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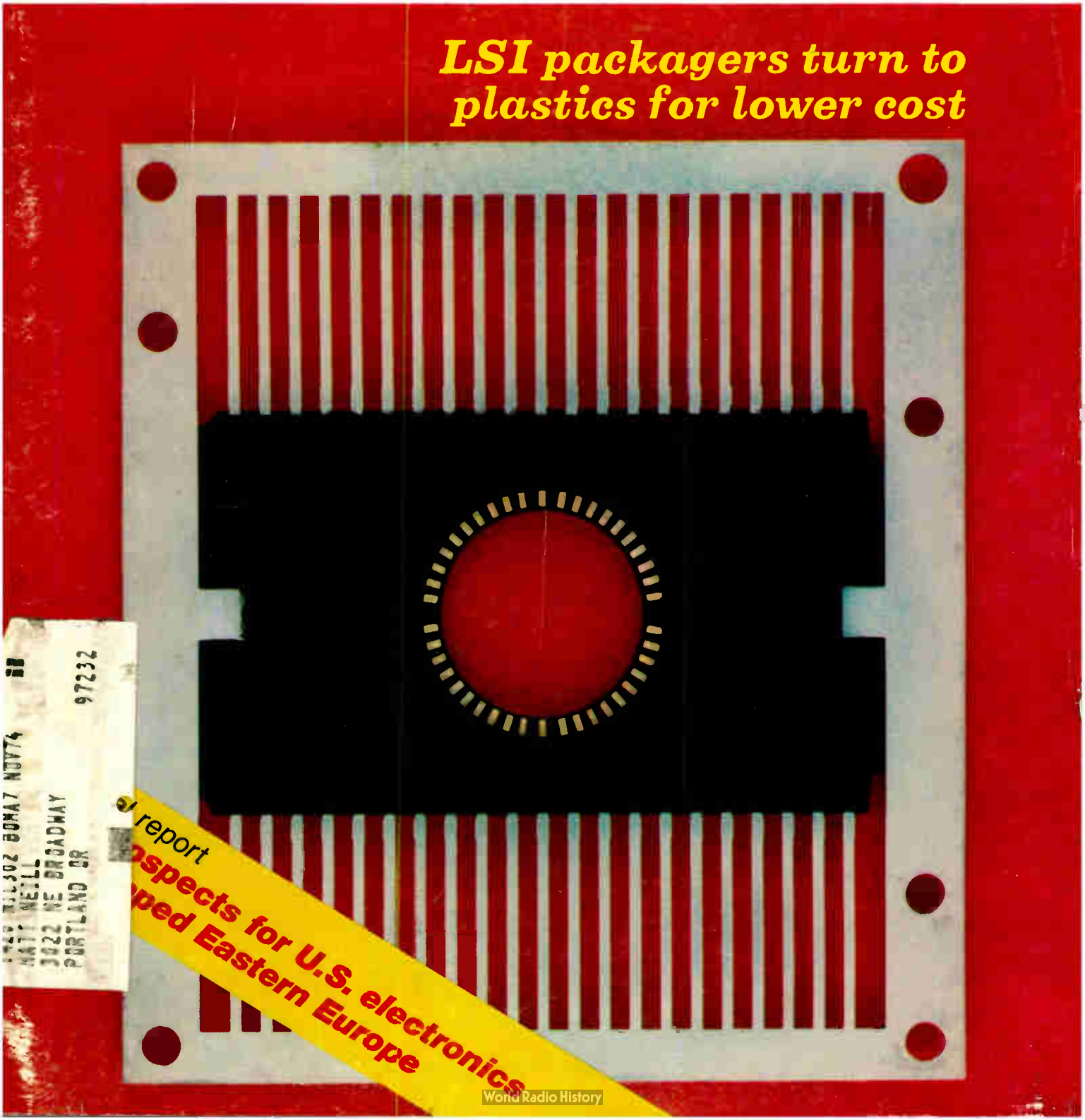
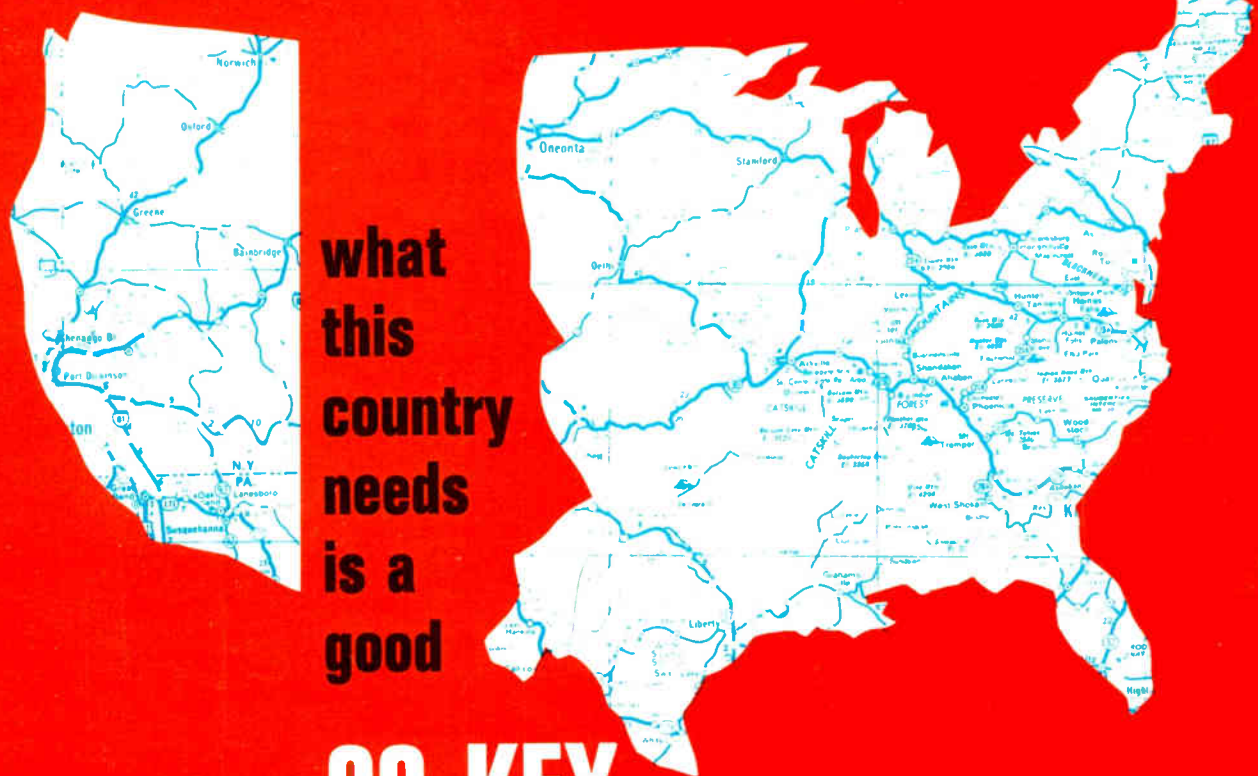
Electronics

