three sources to as many as 12 outputs is a capability of the model 5087A distribution amplifier, which keeps on working when power fails. The sources may be 10 MHz, 5 MHz, or 100 kHz,

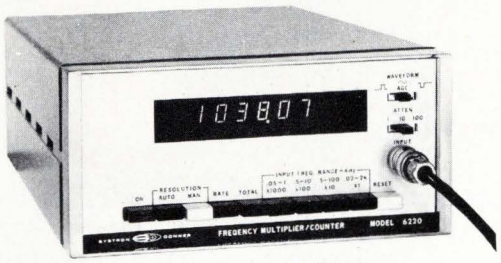


in any combination. Interference or short circuit in one output will not materially affect the others. An option provides for the amplifier to accept a single 5-MHz or 10-MHz input and deliver a choice of 0.1-, 1-, 5-, or 10-MHz outputs. Price is from $1,500 to $1,630.
Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif. 94304 [355]

Picoammeter offers 11 bipolar ranges of current

A general-purpose picoammeter with a cancellation circuit includes dual output for recorders or oscilloscopes. Bipolar output is also provided. The model 1012 offers 11 ranges of bipolar current measurement, from 10 microamperes full scale to 100 picoamperes full scale. Resolution is 1 picoampere on the most sensitive scale.
Gencom Division, Emitronics Inc., 80 Express St., Plainview, N.Y. 11803 [359]

$350



Measure 1038.07 Hz automatically in 1 sec.

* AGC * Autoranging to 2 MHz in 1 sec. * Automatic frequency readings to 0.001 Hz in 1 sec. * 6 digits standard, 2 optional * 25 mV sensitivity * Leading zero suppression * 5 high stability oscillator options * Rechargeable battery option

For Model 6220 literature, contact your local Scientific Devices office or Systron-Donner at 10 Systron Drive, Concord, CA 94518. Phone (415) 682-6161. **Europe:** Munich, W. Germany; Leamington Spa, U.K.

SYSTRON DONNER

Circle 197 on reader service card

$239

First automatic counter-totalizer at that price.

* AGC * Autoranging to 200 KHz * 5 digits standard, 2 optional * Leading zero suppression * 25 mV sensitivity * 5 high stability oscillator options * Rechargeable battery option * BCD conversion optional

For details or a demo of Model 6202, contact your local Scientific Devices office or Systron-Donner at 10 Systron Drive, Concord, CA 94518. Phone (415) 682-6161. **Europe:** Munich, W. Germany; Leamington Spa, U.K.

SYSTRON DONNER

Circle 198 on reader service card

You don't have to cross the Pacific for Hitachi magnets.

You don't even have to cross town. We'll send one of our sales engineers from Los Angeles, Houston, Atlanta, Detroit, Chicago, New York or Toronto right to your office. He'll see that your magnet requirements are completely satisfied.

Hitachi Metals offers a full line of quality magnets, the fruit of modern R&D at our Magnetic & Electronic Materials Research Center. Our experts are hard at work developing new magnetic materials — one of their latest achievements is HICOREX (cobalt-rare earth magnet) — and finding new uses for magnets.

Devotion to improvement, added to integrated production and decades of experience, is behind the quality of Hitachi magnets. Quality magnets featuring high coercive force, big energy product, magnetic field uniformity and stability.

Here are some typical examples:

Type	Residual Induction (Br) gauss	Coercive Force (Hc) oersteds	Energy Product (B×H) max. $\times 10^{-6}$
HI-MAG (ALNICO-5-7)	13,000-14,500	700- 800	6.8- 8.2
YCM-8D (ALNICO-8)	7,500- 8,300	1,700-1,850	5.5- 6.5
YCM-8E (ALNICO-8)	7,500- 8,500	2,000-2,150	5.5- 7.0
YCM-9B (ALNICO-9)	10,000-11,000	1,350-1,500	9.0-11.0
HICOREX ($SmCo_5$)	7,700- 9,200	7,700-9,000	15.0-21.0

For full details about Hitachi magnets, call any of our offices.

HITACHI
Hitachi Metals, Ltd.
Head Office: Chiyoda Bldg., Marunouchi, Tokyo, Japan

Hitachi Metals America, Ltd.
New York: (Head Office): 1, Red Oak Lane, White Plains, N.Y. 10604, U.S.A. Tel. 914-694-9200
☐ **Chicago:** Tel. 312-299-0031 ☐ **Detroit:** Tel. 313-557-7142 ☐ **Los Angeles:** Tel. 213-553-6649 ☐ **Atlanta:** Tel. 404-938-6992 ☐ **Houston:** Tel. 713-528-1769 ☐ **Toronto:** Tel. 416-491-9471

Circle 153 on reader service card

Has Spectrol invented the "universal" pot?

The Model 534 is a pot that can be made to fit almost every application.

Never before has a low-cost pot been made available with such quality, flexibility, and versatility. Take a look at the superior design features of the basic Model 534, and look at the "special" variations available. Then look at the low prices — often from ½ to ⅓ the price of other models which offer some of the same "special" features. With everything going for it, the low-cost Model 534 may prove to be that "universal" pot you've been waiting for.

The features shown are just a partial listing. Many more options and special design features are available. So why wait? Why not get your hands on a 534, and see for yourself? For a data sheet, just use the reader service card; and for price and delivery, call us directly.

Standard Design Features — • ¾" long; ⅞" diameter • 10Ω to 200KΩ • 3 turns (Model 533), 5 turns (Model 535), or 10 turns (Model 534) • Rugged construction, 75 oz.-in. stop strength and Thermoset plastic housing • Stainless steel front lid and shaft • Welded terminations • Bushing or servo mount.

Special Features Available — • Resistance tolerances to ±1%, linearities to ±.075% • High torque, 2 to 6 oz.-in. • Non-turn lug • ¼-32" bushing with ⅛" shaft • Non-linear functions • Extra taps • Screw mount • Added sections • Locking bushing • 1 thru 8 turns rotation • Pot-switch combinations • Shaft variations: dual concentric shafts, various shaft lengths, shapes, materials — slots, flats, plastics, splines, and metal-plastic combinations.

Spectrol

SPECTROL ELECTRONICS GROUP

UNITED STATES

Spectrol Electronics Corporation
17070 E. Gale Avenue, City of Industry, Calif. 91745, U.S.A.
(213) 964-6565 • TWX (910) 584-1314

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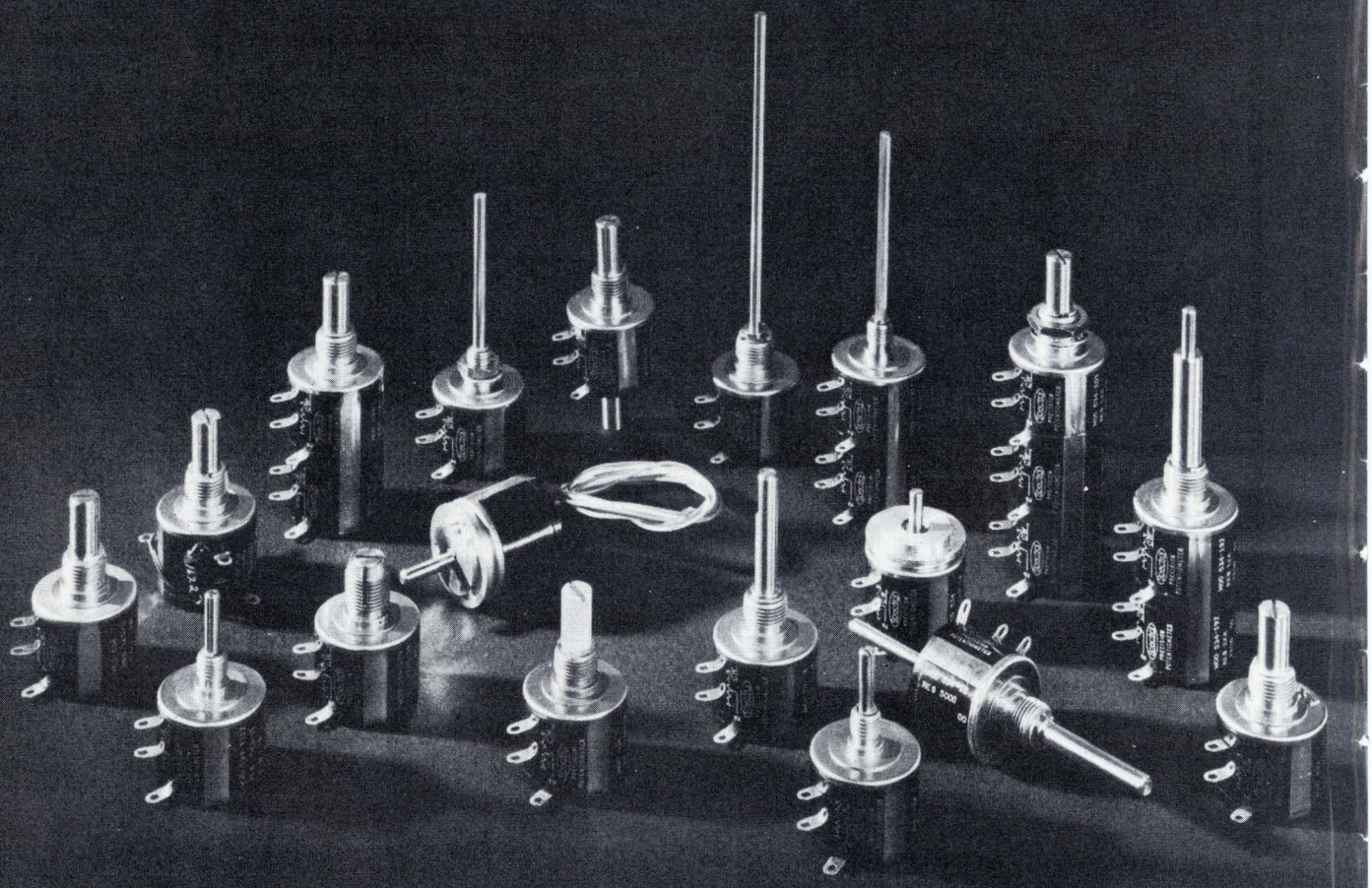
Swindon 21351 • TELEX: 44692

ITALY

SP Elettronica spa
Via Carlo Pisacane 7, 20016 Pero (Milan) Italy
35 30 241 • TELEX: 32242



Circle 154 on reader service card

Semiconductors

RAM aimed at register jobs

Motorola's most complex MECL 10,000 entry boasts 10-ns access time

The first memory in Motorola's MECL 10,000 series of emitter-coupled logic—and the most complex item yet introduced in the line—is a 64-bit, high-speed random-access memory especially suited for register-like use in processors. The new MC10145 is fully decoded, with a typical stored-data access time of 10 nanoseconds, five times faster than similar TTL RAMs, says Jack Burns, product planner for ECL memories at Motorola. The read/write cycle time is typically 17.5 nanoseconds.

The RAM, with the equivalent of 150 gates on one chip, uses high-speed MECL-III-type processing geometries, together with double-layer metalization. Its outputs are MECL 10,000, however.

Burns sees major applications in large mainframes, in minicomputers, and wherever a relatively small amount of data must be stored temporarily and retrieved rapidly. The device can also be used in high-speed data communications.

Burns says that minicomputer makers seem less reluctant to adopt new LSI functions than manufacturers of big computers. And Motorola is planning a number of 10,000 memories aimed at minicomputers in the next year, including a soon-to-be-released 64-by-1 RAM (10144), a 1,024-bit RAM (10146), a 256-by-4 programable read-only memory (10149), and a factory-programable ROM (10150).

The new 64-bit MC10145 is organized 16-by-4 for register use, and its wired-OR capability, plus chip-enable, permit easy interconnection of packages to make larger memories. Four packages, for example, can yield a 32-word-by-eight-bit register. The part can also be used in small scratch-pad, buffer, and cache memories. Furthermore, the RAM's outputs can be bused and are designed to drive lines with as low as 50 ohms of impedance.

As expected, power consumption is a healthy 600 milliwatts per package at 5.2 volts. Burns says this is within the package's capability, but he feels that most applications will be in forced-air-cooled systems, anyway. The 10145 is packaged in a 16-pin black-ceramic dual in-line case. It is priced at $24 in quantities of 100 units or more.

Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, Ariz. [411]

Four-function, 12-digit chip has its own memory register

The industry's first MOS four-function 12-digit chip with a register for memory or constant operation is being marketed by Cal-Tex Semiconductor Inc. The constant feature is operated by recalling the K number from memory.

The CT5005's multiplexed seven-segment outputs permit operation with LED, incandescent, fluorescent, or gas-discharge displays through a minimum of external components. As a result of feedback of timing signals through a matrix-type keyboard, the pin count has been reduced to 28, and keyboard encoding requirements from the printed-circuit board are eliminated.

Features of the CT5005 include add, subtract, multiply, and divide functions; calculations and display up to 12 digits; and provision for decimal point fixed at 0, 1, 2, 3, 4, or 5. Decimal position is keyboard selectable; no separate switch is required. The chip offers automatic lockout of "unsure" repeat operations, true-credit-balance sign display, automatic overflow indication, and suppression of leading zeroes.

The chip is designed for two-phase clock operation at a clock rate of 25 kilohertz. Add/subtract time is 12 milliseconds, and worst-case multiply/divide time is 400 milliseconds.

Price for the CT5005 is about $15 each in large volume. Delivery is from stock.

Cal-Tex Semiconductor Inc., 3090 Alfred Street, Santa Clara, Calif. 95050 [412]

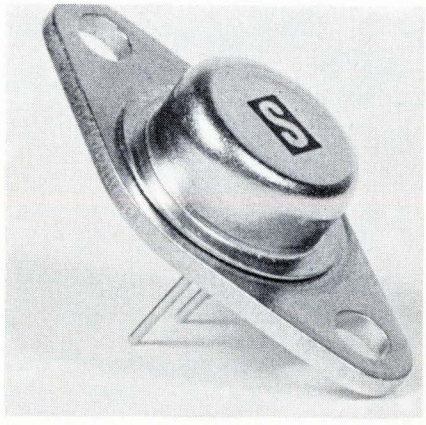
Gallium-phosphide LED offers low current levels

A gallium-phosphide light-emitting-diode display, called the model XMN-120, is available in production quantities. The monolithic readout is 0.120 inch high and is a seven-segment numeric. It is offered in a single digit package with either on-board or edge decimal point configuration. The unit offers low power consumption and is thus directly compatible with MOS driving circuitry. This in turn eliminates interfacing segment-driving circuitry. The XMN-120 is packaged in a nine-pin DIP and is end-stackable for compact spacing. Price in 1,000-lots is $3.