LSI packagers turn to plastics for lower cost



report
spects for U.S. electronics
ped Eastern Europe



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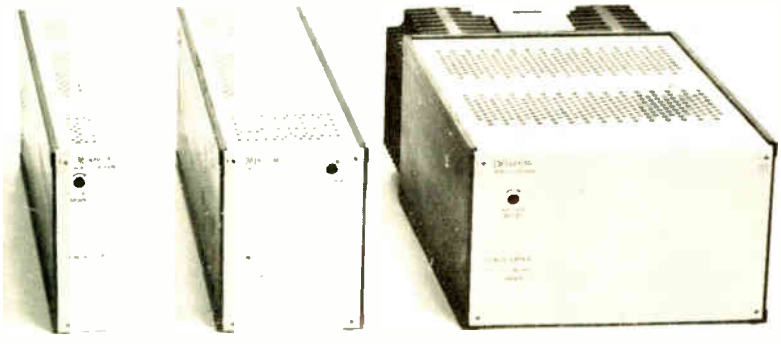

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Electronics

The International Magazine of Electronics Technology

May 22, 1972

 Volume 45, Number 11

Highlights

Who will make tomorrow's watches? 59
With so much of the technology for electronic watches, which are now appearing on the market, coming from IC and display components suppliers, there's not much left for the old-line watchmakers. The question arises: will electronics companies go into the watch business?

Will solar cells shine on earth? 67
Now that solar cells have achieved measurable success powering Air Force and NASA satellites in orbit, they are being eyed for less glamorous but more down-to-earth jobs. They could, in fact, be one answer to the power shortage that is beginning to face the U. S.

Special report on East Europe, 81
At a time when President Nixon is striving to open up Russia and the Soviet bloc to U.S. products, *Electronics* presents a country-by-country assessment of the East's electronic technology in relation to possible trade with the West.

The plastic cavity package arrives, 102 (cover)
Here's a roundup of who's making and using such plastic packages and of the prospects for their taking over from ceramics and completely molded plastic packages. They all compete directly, with ceramics coming down in cost and molded packages becoming more reliable.

. . . and in the next issue
The growing options in linear ICs . . . a one-chip broadband amplifier . . . multichannel graphic displays for minicomputers . . . the employment picture for EEs.

The cover
A new 42-lead plastic cavity package for MOS LSI, made by North American Rockwell Microelectronics Co., Anaheim, Calif., is shown prior to the attachment of the chip, wirebonding of leads to the metal fingers, and cementing of a lid.

Electronics

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Publisher's letter

President Nixon's international economic tools include, among other levers to open world markets more widely to U.S. goods, an easing of the restrictions on sales to the Soviet bloc. Ever since the announcement that he would visit the Kremlin leaders, the word in Washington has been that the President would take advantage of the occasion to ease the strategic-materials embargo list. That move could well mark the start of a new era in trade between capitalist countries and the seven socialist states of the Comecon bloc.

And, the likelihood that there will be some lowering of the trade barriers has set many marketing people to wondering what their chances might be in the Russian-dominated bloc. It's a good time, then, to take a look at what's happening in the electronics industries in Eastern Europe. Our report on the area, which starts on page 81, is another team effort. All of our overseas staffers contributed and we had reporting as well from McGraw-Hill World News correspondents Axel Krause in Moscow and David Leff in Prague.

"In a lot of ways, you're putting yourself into a time machine when you board a plane at Le Bourget bound for an East European capital," says our Paris-based International Managing Editor, Arthur Erikson, who coordinated the report. "Once you land, the propeller planes at the airport, the cars, and the general look of things make you feel the clock has been turned back ten years or so. The time scale seems out of joint, too. You spend more hours setting up appointments for interviews than you do interviewing. You log more time, it seems, waiting for taxis than you do riding in them."

Anyone who wants to do business in East Europe, Erikson says, has first to learn to reset his internal clock. "I was skeptical when a radar salesman in Britain told me he had worked on and off for seven years to sell an air traffic control facility. His explanation: the officials who were buying kept updating the specifications so that their bosses wouldn't come down on them for buying obsolescent hardware.

"But I began to believe him after talking to a computer salesman en route to Bucharest. He was going in for the fourth time in a year in an attempt to swing a smallish deal and figured he was just getting started. Time and time again, Westerners who have been successful in East Europe told me that patience and persistence are essential for a payoff."

"It's a mistake, though, to figure that East Europeans will let suppliers set their clocks back when it comes to technology," Erikson goes on. "In most instances, they'll settle only for the latest-model hardware, no matter what their needs are. That's why an easing of the embargo could mean more business for companies ready and able to play the waiting game. The big scores, in fact, seem destined to go to Western companies willing to sell know-how that will help East European countries catch up with the West in technology."

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Readers comment

More on diode matrix costs

To the Editor: The discussion [April 24, p. 6] between Robert C. Foster and Dave Guzeman on discrete diodes versus digital ICs [referring to the latter's article, "Diode switching matrices make a comeback," Jan. 17, p. 76] is interesting. Whatever either one says is probably open to cogent comment, and I hope my offerings qualify:

- Mr. Guzeman brings diode prices into the real world of quantity users, yet fails to do the same for ICs. Current volume costs for TTL circuits documented in many publications lead to a 7404 price that puts the per-function cost in the 2-to-3-cents area. Each user will have his own standard cost for insertion, but it seems unlikely that the difference here—six insertions versus one insertion—would resoundingly swing the decision to the diode approach, if part costs are as above. [*Dave Guzeman quoted the IN914 diode price as 1½ cents in volume, plus the cost of insertion.—Editor's note*]
- Mr. Foster implies that—once the diode approach is selected—the practical designer will choose germanium over silicon for noise-immunity reasons. "Practical" means many different things to many people, and I will venture to point out that a practical and prudent designer should weigh noise-immunity benefits against the short- and long-term hazards caused by the limited number of sources for germanium devices and their shortcomings with regard to size, price, and maximum operating temperature.

Perhaps it would be reasonable to close with the observation that there are many points to be considered in making this choice, and that each individual design situation needs to be considered in terms of the importance of those points in that particular situation.

Lawrence W. Johnson
Manager, Materials Engineering
Hewlett-Packard Co.
Santa Clara Div., Calif.

More than a page

To the Editor: I was gratified by your reporting on our Trakatron ultrasonic people finder [April 24, p. 44], but I was dismayed by your repeated reference to it as a "paging" system, which it decidely is not. Our system and its variations were designed to overcome the shortcomings of conventional paging systems. Unlike these, Trakatron can locate, track, or establish communication with people without their having to take any action themselves. This is a fundamental difference which I wish you had made clear.