Xciton Corp., Shaker Park, 5 Hemlock St., Latham, N.Y. 12110 [413]

Single-diffused Darlington transistor is rated at 10 A

A series of single-diffused 10-ampere Darlington npn silicon power transistors are available in a range of 60, 80, and 100 volts. The series is designated SDM 2501-6 and is supplied in standard TO-66 cases. The units provide good second-breakdown capability and have low-leakage characteristics similar to those of planar devices. Typical gain is

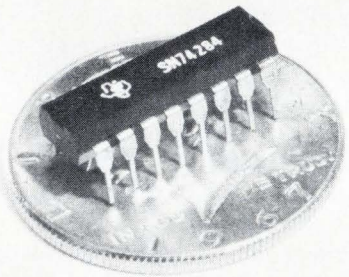


New products

5,000 at 5 A. Applications include power switching, inverters, converters, and stereo and audio amplifiers. Price is $2.60 in lots of 100.
Solitron Devices Inc., 1177 Blue Heron Blvd., Riviera Beach, Fla. 33404 [414]

TTL/LSI multipliers contain 200 gates on a single chip

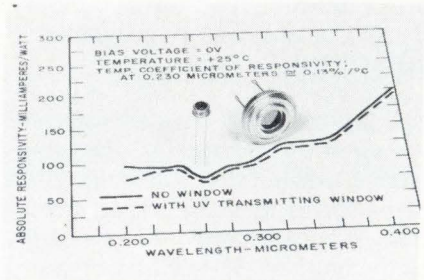
Two TTL/LSI circuits can be used together to generate an eight-bit binary product in 40 nanoseconds. Designated types SN54/74285 and SN54/74284, the four-bit-by-four-bit parallel binary multipliers each contain the equivalent of over 200



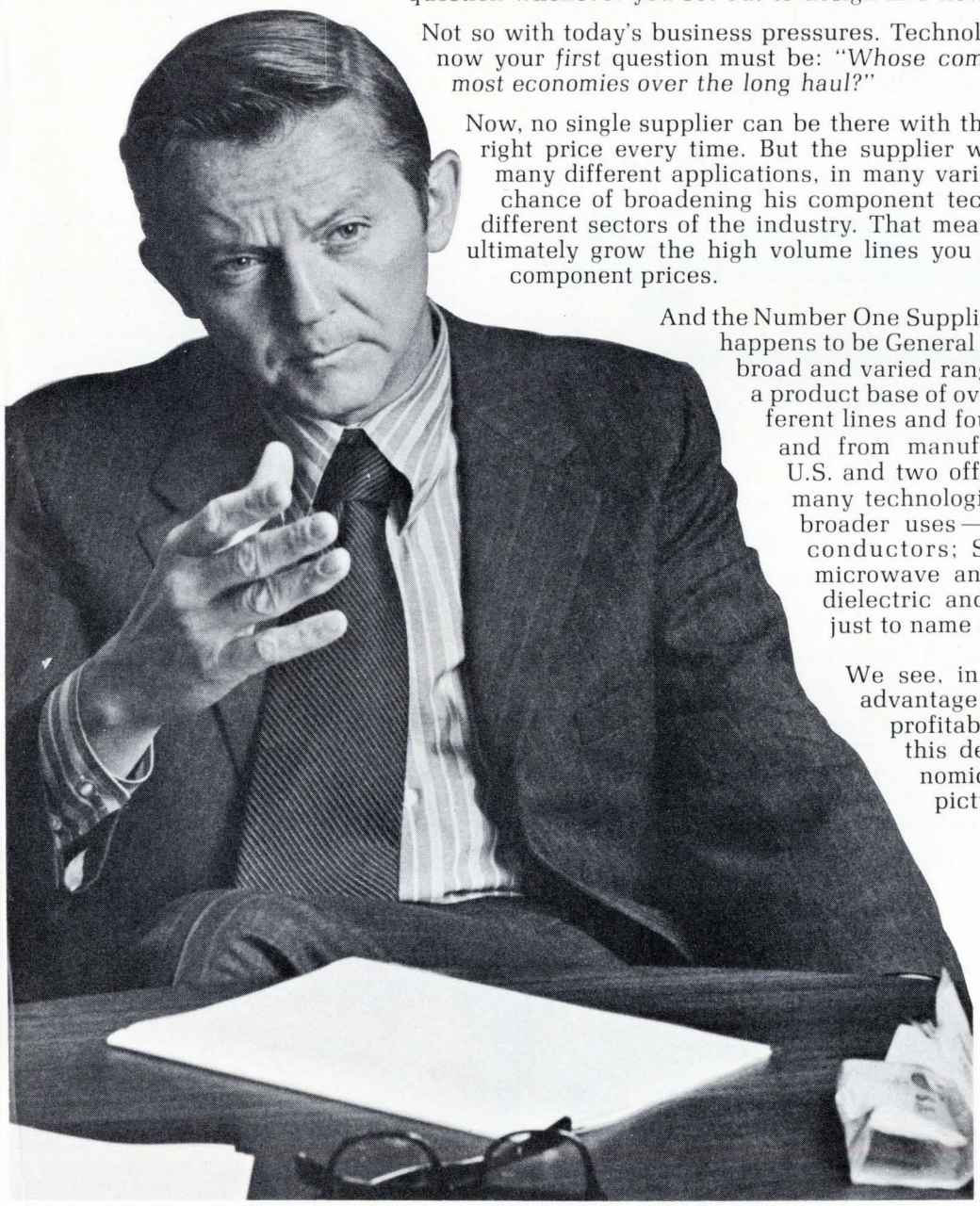
gates on a monolithic chip. If the multipliers are combined with the company's carry-save adder, arithmetic logic unit, and lookahead generator, expandable n-bit-by-n-bit applications are possible. Price in 100-lots ranges from $8.10 to $36.45 depending on packaging.
Texas Instruments Incorporated, P.O. Box 5012, M/S 308, Dallas, Texas 75222 [415]

Silicon photodiodes designed for analytical instruments

The UV series of photovoltaic silicon photodiodes is suitable for use in analytical instrument applications where high spectral respon-



"Straight talk about buying your components from a truly broad line supplier."



"Who's got the edge in technology?" That used to be your instinctive first question whenever you set out to design-in a new component.

Not so with today's business pressures. Technology's still important. But now your *first* question must be: *"Whose component will give me the most economies over the long haul?"*

Now, no single supplier can be there with the right component at the right price every time. But the supplier whose product mix spans many different applications, in many varied markets, has the best chance of broadening his component technologies to serve many different sectors of the industry. That means he's the one who will ultimately grow the high volume lines you will need to lower your component prices.

And the Number One Supplier in that department just happens to be General Electric. We serve a very broad and varied range of manufacturers from a product base of over 40 categories in 13 different lines and four major technologies . . . and from manufacturing facilities in 12 U.S. and two offshore sites. We've led in many technologies we can now apply to broader uses—signal and power semiconductors; SCR's; optoelectronics; microwave and imaging devices; film, dielectric and electrolytic capacitors, just to name a few.

We see, in our breadth, a distinct advantage whereby we can grow profitably with you throughout this decade's tougher, yet economically sounder business picture. 690-12

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BEST BUY Our No.1 Goal QUALITY . SERVICE . VALUE

Dr. Thomas A. Vanderslice, Vice President and General Manager Electronic Components Business Division, General Electric Company

GENERAL ELECTRIC

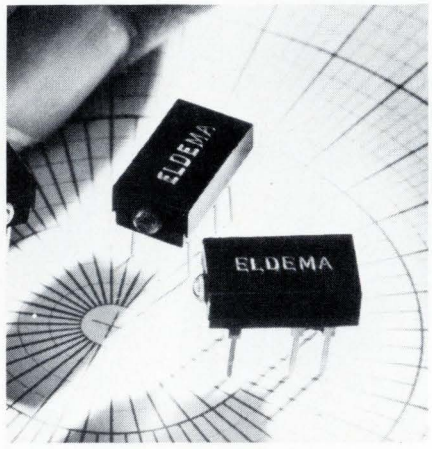
New products

sivity, ultra-low noise, spectral stability, and response linearity are prime factors. Features of the unit include a spectral responsivity at 230 micrometers of 90 milliamperes/watt, spectral stability at 230 micrometers of 0.13%/°C, equivalent Johnson noise current in the range of 2–5 × 10^{-14} amperes per root hertz, and a response linearity to within 1% over seven decades of irradiance.

EG&G Inc., Electro-Optics Division, 35 Congress St., Salem, Mass. 01970 [416]

Solid-state status indicator is aimed at computer uses

Designed to visually describe the status of the circuit or board on which it is installed, a status indicator integrates LED and resistor construction in one package. The unit is



suitable for computers, computer peripheral equipment, and many types of instrumentation. Encased in a phenolic housing, the device is designed for 5-volt, 10-milliampere operation, with other voltages available.

Eldema Division, Genisco Technology Corp., 18435 Susana Rd., Compton, Calif. 90221 [417]

MOS line drivers provide 1-A output current

Hybrid MOS line drivers offer a peak output current of 1 ampere and output voltage swings of up to 30 volts.

HARD COPY MADE EASY

The Philips Mosaic Printer costs less than any other printer of its type. And it's more adaptable to your specific need. It makes hard copy a reality where it was too expensive before.

Unlike ordinary printers, this one forms characters made of individual dots, by means of needle-like hammers. It prints not only plain language and numerals, but any symbol you can think of ...without any modification of the printer itself. The range of characters is determined by a programmable MOS read-only memory in the drive module.

With 60 mm paper*) it prints a 20-character line in one second. Weighing less than 2 kilo, the printer fits into any data processing, digital measuring or general industrial system. It's electronically controlled by this 64-character drive module, or an optimal 20-character unit. Input logic is TTL compatible. Both 24V/50Hz and 24V/60Hz versions are available.

A minimum of moving parts makes it easy on the repair budget. Silent operation makes it easy on the nerves. To make it as easy as possible to fit it into your system, we're ready to provide full application support... including assistance in design of your peripheral circuitry!

*) A fully conversational high-speed page printer with character-by-character operation will be introduced soon.

Easy enough? Send for full information now.

Philips Industries
Electronic Components and Materials Division,
Eindhoven - The Netherlands.

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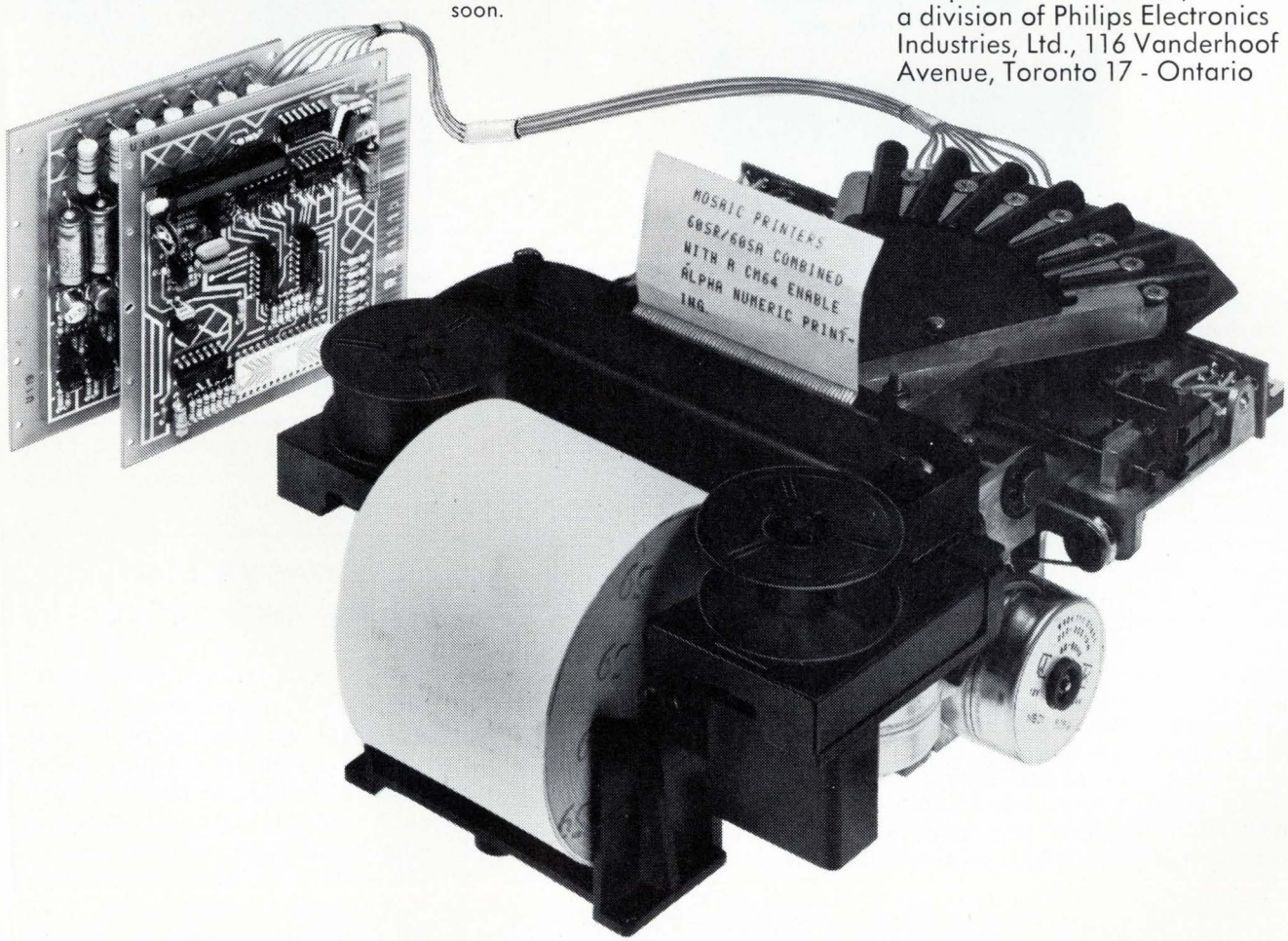
In Canada:
Philips Electron Devices, a division of Philips Electronics Industries, Ltd., 116 Vanderhoof Avenue, Toronto 17 - Ontario

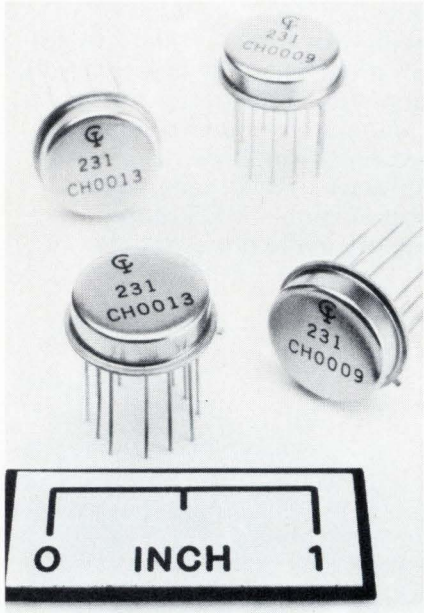


PHILIPS Electronic Components and Materials

PHILIPS

New products

Typical rise and fall times are under 50 nanoseconds when driving 1,000-picofarad loads. The CH0009 series may be direct-coupled to the driving source, or may be used in capacitor-coupled applications. The CH0013 series is designed for capacitor-coupled applications only. But both



are packaged in 12-lead TO-8 cans. Operating temperature range for the basic device is −55°C to +125°C. Price of the units ranges from $9.75 to $16.25 in 100-lots.

Cermetek Inc., 660 National Ave., Mountain View, Calif. 94040 [418]

Fast-recovery silicon rectifiers deliver 100–600 V

Twelve 100–600-volt fast-recovery silicon rectifiers are designated the TA series. Models TA 8411, 8412, 8413, and 8414 are 6-A forward-polarity types. Models TA 8415, 8416, 8417, and 8418 are 12-A forward-polarity versions, and the models TA 8419, 8420, 8421 and 8422 are 20-A forward-polarity units. Four reverse-polarity versions are also offered and are suitable for applications that require the anode to be at ground potential. Price in 1,000-lots ranges from $1.49 to $6.

RCA, Solid State Division, Route 202, Somerville, N.J. 08876 [419]

WE NEED HARDWARE-ORIENTED DESIGN ENGINEERS TO WORK ON THE FRONTIERS OF TECHNOLOGY

System Programmers

with accredited degree in engineering or math and 2-3 years working experience in PDP-9; 10 or 11 system programming, time sharing systems, PDP-10 Monitor; interactive systems; and/or computer-aided design systems.

E-O Systems Engineers

for conceptual design of infrared surveillance, precision tracking, threat-warning receivers, E-O counter-measures. Should be familiar with optical systems, detectors, scanning mechanisms, signal processing. Requires accredited degree, 3 years experience.

Microelectronic Engineers

to design and evaluate integrated and hybrid devices, analyze failure modes, investigate effects of environments and materials on device characteristics, and determine application criteria. Requires accredited degree and 3 years experience.

E-O Circuit Designers

with recent experience in analog and digital circuit design. To be responsible for circuit design, from conception through working hardware and integration. Should be familiar with electro-optical IR systems signal-processing, tracking, and digital-display techniques. Requires accredited degree and 3 years experience.