Robert W. Lester
President
Recognition Devices Inc.
New York, N.Y.

The last word

To the Editor: In letters in your Jan. 3 and Feb. 28 issues, Mr. Hart of Plessey, Mr. Fletcher of Metals Research, and Mr. Wray of M.C.P. Electronics have questioned the accuracy of my data on GaP material [*Electronics*, Oct. 25, 1971, p. 74]. Your readers may be wondering where I obtained this erroneous impression.

In particular, Mr. Hart says the $144/in² price I quoted is "all wrong," while Mr. Wray calls it "exorbitant." Nevertheless, this is the very latest published price on the very latest data sheet I have received from Metals Research—Mr. Fletcher's company, and the world's largest source of GaP material.

In any case, it is somewhat academic, since a MRC representative has told me that the company sells only ingot and substrate materials and has no plans to offer epitaxial wafers for green LED manufacture.

As for Plessey and M.C.P. Electronics, neither company has ever tried to sell GaP materials to Litronix, so Mr. Wray's and Mr. Hart's letters contain the only cost and availability data I have seen from these companies. In the meantime, I stand by my original contention: GaP is a promising material for future LEDs, but is not yet an economical proposition.

George E. Smith
Litronix, Inc.
Cupertino, Calif.

■ *Enough said—we declare this correspondence closed.*

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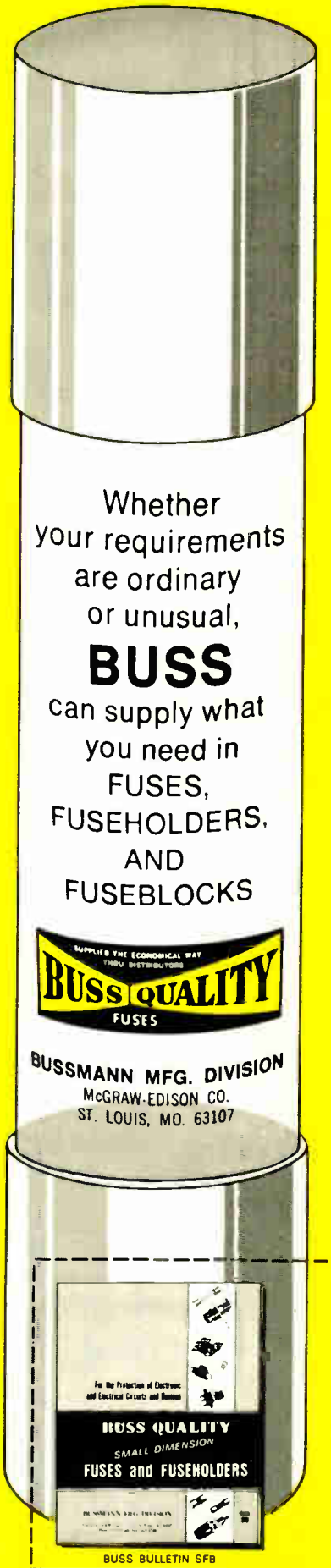

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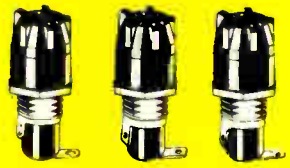

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40 years ago

From the pages of Electronics, May 1932

Skimping, whittling, chiseling—these have been bywords of an increasing part of the radio industry for months. This cheapening process has gone so far that serviceability of the product is endangered, and the good name of radio imperiled.

Electronics has no quarrel with intelligent lowering of price through sound engineering and improved design—when the cheapening is not done at the expense of quality or service. But while lower price ranges often open up wider markets, it is not axiomatic that greater profits result.

Research indicates that distinct advantages accrue when two speakers with slightly different resonant points are properly placed in a baffle. These advantages are a betterment of the overload characteristic and less tendency for hangovers to occur. The future may see radio with two speakers, increased power output, and still other technical advances toward the goal of "perfect quality."

If space radio broadcasting is to have its fullest development, more attention and thought must be given to the elimination of electrical interference by all parties concerned.

The most magnificent program, the most costly radio hour, can be utterly ruined by a heating pad or spark-coil or commutator motor in the vicinity of the listener.

Certainly the time must come when all electrical appliances, switches, motors, etc. are, by filters and condensers, made interference-free. And with that happy day, it will be a real selling point in favor of the device that can be marked "Will Not Interfere with Radio Reception."