Laser Power Supply and Amplifier Circuit Designers

to work primarily with specialized power supplies and video amplifiers, although some digital control and decision work is also involved. Candidates must be well above average in intrinsic brightness and should have the capability of working alone or in small teams. Requires accredited degree and 3 years experience.

Optical Engineers and Physicists

for conceptual design, detailed design, and analysis of very well baffled optical systems with very high off-axis rejection. Familiarity with techniques to reduce the scattered and diffracted radiation levels from off-axis sources reaching the focal plane is required. Experience with computer-oriented analysis of scattering and diffraction would be helpful. Requires accredited degree and 3 years experience.

Please send your resume to: Robert A. Martin, Head of Employment, Equipment Engineering Divisions, Hughes Aircraft Company, 11940 West Jefferson Blvd., Culver City, California 90230.

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HUGHES

HUGHES AIRCRAFT COMPANY

Packaging & production

Reactor handles larger wafers

Epitaxial unit can process 21 3-inch wafers or 44 2-inch types per tube

To meet increasing demands of the semiconductor industry, Hugle Industries has developed an epitaxial reactor system that can double the throughput of a semiconductor production line [*Electronics,* Oct. 23, p. 26]. Called the Unipak X, the new dual-tube machine can process up to 44 2-inch wafers or 21 3-in. wafers in each tube. Present machines usually handle up to 20 2-in. wafers.

Part of the problem in building large horizontal-tube reactors (and the susceptors on the Unipak X are large—they measure 9.5 by 23 in. each) is in getting large quartz tubes. But Jerry Bowers, production manager at Hugle, says, "Once the market for large reactors became obvious, the quartz people made the investment in equipment that could make large tubes."

The Unipak X employs Hugle's automatic flow, time, and temperature controls, as well as a novel rf layout, to achieve a thickness uniformity within 5 to 10%. Resistivity uniformity is within ±10%.

The range of performance for the Unipak X includes silicon epitaxy resistivities from 0.005 to 20 ohms/cm and thicknesses from 0.5 to 100 micrometers; background resistivities greater than 100 ohms/cm for n-type; polycrystalline silicon deposition with rates from 0.1 to 8 μm per minute; graded and multiple layers of the same and opposite conductivity type; and deposited single and multiple dielectrics such as Si_3N_4, SiO_2, with over-all uniformity better than to within ±10%.

The gas-control system of the Unipak X reactor can be operated either manually from the graphic panel or automatically by the real-time programer. The system features Hugle Industries' gas-injection block system with positive-acting 24-v dc solenoid valves. The injectional block system provides independent vent/deposit selection for each flow line. The pressure balance between vent and deposit is controlled by inert purge flow.

As many as 16 flowmeters or mass flowmeters can be incorporated into the gas-control system.

Unipak X is available 12 weeks after receipt of order. The complete system, including the reactor with automatic time and temperature controllers and rf generator, sells for about $85,000.

Hugle Industries, 625 N. Pastoria Ave., Sunnyvale, Calif. 94086 [391]

Bonder can attach 1,000 light emitters an hour

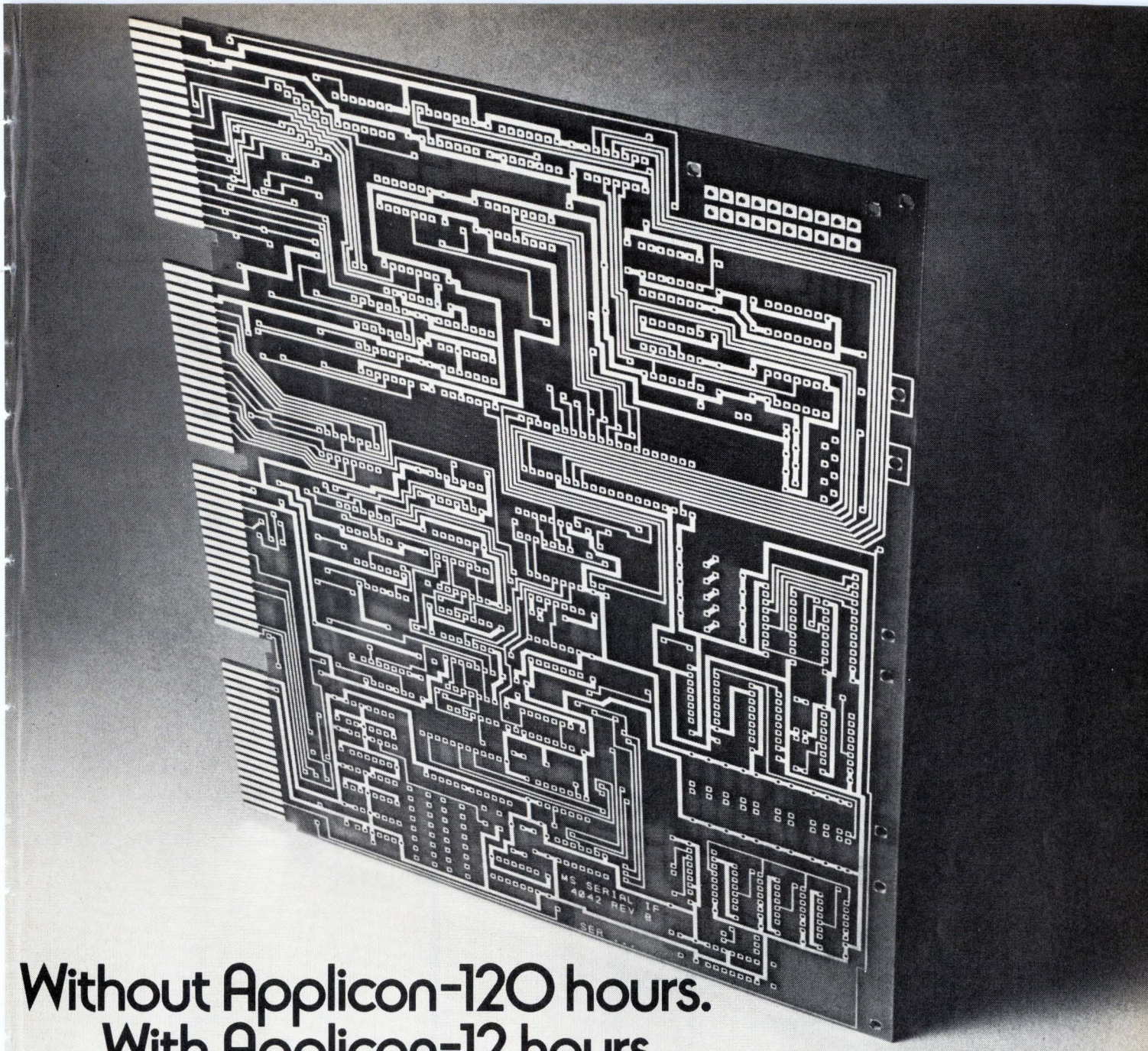
An epoxy lead-frame bonder that attaches 800 to 1,000 light-emitting diodes per hour promises to give a big boost to the art of fast epoxy-chip attachment. The LF 251, developed by Laurier Associates of Westford, Mass., offers a 10-fold improvement over manual placement rates of no more than 100 an hour, according to the company.

What's more, even though the machine is designed for LEDs, feed mechanisms are available for handling virtually any kind of lead frame.

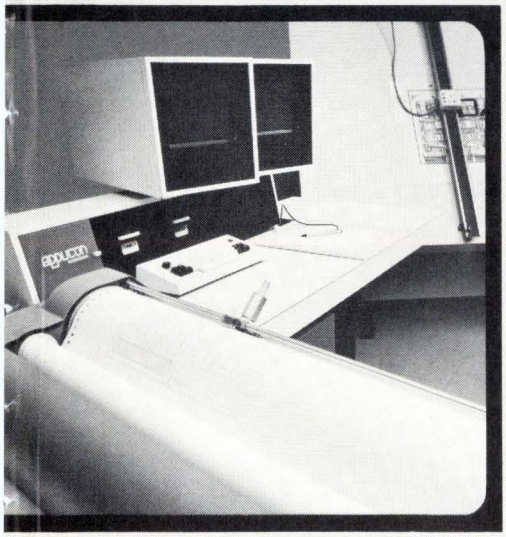
Lead frames are advanced automatically. Indexing is performed by a tapered pin so that errors are noncumulative. The company says that die-placement accuracy is within 2 mils.

The operator begins the attachment sequence by aligning the die-pickup arm with the chip and pressing a handle to simultaneously pick up the die and dispense the epoxy on the lead frame. The LF 251's sliding table is then moved toward the operator, and the chip is precisely placed on the lead frame. Then the slide moves back and automatically indexes the lead frame to the next position.

The die-placement pick-up arm is



Without Applicon-120 hours. With Applicon-12 hours.



Look at the detail in this printed circuit. You could easily imagine it would take at least 120 hours to complete—from the original drawings to the finished taped result.

Actually it took less than 12 hours—thanks to Applicon, an advanced new computerized system that processes graphic data much like a computer system processes business data.

Applicon can speed drafting work many times over. It can be commanded to add, delete, move, flip, rotate, stretch, step, repeat and copy all kinds of graphic information... and do it in seconds.

Comes with a full range of ready-to-use hardware and software to handle input, storage, manipulation and output of drawn lines fed into its computer. Fully compatible with conventional production operations, it permits productive interaction by the designer or draftsman, generating artwork masters consistent with normal workflow methods.

Want more information? Then send for a free sample PC master from Applicon, Inc., 22 Third Avenue, Burlington, Mass. 01803. Or, call (617) 272-7070. Today.

applicon INCORPORATED

Circle 163 on reader service card

counterbalanced, and an adjustment enables placement force to be adjusted from zero grams upward.

Base price of the machine is $3,900, plus whatever lead-frame mechanism must be built for a particular customer's requirements. Delivery time is 12 weeks from receipt of order.

Laurier Associates Inc., 2 Vose Rd., Westford, Mass. 01886 [392]

Positioning of load board optimizes IC test conditions

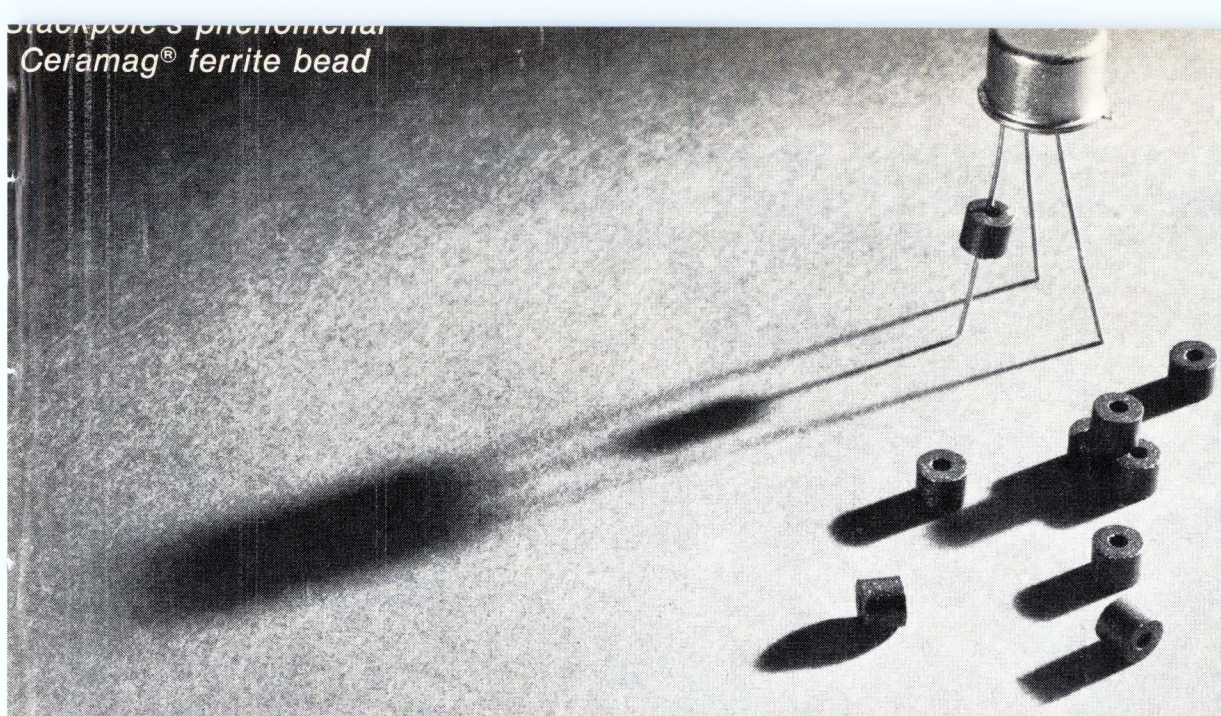
Effective IC testing requires simulated input and output circuit loading during the application of dynamic signals. In its new test handler, International Production Technology accomplishes this by placing the circuit load board right at the contactor that engages the pins of the IC. This means that the connections from IC to load board are less than one inch and exhibit low inductance and low inter-lead capacitance - crucial requirements for valid testing at speeds of 1.5–2 nanoseconds.

The handler, called the IPT-701-37, is designed for table-top mounting, and performs static and functional tests at throughputs exceeding 5,000 units per hour. Virtually all DIPs with 0.300-inch (center-to-center) pin spacing can be tested. This includes devices with 8 to 18 leads, and package thicknesses ranging from 0.11 to 0.200 in. Most 0.600-in. ICs can also be handled; other package sizes can be accommodated on special order.

The contactor grips each device lead just below the lead neck, and thus below the region where lead flash sometimes occurs, so a positive contact is assured. However, virtually no cosmetic damage is done to the leads, and the company says the contactor itself has endured better than 3 million cycles without any discernible wear.

The handler mechanism is hinged to a baseboard so that it may be tilted to afford access to the contactor assembly and load board. The electro-pneumatic drive system is

Stackpole's phenomenal
Ceramag® ferrite bead

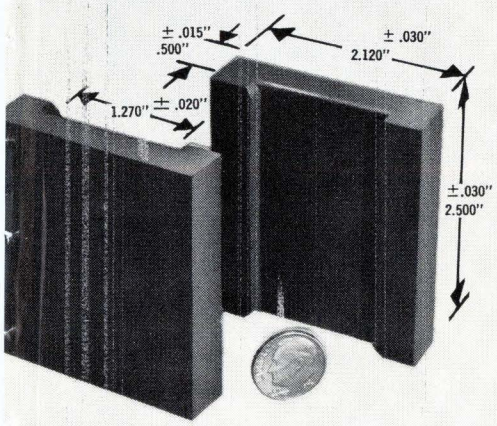


The Silencers

Ceramag® Beads Do Away with Noise

Stackpole ferrite beads offer a simple, yet effective means of suppressing spurious RF signals to prevent them from entering areas susceptible to such "noise." No other filtering method is as inexpensive as a ferrite bead.

How can you use a bead? Consider it as a frequency-sensitive impedance (Z) element. Beads are available in a variety of Stackpole Ceramag® materials. Depending upon the material selected, beads can provide increasing impedances. From 1 MHz to over 200 MHz. Keep in mind, the higher the permeability, the lower the frequency at which the bead becomes effective.



Should a ferrite bead be small? Not necessarily. The unique, giant bead shown below is used by IBM to eliminate the effect of transient noise.

The impedance of Stackpole ferrite beads can be changed by simply varying the length or the O.D.-I.D. ratio.

Installation of Stackpole beads is easy. And inexpensive. Simply slip one (or several) over the appropriate conductor(s) for the desired noise suppression or high frequency isolation.

Additional savings in production time and labor costs are possible by utilizing automatic insertion equipment to install ferrite beads *with leads* in printed circuit boards.

CERAMAG® FERRITE BEAD CHARACTERISTICS

	24	7D	5N	11
Initial Permeability	2500	850	500	125
Volume Resistivity @ 25°C	1.0×10^2	1.4×10^5	1.0×10^3	2.0×10^7
Effective Suppression At:	1 MHz.	20 MHz.	50 MHz.	100 MHz.
Curie Temperature	205	140	200	385

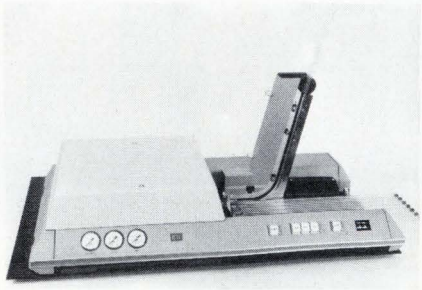
Beads are available in sleeve form in a range of sizes starting at .020 I.D., .038 O.D., and .050 long. For special compact filtering applications, beads can be supplied to tight mechanical tolerances.

Sample quantities of beads and beads with leads are available upon request. Send your requirements to: Stackpole Carbon Company, Electronic Components Division, St. Marys, Pa. 15857. Phone: 814-781-8521. TWX: 510-693-4511.

STACKPOLE
ELECTRONIC COMPONENTS DIVISION

Circle 165 on reader service card

inoperative during each device test, and this minimizes test contamination from spurious electrical signals. The open construction of the feed chutes enables clearance of any jam which might occur. In addition, the



IC under test is observable during the handling cycle.

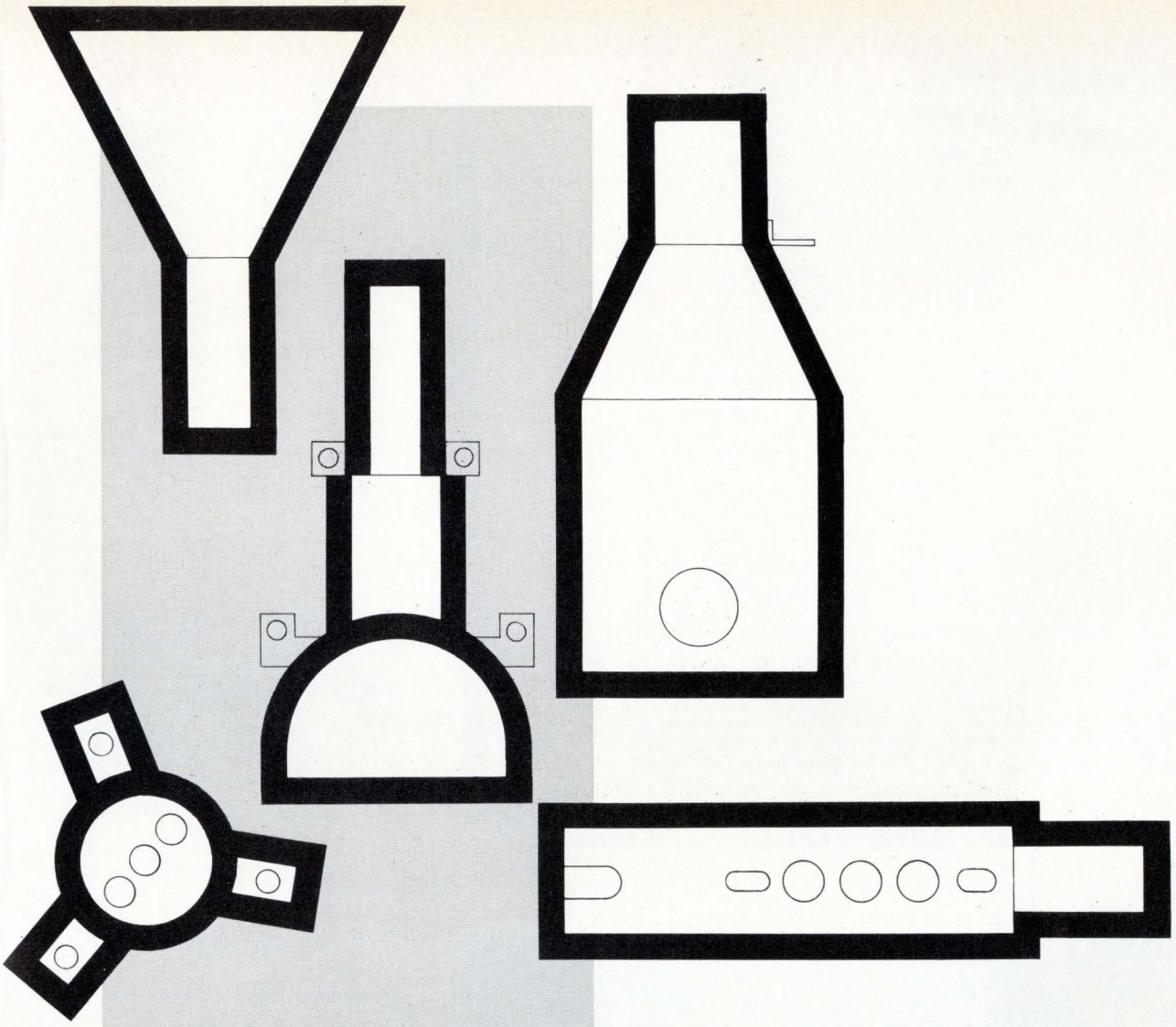
Operation can be either manual or automatic. In the automatic mode, the device will continue to cycle ICs as long as there are devices in the input reservoir and as long as there are unfilled output tubes.

International Production Technology, 185 Evelyn Ave., Mountain View, Calif. 94040 [401]

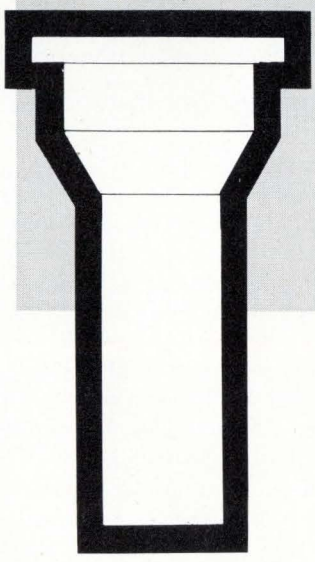
Limit bridge for production testing goes to 100 megohms

A limit bridge includes all the equipment necessary for making accurate four-terminal resistance measurements from 1 ohm to 100 megohms. The unit is for production

and inspection testing and includes a modified six-dial Wheatstone bridge, a linear amplifier, and a solid-state bridge power supply. The model 4271 is equipped with "low," "go," and "high-limit" lights, and provides 10 switch-selectable limit ranges. In addition to percentage



Famous Hipernom® shielding alloy comes only from Carpenter. Quickly.



More than ever, Hipernom is the magnetic shielding alloy to use . . . for its quality, availability, and prompt Carpenter service.

You may recall, this extremely high permeability material was once made by Westinghouse. Now, however, it's manufactured and stocked exclusively by Carpenter . . . in standard 30″ x 120″ sheets, in seven thicknesses ranging from 0.014″ to 0.062″. And if you need something special, that's also available, all with traditional built-in Carpenter uniform quality.

For full information and quick Hipernom delivery, call your Carpenter Service Center today. The one nearest you is listed in the yellow pages. Or write Carpenter Steel Division, Carpenter Technology Corporation, Reading, Pa. 19603.

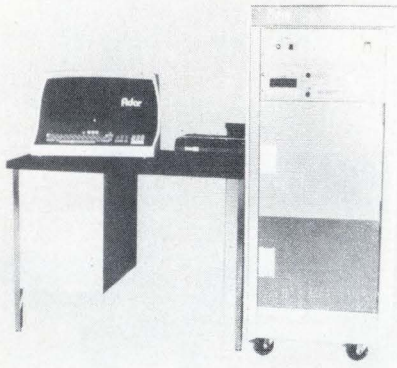
CarTech CARPENTER TECHNOLOGY

CARPENTER STEEL DIVISION

limit measurements, the unit can be used for null measurements.
Leeds & Northrup, North Wales, Pa. 19454 [393]

Memory tester can check up to 16 million locations

A computer-controlled microprogramable test system can check memory cards or memory systems at up to 16,000,000 locations by 72 bits. An optional test head converts



the Doctor 12 unit into a chip tester. Test programs are activated by a CRT-keyboard link, and both program and results are displayed on the CRT. In addition to go/no-go testing, the unit performs memory system debugging and engineering evaluation. Price is about $25,000.
Adar Associates Inc., 85 Bolton St., Cambridge, Mass. [394]

Plastic plated DIP sockets eliminate separate contacts

A range of dual in-line sockets is designed so that the need for separate contacts is eliminated. Contact between the integrated-circuit leads and pins connecting the socket to the printed-circuit board is made by gold- or tin-plated copper deposited on the plastic body. The plated body is in the form of a saddle over which the IC leads are slipped and located in open-sided slots. The IC is held in place by a plastic retainer that presses the leads inward to contact the plated areas. Four sockets are available, ranging in price from

It takes us less time to tell you what it's not.

What it's not.

It's not an office copier. But it's as fast and easy to use as an office copier. The output is a digital bit stream. And that's the major difference: You can optically scan input documents. Or pictures. Or patterns. Or characters to your computer system. Or storage system. Or high-speed communications system. Or pattern recognition system. In short, it begins to relieve the input bottleneck of *your* system.

What it isn't for.

It isn't for the guy without ideas. More applications exist than time to list them all. But you might consider these few: A photocomposition system for the typesetting trades. An optical character reader for computer input. A document storage and retrieval system for large filing requirements. A facsimile scanner for high speed communications (up to one megabit per second). A pattern recognition system for computer analysis of any type of graphics—such as line drawings, symbols, half tone prints, handwriting and fine art. An automatic inspection system for most surfaces; natural or manufactured; animal, vegetable, or mineral. An input to any machine requiring the translation of artwork to digital form—computer controlled knitting machines, welding machines, graphics plotters, and artwork generators.

Why you might not buy it.

You might not buy it if you like to tinker. It has one moving part and all solid-state electronics. You might not buy it if you're not in a hurry. It optically scans and digitizes a complete document in two to four seconds depending on the resolution desired. You might not buy it if you don't want photopic response. It recognizes every color—from light blue to dark red—and, like the human eye, differentiates the data from the background by degrees of contrast.

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It won't scan at infinite speeds. And it won't deliver at infinite resolutions. But it *will* scan at up to one megabit per second—with resolutions of 240 points per inch. That translates to mean our product can scan an 8½ x 11 inch field and then reduce it to digital data in less than four seconds. And that's about five times faster than anything else we know of on the market. And that's pretty important if you need your data rapidly digitized. If you need more information rapidly, call John Brown direct at (408) 734-1225.

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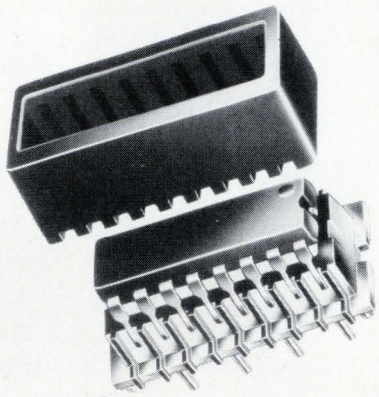
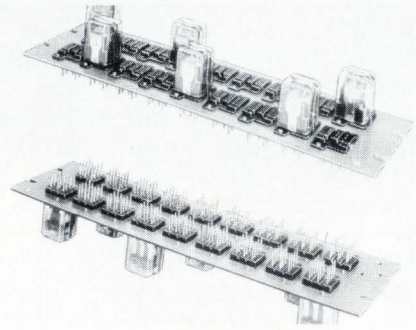
New products



45 cents in 100 lots to $18 for 10,000 pieces in quantities of 1,000.
Jermyn, 712 Montgomery St., San Francisco, Calif. 94111 [395]

Socket panel assembly is solderless-wrap type

The series 203 assembly is a 19-inch panel capable of accepting several common contactor relays, including the type 157 triple-pole double-throw relay or the type 113 solid-



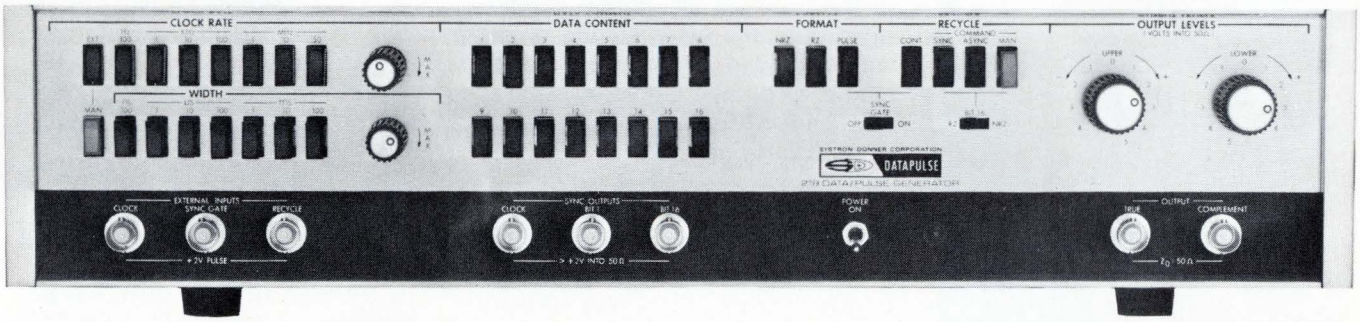
state time-delay relay. Up to nine sockets can be mounted per row, with from one to four row assemblies available. The solderless-wrap sockets have 11 terminals of 0.031 by 0.062 by 0.75 inch.
Midtex Inc., 10 State St., Mankato, Minn. 56001 [397]

Flat-cable connectors act as contacts to pc boards

The series K interconnection system is designed so that the connector body and flat multiconductor cable are a single unit. Solder joints are eliminated, since each conductor in

Now there's a *or* generation gap

Here's the 50 MHz data generator you've needed all along—the one you've been stacking pulse generators to simulate. And it's a high speed pulse generator, too.



Check out the front panel. You have pushbutton control of the data content of 16-bit words in either NRZ or RZ format. You can recycle words continuously (synchronously or asynchronously), manually or by external command. You can vary pulse width continuously when using the 218 as a pulse or RZ data generator. Output is upper/lower level controlled.

Of course, there's a remote programming option. And two or more 218's in parallel provide multi-channel outputs, if you need them. In series, they permit longer word lengths.

You can't buy or build a more complete, more versatile data and pulse generator.

Get the full story on the low-cost ($925) Model 218 Data/Pulse Generator from your nearest Scientific Devices Office, or contact Datapulse Division, 10150 West Jefferson Boulevard, Culver City, California 90230. Telephone (213) 836-6100; TWX 910/340-6766; Telex 67-3219. In Europe: Systron-Donner GmbH, Munich W-Germany; Systron-Donner Ltd., Leamington Spa U.K.

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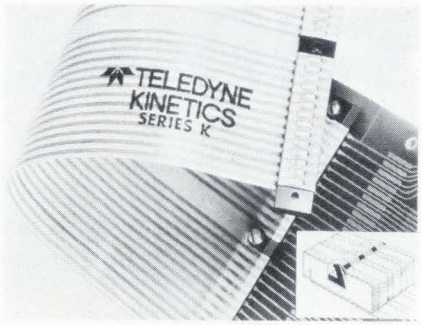
New products

the cable serves as its own contact. Electrical and mechanical connections are made simultaneously, facilitating installation or removal of the printed-circuit board. The K series is adaptable to almost any

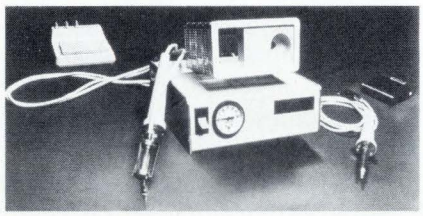


packing design or circuit requirement, and the cable section of the connector can be supplied to any length with any number of conductors and with contact spacing as close as 0.010 inch.