The Radio Corporation of America, David Sarnoff, president, reports for the first quarter of 1932 a net income of $503,224 after depreciation, charges, taxes, and amortization of patents, compared with $1,566,519 in the first quarter of 1931. Gross income was $20,322,408, against $24,562,683 in 1931's first quarter.

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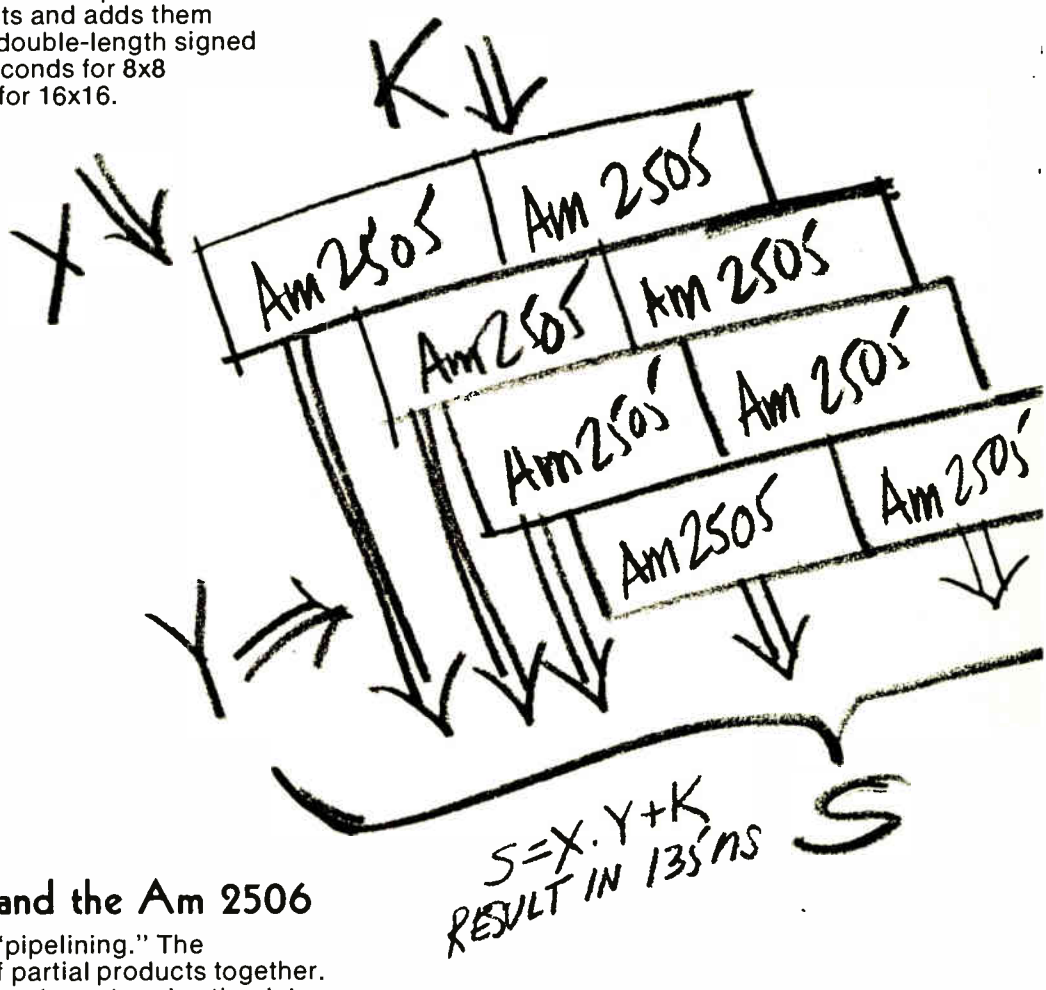
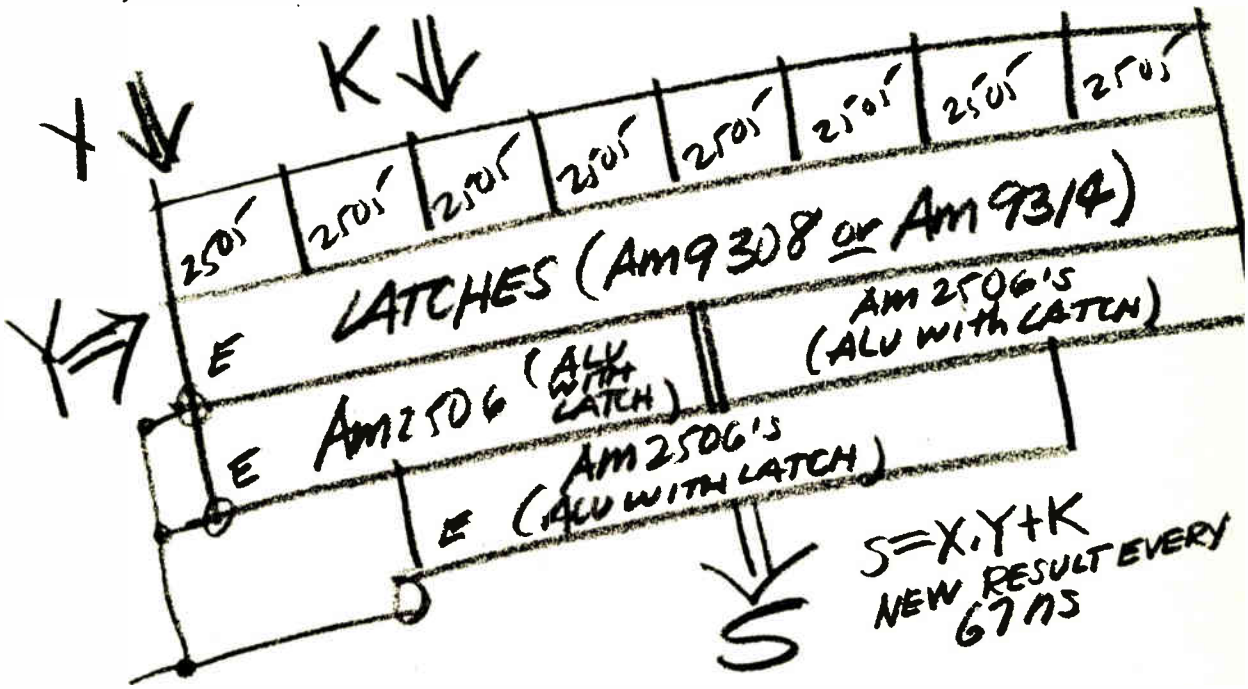
The Am 2505