Teledyne Kinetics, 410 South Cedros Ave., Solana Beach, Calif. [396]

Soldering-desoldering station works from on-site air source

A portable power soldering-desoldering station operates directly from the factory compressed-air source. The model DS100 is suited to production rework, as well as electronic



service applications. Temperature control and output control are automatic, and operation is at 24 vac from 110-v supply.

Weller Division, The Cooper Group, P.O. Box 728, Apex, N.C. [398]

Ribbon bonder is pulse-heated

A pulse-heated thermocompression ribbon bonder is designed for large production rates on devices using

The only digital ohmmeter that gives you the accurate lowdown.

From 200 ohms down to 10 microhms, that is. Automatic measurements with a basic accuracy of ±0.02% plus 1 digit. Plus 0.01% linearity, 10 microhm resolution, automatic cancellation of thermal emf's, and ac rejection of better than 80 db at 60 Hz. Test leads can have up to 10 ohms resistance with *no* effect on accuracy.

We call it our SP 3789 Low Resistance Digital Ohmmeter, and it is the ideal instrument for use in design and production work where small resistance value need to be measured. Compact, fully solid state, with a highly visible 4½-digit LED readout, it may be operated in a single measurement or continuous measurement mode.

The SP 3789 Low Resistance DOM consists of the SP 3780 Digital Converter and the SP 3790 Low-Ohm preamp plug-in. The converter is available separately for those who want to make their own plug-ins.

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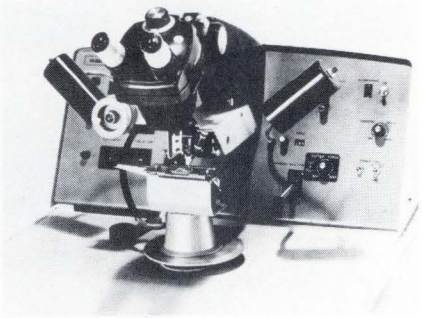
Circle 173 on reader service card

New products

ribbon instead of wire. The model HPB-360/RB is for applications in the fabrication of microwave devices, hybrid circuits, and tunnel diodes. Operation is by a current pulse of extremely short duration passing directly through the capillary tip. Thus, the substrate is not heated, and damage to heat-sensi-

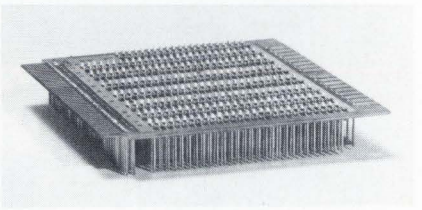


tive devices or adjacent components is prevented. The bonding cycle is programed, but the operator has a manual override control to permit any number of stitch bonds. Price is $4,250.

Hughes Metal Bonding Equipment, 2020 Oceanside Blvd., Oceanside, Calif. 92054 [399]

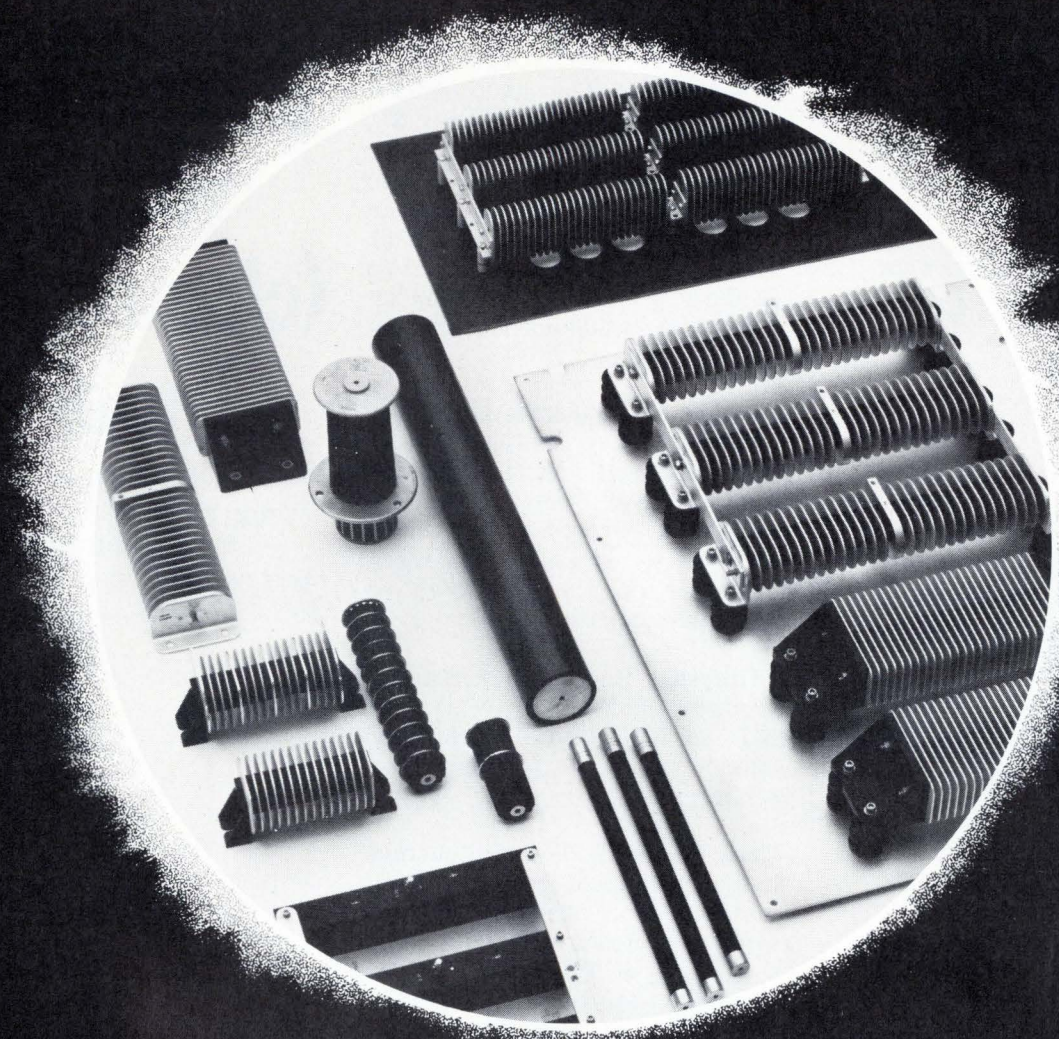
Solderless interconnectors feature low socket profile

A solderless interconnect system features a low socket profile, one-piece construction, and a design that provides good lead retention and surface contact, while allowing the use of very short IC lead lengths.



The unit is designated Allochiral and is made specifically for high-volume production applications. It can be machine-inserted in predrilled pc boards, becoming a self-supporting connector socket or a complete back-panel solderless interconnection system.

Robinson-Nugent Inc., 800 E. 8th St., Box 470, New Albany, Ind. 47150 [400]



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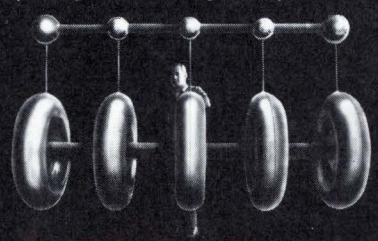
820,000 volt fast recovery device.



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New literature

MOS handbook. Fairchild Camera & Instrument Corp., 464 Ellis St., Mountain View, Calif. 94040, will distribute an MOS handbook to readers who submit a written request on a company letterhead. The handbook provides data on products, including application information, in addition to basic design information.

Connectors. A short-form 20-page catalog has been published by Elco Corp., Willow Grove Division, Willow Grove, Pa. 19090. Described are product lines, consisting of solder receptacles, terminated packages, and other connectors. Circle 422 on reader service card.

Crimping. Buchanan Electrical Products, 1065 Floral Ave., Union, N.J., has published a brochure on crimping tools for pin and socket connectors. [423]

Capacitor matrix. Fourteen-pin dual in-line multi-layer ceramic capacitor matrices are described in two bulletins being offered by the Potter Co., a division of Pemcor Inc., 10441 Roselle St., San Diego, Calif. [424]

Microwave components. A four-page brochure details the miniature directional couplers, diode switches, isolated power dividers, terminations, and 15 other stripline assemblies available from Norsal Industries Inc., 34 Grand Boulevard, Brentwood, N.Y. 11717. [425]

D-a converter. Perkin-Elmer Corp. describes its multiplying digital-to-analog converter, model 2000, in a data sheet available from the company's Industrial Products Division, Main Avenue, Norwalk, Conn. 06856 [426]

Induction heaters. An eight-page catalog covering solid-state induction-heating inverter power units, called Statipower III, has been published by Induction Process Equipment Corp., 32251 North Avis Drive, Madison Heights, Mich. [427]

Solid-state components. Avantek Inc., 2981 Copper Rd., Santa Clara,

With the Xerox MD40 you get a bit more.

0101
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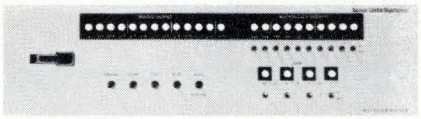
1



For starters, when you buy the MD40, you get 13-bit resolution for the price of 12. But that's not all.

You also get an instrument you can use as an A-to-D converter, as a high level multiplexer-digitizer with up to 256 channels, as a digitizer-controller for up to 1024 low-level channels, or as a combination high-and-low level digitizer. All without changing wiring or documentation, simply by plugging in different modules.

And you get the MD40 in standard 19" rack mounting, with your choice of two types of digital I/O connections, and any of six different output formats: 1's complement, serial or parallel; or BCD, parallel. Input can be single-ended or differential, gain programmable. And a list of other options.

And even though the MD40 is a 13-bit instrument, with double the resolution of comparably priced units, you can also get it with 8, 9, 10, 11, or 12-bit resolution, to get the perfect match for your application.

Finally, you get compatibility with our full line of 15-bit instruments.

To sum it up, with the MD40 you get not only one more bit, but quite a bit more.

To get more information call (213) 679-4511, ext. 2208 or 1210, or write to Xerox, A3-73, 701 South Aviation Blvd., El Segundo, California 90245.

XEROX

New literature

Calif., has published a 16-page catalog detailing the company's solid-state component line. These products include high-frequency transistors, YIG-tuned oscillators, unit amplifiers, and amplifier modules. [428]

DIP sockets. Medium-range-profile sockets designed in a dual in-line configuration are described in a bulletin released by Berg Electronics Inc., New Cumberland, Pa. [429]

Counter-display circuit. Mostek Corp., 1215 West Crosby Rd., Carrollton, Texas 75006. A revised eight-page applications note on the operation of the MK 5002 p-MOS four-digit counter decoder contains new information on display interfacing, cascading, and annunciator applications. [430]

IC testing. An applications note on the techniques of linear integrated-circuit testing is available from Sitek Inc., 1078 W. Evelyn Ave., Sunnyvale, Calif. 94086. [431]

Components. EMI Electronics and Industrial Operations, Blyth Rd., Hayes, England. Details of a range of electronic components including miniature transformers and potentiometers, switches, capacitors, and printed-circuit amplifiers are given in a new brochure. [432]

Shaft encoders. Bulletin 67-21A, available from Theta Instrument Corp., Fairfield, N.J. 07006, is a four-page description of the company's line of shaft encoders. [433]

Product catalog. ITT Semiconductors, 3301 Electronics Way, West Palm Beach, Fla. 33407, has published a catalog containing over 700 pages on integrated circuits, transistors, and diodes. Electrical characteristics, circuit diagrams, and packaging dimensions are given. [434]

Microwave instruments. A microwave-instrument catalog from Polarad Electronic Instruments, 5 Delaware Dr., Lake Success, N.Y. 11040, summarizes specifications for modular signal generators and signal sources, antennas, receivers, field-in-

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tensity meters, and spectrum analyzers. [439]

Test jacks. Electronic Molding Corp., 96 Mill St., Woonsocket, R.I. 02895. Bulletin FS-21 gives details of commercial nylon-insulated test jacks for 0.080-inch-diameter probes. [435]

Ceramic capacitors. A data sheet describing the CK05 and six lines of ceramic capacitors is available from Bell Industries, J.W. Miller Division, 19070 Reyes Ave., Compton, Calif. 90224. [437]

Power supplies. Pacific Photometric Instruments, 5745 Peladeau St., Emeryville, Calif. 94608. A bulletin describes negative high-voltage power supplies. [438]

Analog multipliers. GPS Corp., 14 Burr St., Framingham, Mass. 01701. A technical bulletin describes the MU4100 series multipliers, miniature components that need no operational amplifiers. [440]

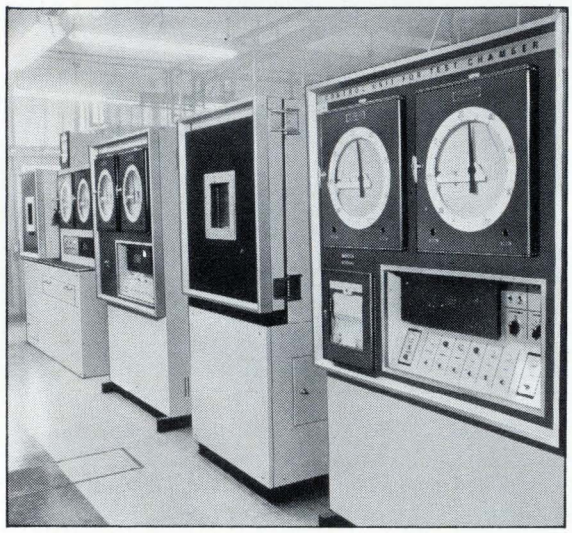
Power supplies. A 16-page product guide has been published by Zeltex Inc., A subsidiary of Redcor Corp., 1000 Chalomar Rd., Concord, Calif., that details linear products, data-conversion modules, multichannel a-d converters, and power-supply modules. Electrical and mechanical specifications are listed, in addition to photos, graphs, and circuit diagrams. [403]

Television. A four-page illustrated technical paper surveying three-dimensional television systems is being offered by Stereo-tronics Television Co., 13720 Riverside Dr., Sherman Oaks, Calif. 91403. [404]

Frequency response. A 12-page technical bulletin, No. 7172-1, details the mechanization of Fourier analysis for high noise and harmonic rejection in frequency-response testing. The bulletin is available from Bafco Inc., 717 Mearns Rd., Warminster, Pa. 18974. [405]

Contactors. Two brochures available from Vectrol Inc., 1010 West-

GOING TO EXTREMES TO INSURE QUALITY



If you could take an express trip from the North Pole to the equator, you'd experience roughly the same effect as our special environmental testing has on the fingertip-size "Toko Pulsetrans." More than a thousand hours of exhaustive testing in temperatures ranging from −55°C to +85°C and humidity increasing from zero to 98% allow no rest for these electronic machine parts. In addition, anti-vibration and anti-shock tests are repeatedly performed to satisfy uncompromising Toko standards.

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New literature

more Ave., Rockville. Md., describe the VSSC 500 and VSSC 1000 solid state ac contactors. Design features and typical applications are included. [406]

Microwave systems. Farinon Electric, 935 Washington St., San Carlos, Calif. A 32-page catalog of systems and accessories for point-to-point communications includes specifications for microwave systems operating in the 13-GHz region. [407]

Potentiometers. An eight-page brochure from James G. Biddle Co., Township Line and Jolly Roads, Plymouth Meeting, Pa. 19562, describes a line of portable potentiometers including the new Versapot. [408]

Transistors. Carter Semiconductor Inc., 6901 Jericho Turnpike, Syosset, N.Y. 11791, has available a 12-page catalog describing the company's line of metal-can epoxy and TO-9 transistors. [409]

Incremental encoder. Bulletin 820 details the electrical and mechanical specifications for the model 225L TRim-step incremental encoder. The bulletin is available from Trump-Ross Industrial Controls Inc., 265 Boston Rd., North Billerica, Mass. 01862 [410]

Variable resistors. Reon resistor Corp., P.O. Box 925, Malvern, Pa. 19355, is offering a short-form catalog describing the line of variable resistors. Specifications and dimensional data are provided. [341]

Thermometer. A six-page brochure from Yewtec Corp., 1995 Palmer Ave., Larchmont, N.Y. 10538, describes the model 2809 digital thermometer that operates by switch selection from five different types of thermocouples. [342]

Lamps. Lamps Inc., 19220 So. Normandie Ave., Torrance, Calif. 90502. A 40-page catalog describes and gives specifications for over 470 miniature and subminiature incandescent and solid state lamps. [343]

High Speed, High Voltage Silicon Diode Glass Passivated for Incredibly High Performance

Revolutionary glass mold surface passivation
is behind the amazing high voltage and mechanical strength characteristics,
incredibly compact design and outstanding versatility of this new Hitachi diode series.
Boasting excellent voltage stability,
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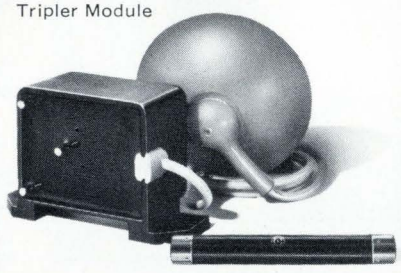
Add to this the low maximum reverse leakage current and short maximum reverse recovery time and you have an ideal diode for the most demanding uses,
especially in television receivers.

Ratings and Typical Applications

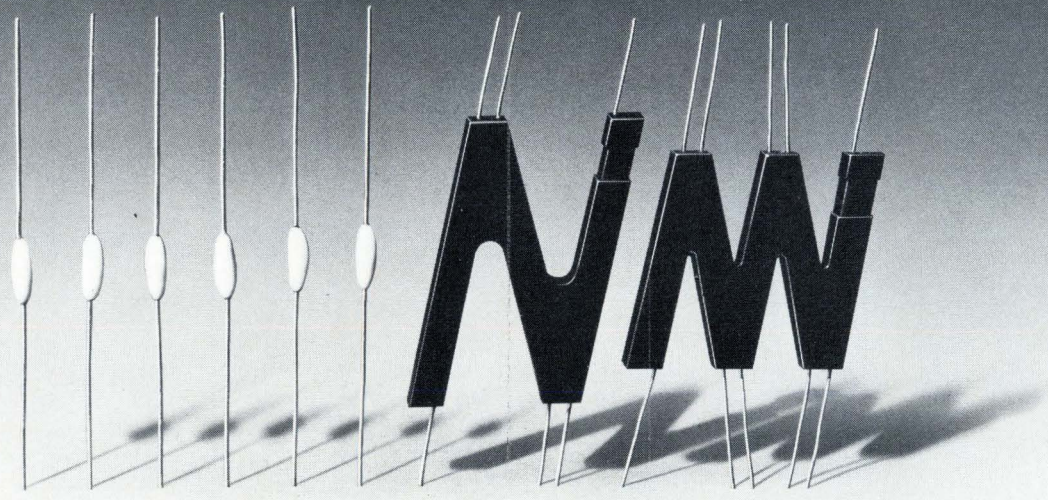
Item \ Hitachi Type		Y13	Y14	Y15	MY22	MY14
Ratings of Device						
Repetitive Peak Reverse Voltage (kV)		11.0	12.0	17.0	33.0	36.0
Average Forward Current (mA)		10.0	10.0	10.0	1.5	1.5
Max. Reverse Current (μA)		2.0	2.0	2.0	5.0	5.0
Max. Reverse Recovery Time (μS)		0.25	0.25	0.25	0.25	0.25
Max. Surface Temperature (°C)		100	100	100	90	90
Storage Temperature (°C)		−40 to 100	−40 to 100	−40 to 100	−40 to 100	−40 to 100
TV. Applications						
Color T.V.		Tripler Quadrupler	Tripler Quadrupler	Doubler	Single	Single
B/W T.V.		——	Shingle	Single	——	——
D.C. output voltage (kV) DC	No Load	30.0	9.5	30.0	25.0	27.0
(15.75 kHz Capacitive Load)	On Load	25.0	8.5	25.0	23.0	25.0

Note:
Devices in application of T.V. Tripler or Doubler circuit will be operated under oil or further insulating material encapsulation.

Tripler Module



MY22 Single



Y15 diodes

Diode sub-assemblies for Doubler and Tripler Module

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New books

Basic Electronic Instrument Handbook, Clyde F. Coombs Jr., Editor-in-Chief, McGraw-Hill Co., New York, 836 pp., $28.50.
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The book is true to its title: it covers all the basic aspects of electronic instruments. And while it is aimed at a broad cross-section of readers—technicians, physicists, and engineering students—it contains the kind of information that can be helpful to an electrical engineer who may have forgotten some basics.

About half of the book is devoted the basics of measurement, such as electronics and the accuracy and precision of instruments. There are four clearly written sections on the fundamentals of evaluating, using, and getting the most out of instruments. Here the book also deals with such problems as getting information into measurement systems—showing how transducer signals are linearly processed, multiplexed if necessary, and transmitted via telemetry. The section on instrumentation systems discusses the implementation of many types of analog and digital measurement systems.

Although a number of authors have contributed to the book, the writing is consistently clear. Definitions, functions, and applications are readily understandable. The book is not intended for the instrument specialist, but it should be extremely useful to the engineer who needs to solve a variety of measurement problems and who needs a few basic details to indicate what instrument can do the job most efficiently.

Basic Electromagnetics with Applications N. Narayana Rao, Prentice-

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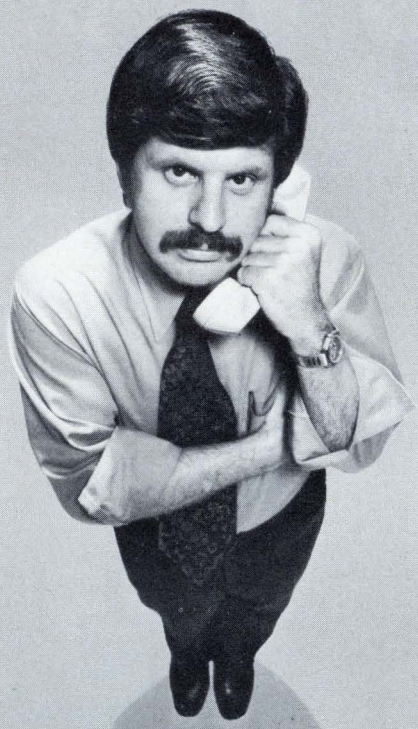

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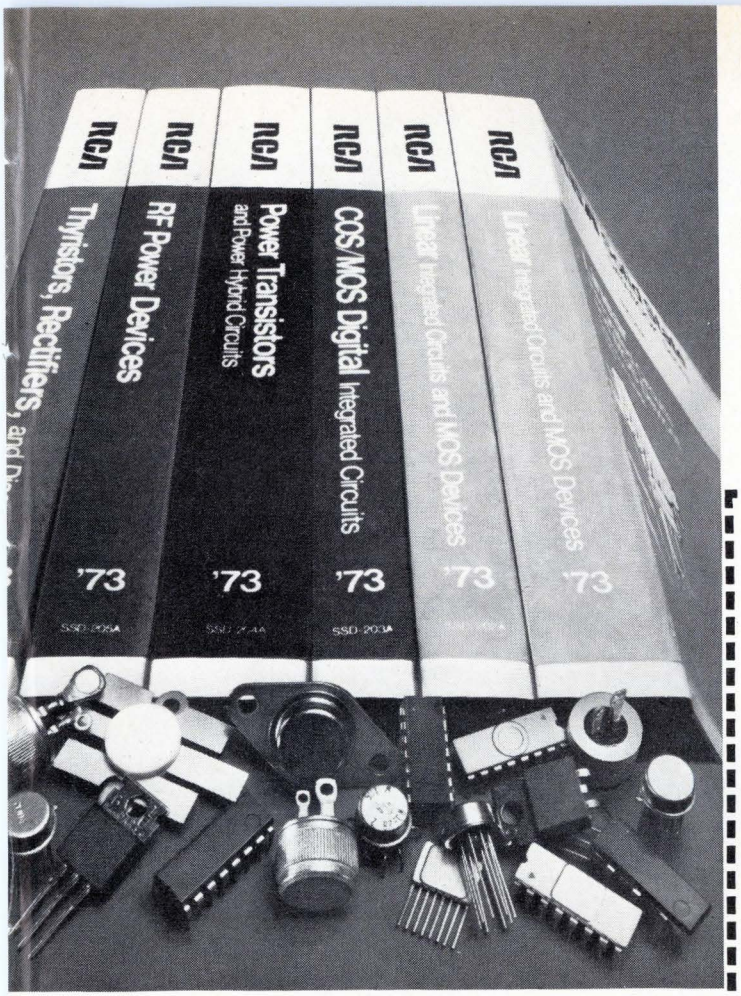

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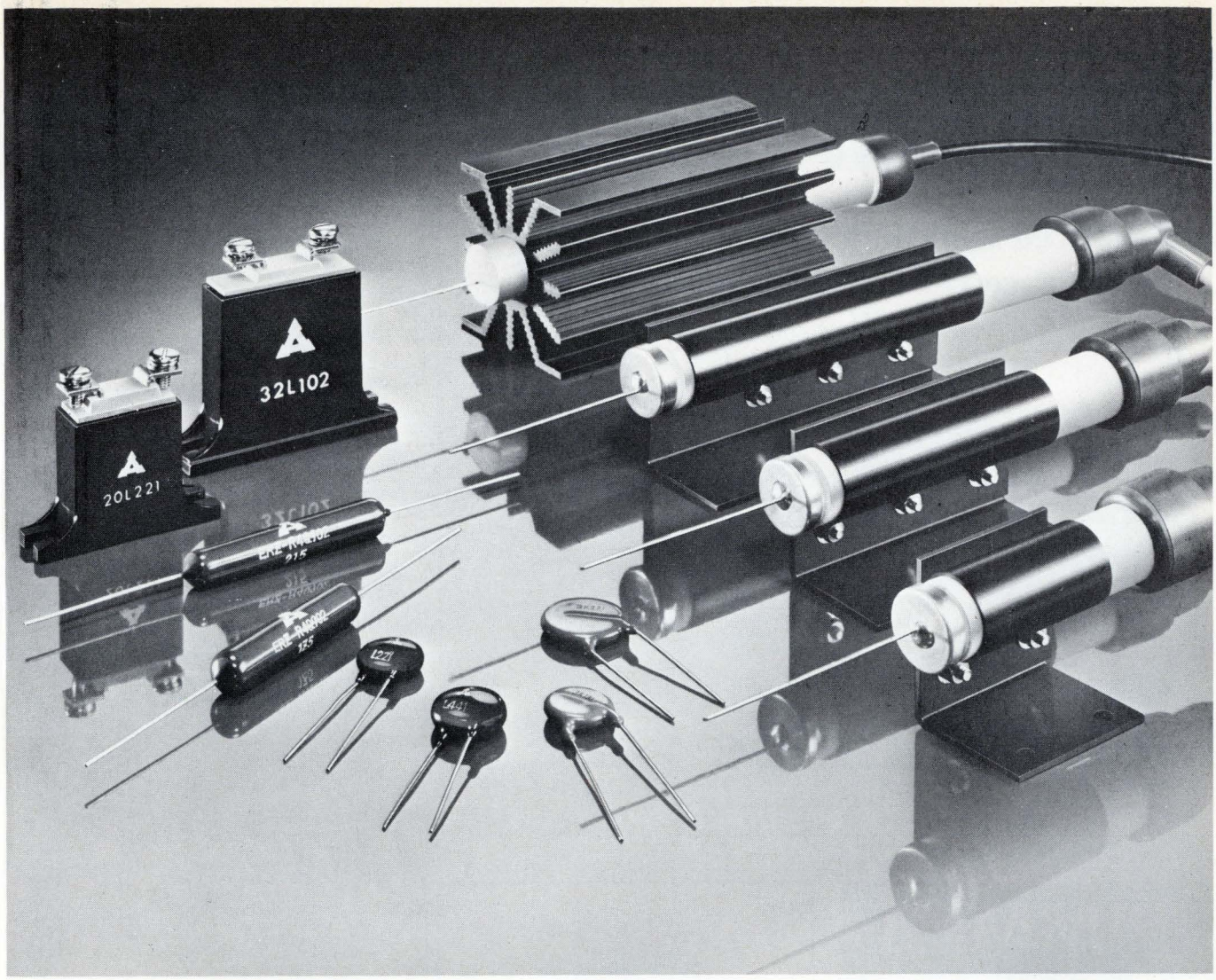

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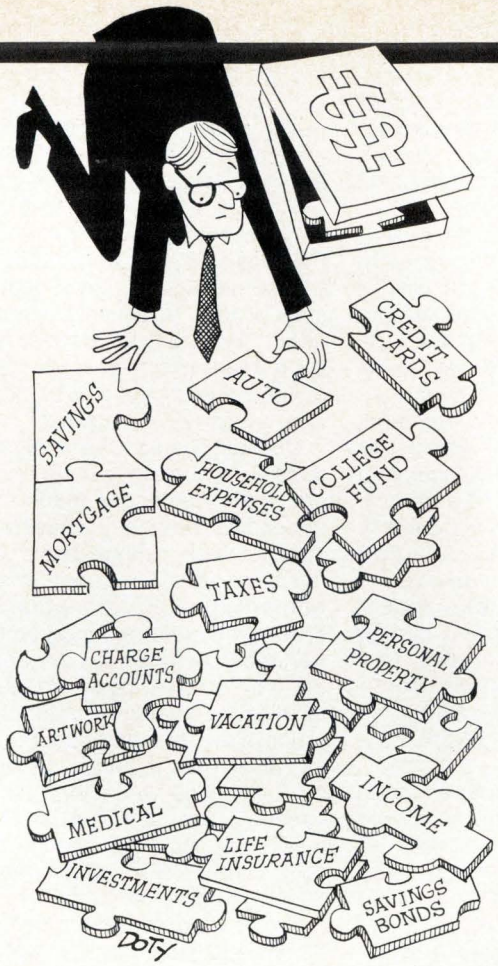


IN THIS SECTION:

personal business®

MONEY MANAGEMENT

The annual audit: a way to sharpen dollar decisions

Many people with business or professional incomes pushing $25,000 to $50,000, or more, manage their money hit-or-miss. "The trouble is, they do it piecemeal," says a New York lawyer-CPA whose clients range from young men in advertising to older men in shipping, airlines and oil. "They save money in spurts, go on one-shot budgeting crusades, and invest without clear objectives in mind. They never quite reach the overall view—and this is where the annual audit can play a big part." The audit, he adds, can mean two things:

- More hard cash tucked away—with a *plan* for yearly savings.
- More hard decisions made—with a *plan* encompassing long-range needs.

Now, toward the end of the year, is a logical time to consider a complete personal accounting; and it's a good time of year to make a contact with a professional needed to do the job. Why hire a pro?—because the audit, if undertaken seriously, reaches deeper into a man's affairs than, say, filing the tax return in April. The basic object: to help make surer decisions, not only on budgeting, savings and investments, but on such things as insurance, home purchase, college financing, and estate planning. The audit helps decide when estate planning is really needed—and how much is needed.

The audit by a qualified pro becomes practical, generally, when a career man's income is fixed on a steady upward climb *above* the junior executive range. It's foolish to pin down dollars: Some people ought to consider the idea at the $20,000 mark, others at $30,000 or $40,000—it depends on kinds of property owned, family responsibilities, prospects of inheritance, career income potential, and even life style. In some cases, a "self-auditing" can be done quite effectively and profitably. But where a pro is hired, a fee of about $500 to $1,000 must be paid, assuming a reasonably complex set of facts, plus the use of a CPA or someone equally qualified. Note: A good part of the fee may be saved by means of the more efficient 1040 tax returns that will be included as part of the overall accounting job.