A 2's complement digital multiplier. It forms partial products and adds them together giving you a double-length signed product in 135 nanoseconds for 8x8 multiplication. 265 ns for 16x16.



The Am 2505 and the Am 2506

Superfast, supersafe "pipelining." The Am2506's add pairs of partial products together. Latches serve to hold and synchronize the data at each level. In 8x8 multiplication you get your first answer in 210 nansoseconds and a new result every 67 nanoseconds.



The first digital multiplier and the first ALU with a built-in latch. Together. S=X·Y+K.

We're first with both products. In fact, we're starting to collect a lot of firsts. (We're first in ALU's, Low Power MSI and Flat Paks.)

It doesn't take too many #1's to get to #6. That's one of the reasons why we're going to be the sixth largest integrated circuits company in the country.

We mean it. We're going to be #6.

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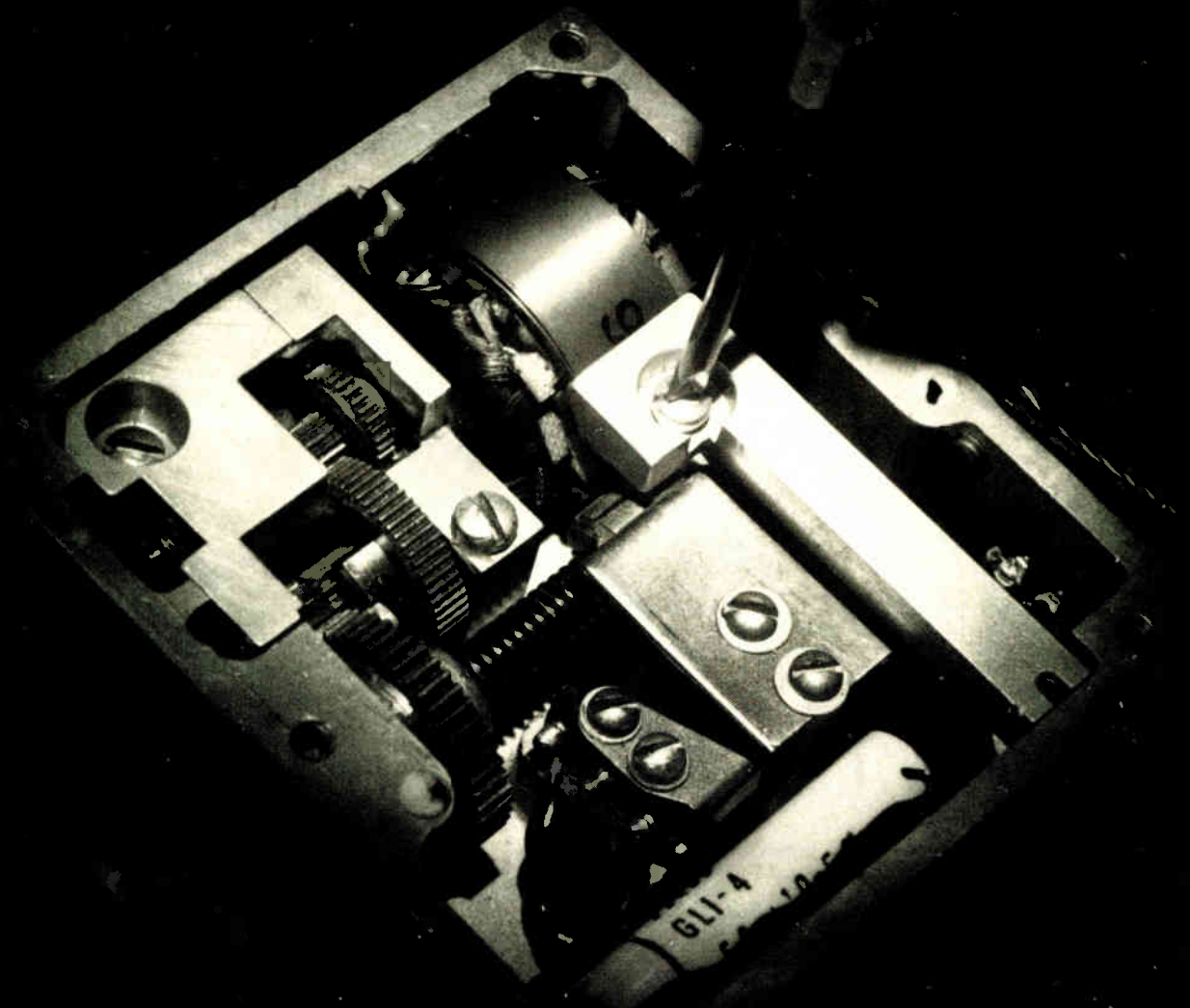
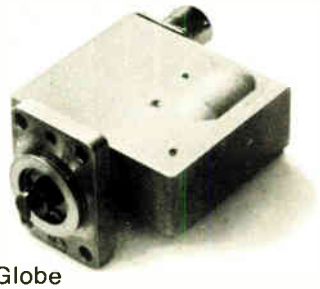
Circle 11 on reader service card

If TRW can deliver twice the expected HP from precision motor systems

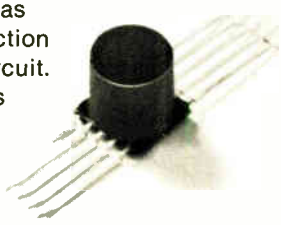
...think what TRW can do for you in miniature transformers, multi-layer circuits and microwave transistors.



The TRW/Globe integral gearmotor shown here will operate over the widest voltage and frequency ranges in the world, and deliver twice the expected hp for its size. It will operate over 10,000 hours maintenance-free. More than just transmitting torque, the highly efficient gear train functions as a mechanical servo because of its precisely controlled friction characteristics. TRW/Globe motors, gear trains, fans and mechanical assemblies are used in the latest military, industrial and commercial systems. (For more information, circle 240 on the reader service card.)