Assume that an accountant has been hired. The client first gets from him a personal balance sheet showing assets and liabilities *in detail*—everything owned from art objects to insurance policies, as well as all amounts owed, down to revolving charge accounts. "A homeowner should inventory his personal property—furnishings, art works, everything—for insurance coverage, in any case," notes a northern New Jersey CPA, "so the inventory does double duty." In addition, the client's income picture, present and potential, is reviewed and related to the balance sheet.

Heart of the service is the consultation that arises out of the paperwork. "The recommendations of the expert are what really pay off—not the bald figures,"

This PERSONAL BUSINESS section is written by McGraw-Hill editors to give you helpful information on the better management of your leisure time and money. Personal Business covers everything from taxes and investments to education and travel. We feel that today, more than ever, personal-business planning is of prime concern to businessmen and professionals.

adds the CPA. Generally, two early sessions with the accountant are needed, and then two sessions a year thereafter: one for the annual chore of filing tax returns, the other to update and discuss the audit. Getting records together at the outset is tedious—but rewarding.

The accountant (or possibly lawyer-accountant) won't come up with ironbound rules for planning a client's dollar flow. But he will give some reasonable guidelines. Consider, first, the case of a management executive, with some conclusions that are valid for most income brackets. Jones is 45, married, has two teenagers in high school. His salary is $50,000, and he has income of $2,000 from investments. His assets include $35,000 of equity in his house, life insurance cash value of $10,000 ($50,000 coverage), cash savings of $10,000, common stocks worth $20,000, personal property worth $10,000 (including two cars, paid for), and vested pension funds worth $15,000. Liabilities include $2,000 in debts and $2,000 in taxes payable. So, net worth is $96,000.

Generally, the advice is that a man in roughly these circumstances should save *at least* 10% of his after-tax income. Thus, Jones—who pays about $16,000 in taxes—should be putting away $3,500 a year, or more. Note that a man in a more *modest bracket* might be advised to save at the very least 5% of his after-tax net. "It really should be 10% minimum, too, for someone in, say, the $25,000 range," notes a CPA, "but few people will hold to that, what with today's prices."

On the budget side, one rule of thumb is that a man in the executive salary range should turn over to his wife 40% to 50% of his net income after both taxes and savings, for running the house (excluding mortgage payments and utilities). In the example, Jones has $2,625 a month for his budget. If he gives his wife, say, 45%, she gets about $1,200 a month—leaving Jones with $1,425. The $1,425 must cover the mortgage, property taxes, all types of insurance, household repairs, new furniture and equipment for the house, auto expenses, entertainment, vacations, the husband's expenses—plus at least a modest sinking fund for special purchases. "The formula varies family to family," says a CPA. "But once arrived at for a family, the budget ought to stick, and not flip-flop with everybody's whims."

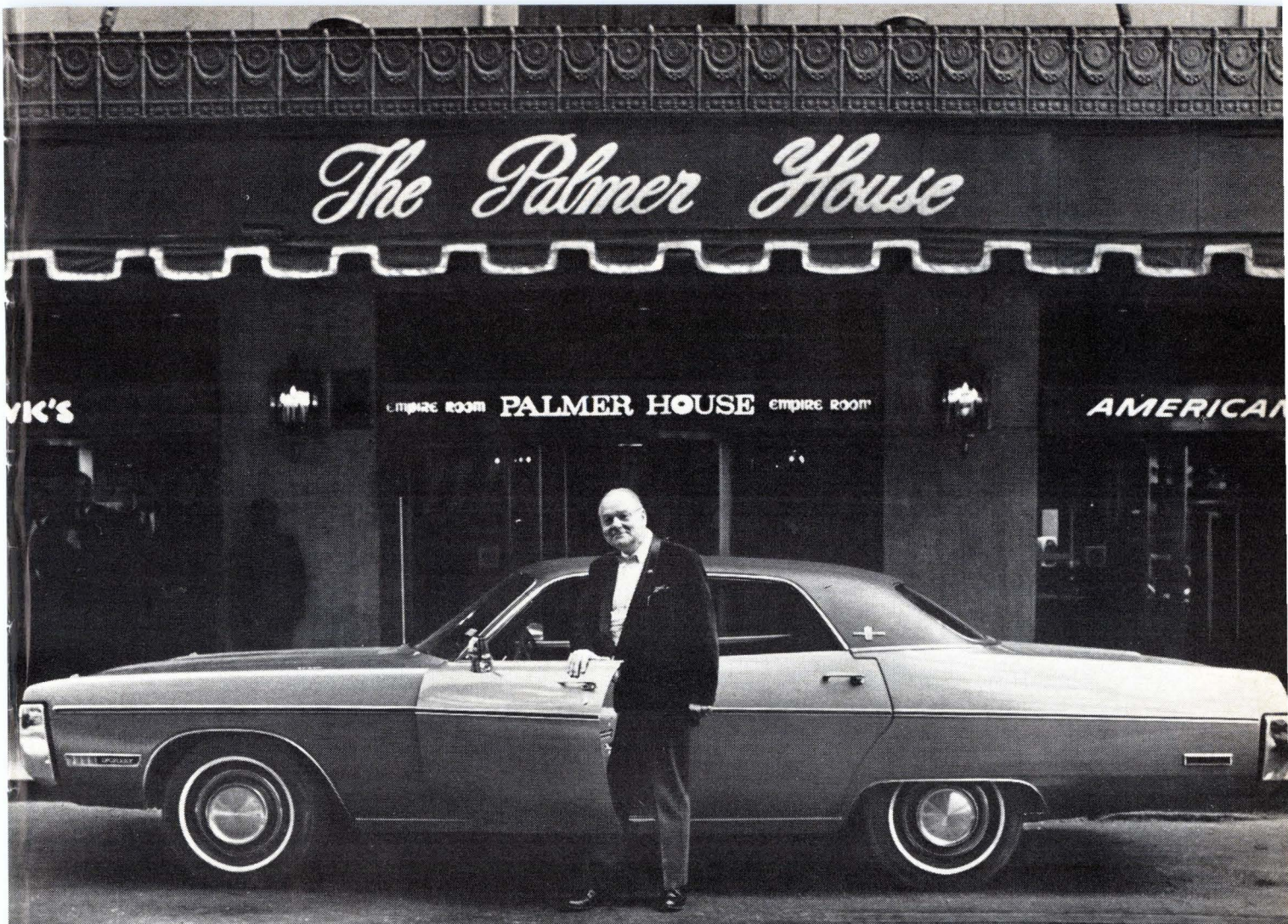
Investment objectives can be sharpened, too. Broadly, the annual audit will give a clear idea of how much can safely be put into the stock market each year (if any)—*and* how prudently or speculatively this amount should be managed. A very rough rule followed by some investment advisers says that a business executive or professional man, in fairly average circumstances, ought to put no more than 10% to 15% of his total market investment into speculative stocks. In the example, Jones's bare minimum $3,500 savings should probably go into safe growth investments—not speculation. "Some people actually find it a relief to learn that they really shouldn't be in hot new issues or $10 high flyers," says a Connecticut adviser.

College financing is a must for most families, and many people find that they are aiming under the mark. Costs vary, depending on many variables. For instance, state college costs can be as much as 30% cheaper, overall, than comparable private college costs. Three-year degree programs (a new trend) can sometimes save up to 25% of the total cost. At best, though, for most families the total college tab comes as a rough blow. Annual accounting, if nothing else, gets a father on the road to smart college financing years in advance—it gives him a clear idea of how much he can and should be putting aside. Thus, the sooner annual-audit thinking begins, the better.

On housing, there is a somewhat traditional estimate that the average family can "afford" a house that cost up to 2½-times pretax income (so, Jones, with a $50,000 salary, might go to $125,000). But rules bend, and today most conservative advisers suggest twice the income as the *top* figure. It may be more practical to budget for housing in terms of annual outlay. Accountants note that businessmen and professionals prudently will spend about 10% to 12% of pretax income on family housing. There are also recommended ranges for other expenses; for example, about 10% for food, 5% to 7% for life insurance, 4% to 6% for recreation, and 4% to 6% for clothing. The annual accounting, properly handled, therefore lets the individual compare his own expenses with suggested standards.

Pre-audit paperwork pays. Dusting off old records and making careful computations *before* the first formal session with the accountant will ease the strain—and maybe cut the fee. Accountants and similar consultants charge on a time-basis, and the fee can run from about $20 an hour, up.

In picking an auditor-adviser, it is wise to think in terms of hiring a younger man instead of a senior member of a firm. He will more likely be interested in a smallish account, and will give the time and attention needed. He will also be around to handle the work in later years. A senior man in an established firm will usually be happy to suggest the younger man you seek.



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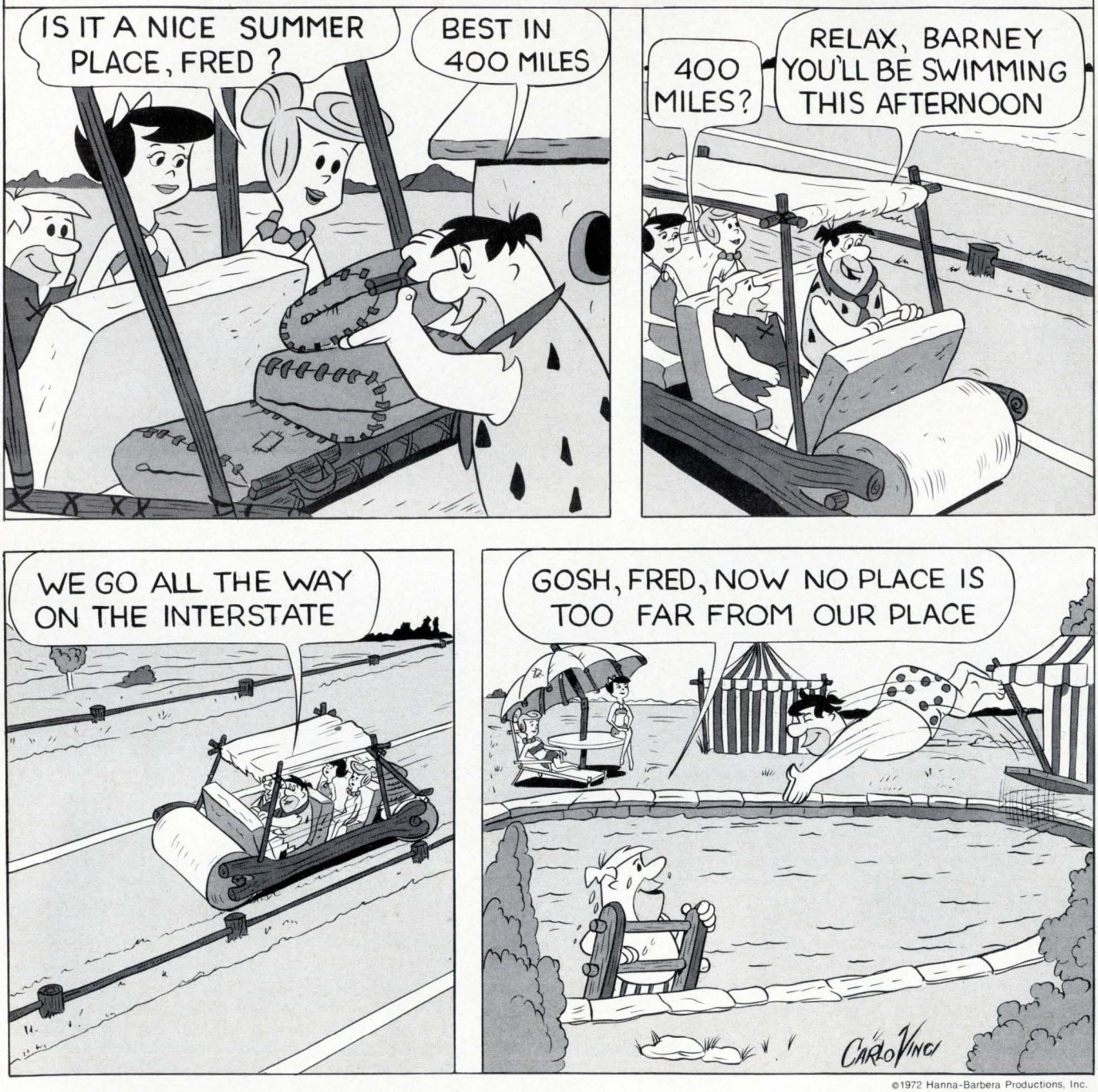

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The "municipals": the good and bad of tax-free bonds

The market for tax-exempt bonds—the so-called "municipals"—was once the exclusive sanctuary of the ultra-rich and their financial advisers. Now, for one reason or another, nearly everybody seems to want to get in, and already enough bumpkins have arrived trailing sharp-eyed predators to alarm the landlords. Wall Street houses which deal in these securities have begun posting a few warning signs for the uninitiated at the gates.

One reason is that municipal bonds have suddenly become big and important business. Last year, U.S. communities floated $24-billion worth of them; U.S. industry at the same time issued only $9-million worth of common stocks. Another reason is that a lot of American families suddenly find themselves in income tax brackets where the tax exemption of municipals makes sense.

For instance, you and your wife need only be filing a joint return on between $16,000 and $20,000 in combined *taxable* income (after deductions) to find yourself in the 28% bracket. A single man paying taxes on $14,000 is in the 29% bracket. For either of them, a municipal bond yielding 6% to maturity *tax-free* is worth its weight in taxable securities paying 8.33% and better. In New York, where (as in other metropolitan areas) city and state income taxes add to the bite, the tax-exempt municipals are even more attractive.

With more and more U.S. families attaining those income levels—and with many still leery of common stocks—municipals have understandably captured their investment imagination. Unfortunately, this interest has also drawn some shady operators. A variety of sleazy tactics were exposed in a crackdown in Memphis last year, and early this year Florida state authorities detected so much smelly dealing in tax-exempts that they circulated a warning pamphlet, *How Not To Get Burned in The Municipal Bond Market*.