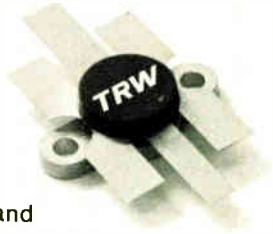


The TRW/UTC BIT-250 line of audio transformers and inductors represent the ultimate in fine-wire winding technology. Significant size reduction without loss of performance has been achieved by major reduction of air gaps in the magnetic circuit. Core permeability approaches the theoretical maximum. Power transformers, pulse transformers, high-Q inductors, electric wave filters and magnetic amplifiers are some other examples of TRW/UTC advanced capabilities in iron core inductive devices. (For more information, circle 241 on the reader service card.)



The Cinch-Graphik multi-layer circuits shown here are typical of TRW capabilities in the manufacture of single-sided, double-sided and multi-layer PC boards for communications, computer, commercial, industrial and military applications. State-of-the-art testing, using fully computerized circuit testers assures 100% performance of multilayers. (For more information, circle 242 on the reader service card.)

TRW's J-Ø series microwave transistors feature instantaneous octave bandwidths from 30 to 1000 MHz with output power to 60 watts. TRW RF power transistors offer the industry's highest power at frequency with outstanding reliability all the way out to 4GHz. Power switching transistors, high speed diodes, power hybrids and varactor diodes (Varicaps) are some other areas where TRW semiconductor technology can match your exact requirements. (For more information, circle 243 on the reader service card.)