Bond men suspect that broad changes lie ahead. They predict strict

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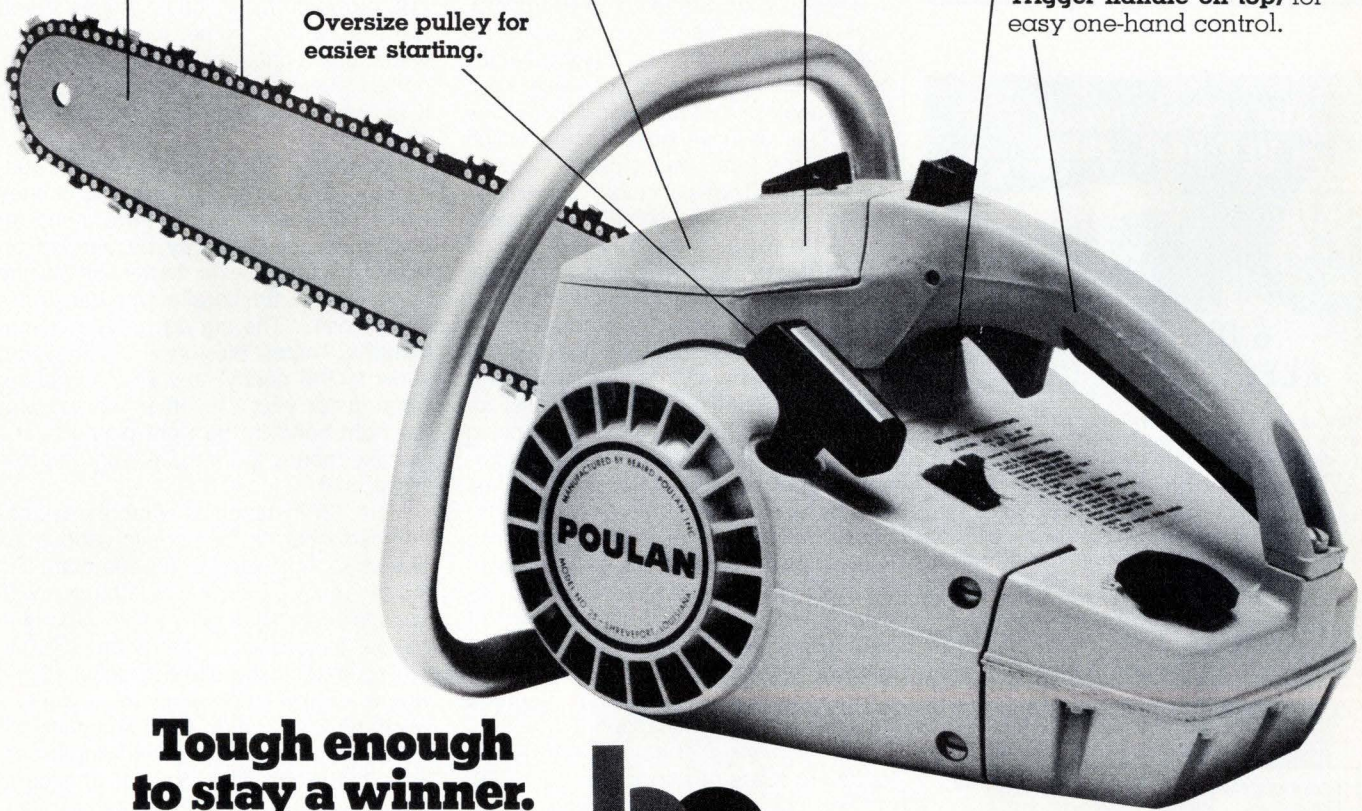

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regulation in the near future, and probably tax reforms to sharply alter the privileged status of municipals. (Indeed, some foresee the evolution of *taxable* public securities eventually.) The net result: Generally tougher going for the market, its customers, and its dealers.

With so much negativism in the air, reputable bond dealers are trying harder than ever to educate their expanding audience in the pitfalls, as well as the benefits, of municipals. A recent advisory of T. J. Holt & Co., for instance, puts emphasis on some of the caveats.

"Municipals are not really top-notch bonds across-the-board," says Thomas Holt. "Many are by no means risk-free, or even low-risk. Many municipalities are for all practical purposes bankrupt, or close to it. They face tax revolts among their citizens. It's not inconceivable that some could go under."

His message: Investors can no longer blindly accept general-obligation bonds—the blue-chips of the tax-exempts, since they are backed by the unlimited taxing authority of their issuing municipality—as the Gibraltars they would seem to be.

Certainly revenue bonds (which depend on such things as bridge tolls and stadium ticket sales for their return) are hardly meat for the average investor. "He has all he should worry about in evaluating the yields and ratings" (i.e., in Moody's or Standard and Poor's), says one top dealer, "to be trying to guess what the traffic on a highway may be." Most reputable dealers also warn firmly against certain bonds that some municipalities have been issuing which may not be true "municipals"—or even tax-exempt. These include "arbitrage" bonds, with which some towns have sought to raise funds to re-invest for a higher return, and so-called "industrial revenue bonds", the proceeds of which are used to encourage new industry.

The biggest danger, as Holt sees it, lies in the sheer volume of issues. Mainstay of the tax-exempts market has always been the U.S. commercial banking community, he notes. Commercial bankers bought up more than half of last year's record $24-billion in bonds. Lately, however, the commercial banks have showed some signs of saturation; their holdings of U.S. bonds, for instance, are the lowest since 1929. "If another $15-to-$20-billion worth (of new issues) comes in without the commercial banks to support it," he warns, "there is no telling what might happen."

Such warnings, of course, are not intended to scare new investors out of the market, but merely to open their eyes. "There is no such thing, for instance, as a *bargain* in municipal bonds—at least from a reputable dealer," says Gerard Bissinger, a principal in Lebenthal & Co., which deals exclusively in tax-exempts for individual accounts. "Beware of the salesman who calls and says he has 'some awfully good buys today.' "

Indeed, the bid-and-asked prices of municipals are fairly well circumscribed by going interest rates and their own *yield to maturity*. The latter is the single most important figure for the investor. He should know, for instance, that a $1,000 bond ($1,000 and $5,000 are standard units) maturing in five years, with a coupon rate (annual return) of 4¼%, should cost him no more than $885.65 if he is to realize a 7% *yield to maturity* on his investment. Indeed, every bond dealer keeps a book at his elbow containing tables that work out these relationships at a glance. This yield is, of course, quite apart from the tax-exempt feature which is an added attraction.

"The salesman who touts price alone can be misleading you; it may well be that a bond discounted at $750 is a poorer buy than one offered at a premium (above $1,000), in terms of yield to maturity," says Bissinger. "Such a salesman also is likely to forget to mention the effect of capital gains taxes on the discount bond."

His recommendation (seconded by a number of other top dealers) is this: "Buy to *maturity*. In other words, if you want to invest some money for five years, buy a bond maturing in five years, not a 10-year one with the idea of selling it in five at a profit—you probably will lose."

This underlines a basic rule for investors in municipals: Use only that money which you can afford to leave alone for awhile. Money that may be needed on fairly short notice is better off in the bank. Indeed, the parallel with banking is quite close. "The big advantage of municipals," notes Bissinger, "is that you know to the penny how your money is working for you." In other words, with the right bond in the right portfolio, it's just like money in the bank—and there's no tax on it.

Here, for instance, is what tax-exemption can mean for persons in various tax brackets. According to figures compiled by *The Bond Buyer*, a single person with taxable income of $14-$16,000 and a couple filing a joint return on $20,000 are roughly in the same bracket (31%) where a 6% yield on a municipal bond is worth an 8.7% return from securities on which they must pay taxes. Single persons reach the 50% bracket at around $32-$38,000 and joint filers at $44-$54,000. At this level, of course, a taxable investment would have to yield 12%—or twice as much—to match the municipal's 6% return.

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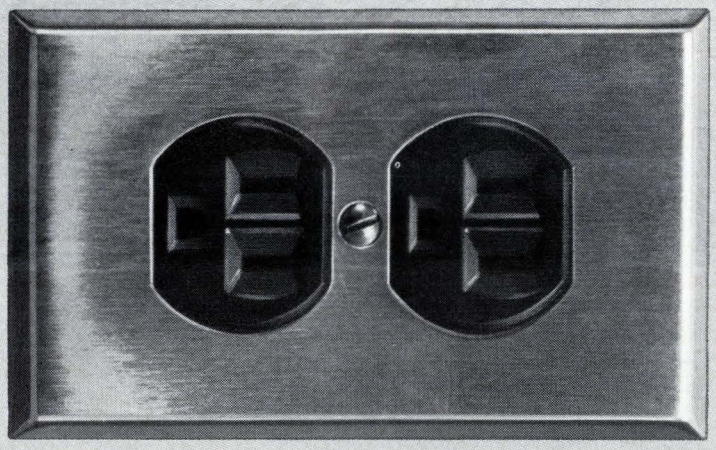

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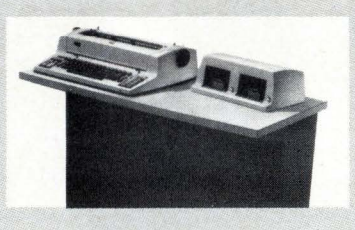

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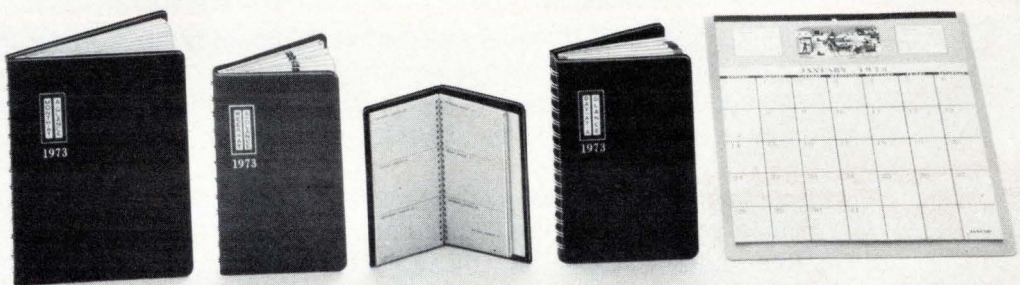

a. b. c. d. e.

by Joseph Wiltsee

Blowing gold dust off Oriental art (or how to make 10% on a teapot)

Right now it's Oriental art (rare, fine, and not-so-fine) that has appreciation-minded collectors raising their hands at auctions and ignoring do-not-handle signs in galleries from London to San Francisco. Chinese art, especially, has become the most "interesting phenomenon" in the market today, say the experts at London's Sotheby's and New York's Sotheby Parke Bernet galleries. President Nixon's China visit spurred an already established upward trend. Sales of collectable Oriental items were *up* about 50% for the 1971-72 season, over 1970-71. Appreciation has been *up* at a 10% clip since 1965. Outlook: also *up*.

Sung Dynasty figure at recent auction.

But before buying an ebony chest in which to stash his treasures, the average collector must do some research. "First decide just *what* you want to collect," says Martin Lorber, Parke Bernet's Oriental art expert, "—prints, bronzes, paintings, porcelain, fine 'china', or whatever." He adds: "It will be difficult enough to learn the essentials of your specialty, let alone all Oriental art." See first, *The Arts of China,* by Hugh Honour, and then *The History of China,* by C. P. Fitzgerald (American Heritage). And steep yourself in the specialty you've picked, particularly in the museums—and only then venture into a gallery or fine antique house with a meaningful purchase in mind.

Sharpest recent rise in values has been in Japanese swords and prints, with interest stimulated by some major auctions last month. On a lower investment scale, the familiar "rose medallion" china, and blue-and-white Canton china, have lately increased in value in a $25 to $250 price range—and more appreciation is predicted for authentic 19th century pieces (despite the rash of recent copies). . . . A Chinese understatement: In the Oriental art field, the chance of fraud is present. *Greatest danger*: the highly skilled copyist.

Tax brew: dollar-savers on the fire

Custodian accounts let you split off taxable income by gifts to children (usually securities), and if it's handled properly, the assets will be outside the father's taxable estate. A new Tax Court case shows that a father can avoid the danger of having estate tax levied simply by naming *another* person as "custodian." Says a top New York tax man: "Why name yourself—why not your brother, or your cousin? Or why not your wife?" . . . *Hobby losses* get liberal treatment. The law says that a business-hobby (like a farm) justifies tax deductions *if* there is a true underlying profit motive. The Tax Court allowed the deductions by two wealthy weekend farmers, even though they showed operating losses for eight years. They *proved* a profit motive—or, at least, sold the court on the idea. . . . *Political gift deductions* aren't allowed for the *true value* of money-raising shindigs such as black-tie dinners and dances, nor for political raffle tickets, says Internal Revenue. But the *excess* tab charged by the political group (over and above true value, or regular cost of, say, a dinner or show) can be deducted. . . . *Office-at-home*: New case shows, in effect, that the homework must have *practical value,* not just convenience value.

Who will get your money?

John Barnes' *Who Will Get Your Money?* provides a sensible, painless passage through the tedium bounded by wills on one side and trusts on the other. In a word, this review tells you how best to transfer your assets to your heirs, in terms of least trouble and expense. Cutting "probate" down to size is included (Morrow, 250 pp., $8.95). . . . In his new book, *Being Safe,* Mel Mandell argues against, among other things, the idea of owning a weapon for home protection. His guide to protecting your property and, more importantly, your person, is good solid stuff and recommended to any nervous, crime-conscious apartment dweller or suburbanite (Saturday Review Press, 312 pp., $6.95).

Executive chef: Put *fresh strawberries* into bowls and sprinkle with fresh lemon juice and sugar; at the last minute pour ¼-cup Grand Marnier over each serving—then add on top some whipped vanilla ice cream. From *The Plaza Cookbook,* by Eve Brown, which has many fine mixes from Manhattan's fine Plaza Hotel.

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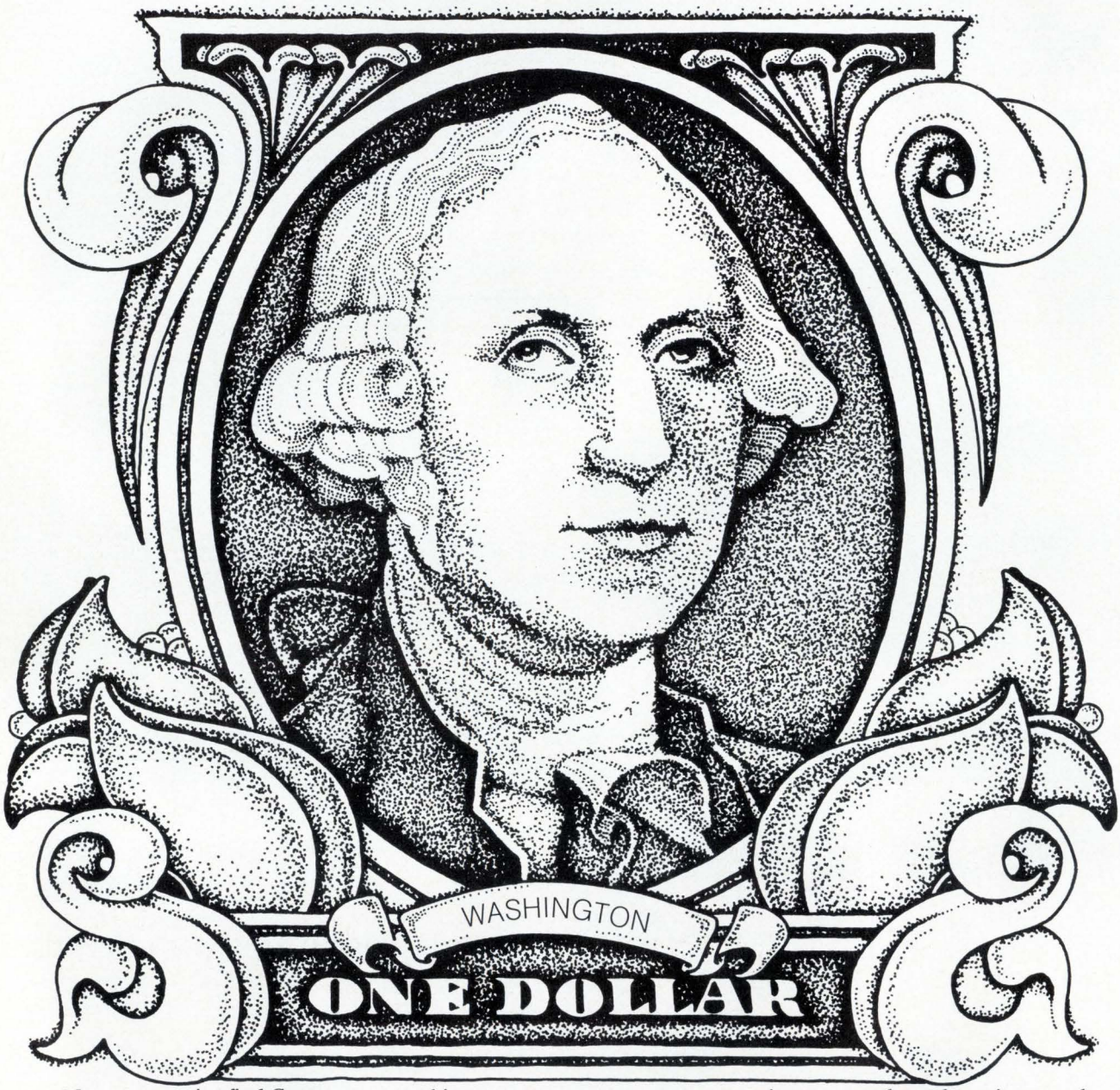

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