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People

CATV engineer Bresnan to head trade group

A 38-year-old pioneer in cable television has been elected chairman of the National Cable Television Association. William J. Bresnan, who at age 25 designed and built the CATV system for Rochester, Minn., is also vice president and assistant to the chairman of TelePrompTer Corp. in New York.

Both the cable industry and the NCTA are on the verge of new and rapid growth, thanks to the recent FCC liberalization of CATV's entry into the major markets. From the engineering side, Bresnan feels, this growth is essential to make the industry sturdy enough to reinstitute R&D, shut down during the years of uncertainty.

Disagrees. Responding to criticism that CATV operators and their hardware suppliers are technologically backward, Bresnan, a nondegree engineer who attended technical schools in Minnesota, bristles. "Instant experts on CATV go on record that current engineering specifications are inadequate, but they do not understand the problems. On the other hand, it's true the industry must achieve higher quality and reliability, and equipment manufacturers who have higher quality and reliability will enjoy a good market, even if their prices are higher. As we get into public safety services in the major cities, there will be a lot more at stake in reliability than missing an 'I Love Lucy' rerun."

He points out that the FCC's freeze on cable expansion while it deliberated on regulating entry into the top 100 markets set the industry back in technology. Manufacturers cut R&D because there was no clear future, he adds. Now, with a better idea of where the industry is heading, funding for new developments will be easier to justify.

As for NCTA business, Bresnan's first concern will be trying to get a new copyright law passed. It has been hanging fire in Congress since the mid-1960s despite the support of Sen. John L. McClellan, chairman of the subcommittee on patents. The second important task for the association during the coming year will be trying to develop a coordinated regulatory system involving Federal, state, and municipal authorities. "It is too early in the development of this industry to expect it to shoulder the same kind of regulation burden that utilities have. I contend that CATV is not a utility," the TelePrompTer executive states.

"We've reached the stage when it's time to start doing things in the major markets. It's time to build some systems, then take a look at them after they are providing new services, public access, local origination, and interactive television. The potential advantages to the public of the growth of cable have been studied enough," Bresnan stresses.

Bresnan: CATV needs higher quality levels.

Electronics packs punch at TSC, says Roberts

When NASA's Electronics Research Center in Cambridge, Mass., became the Transportation Systems Center of the Department of Transportation in March 1970, "we started out as a bunch of EEs," says Louis W. Roberts, TSC's newly appointed director of technology. "But now we have civil and mechanical engineers and people in soft skills such as economics, sociology, psychology, and engineering psychology."

But while only half of the old ERC staff was retained, electronics impacts almost everything done at the center in some manner, even if it does not play a dominant role. About 20% of all technical efforts—

What do you get when you cross a signal source with a calculator?

Automatic testing with HP's new 3330B AUTOMATIC SYNTHESIZER. In this one outstanding instrument, you get a flexible synthesizer, a top-performing sweep generator, and a precision level generator—all under digital control. Its built-in controller adds computer flexibility—you can forget about tying up an external computer for your automatic testing on the production line, and for the first time make this level of testing economically feasible in your lab.

For man-machine interfacing, 3330B's convenient swing-out keyboard, coupled with 9-digits of frequency and 4-digits of amplitude readout, gives you complete flexibility for setting up your test routines.

As a frequency synthesizer spectral purity is exceptional. Spurious is down 70 dB, and harmonics at least 40 dB below the carrier. Through its easy-to-use keyboard, you can, with 0.1 Hz resolution, set in any frequency between 0.1 Hz and 13 MHz, then automatically or manually increment (tune) that frequency by any amount. Each point has the synthesizer stability of ± 1 part in 10^8/day.

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Systems Designers will find the standard 3330B fully programmable—ready for low-cost interfacing to other ASCII instruments and controllers, like marked card programmers, calculators, and computers.

Price? If you think about it, you would have bought a synthesizer, a sweeper, a marker generator, a counter, a programmable attenuator, and some computer time to come anywhere close to solving the same problems now done by the 3330B. At $6000 for a complete frequency lab, we think you'll agree that the price-performance ratio of the 3330B is great. (Model 3330A, priced at $5100, performs identically to the 3330B but has manual amplitude control and 13 dB range.)

For further information on the 3330A/B, contact your local HP field engineer. Or, write Hewlett-Packard, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

A092/1

Circle 15 on reader service card

for instance, projections of noise around airports when various factors are changed—depends on the ability of Roberts' directorate to do simulations on computers, and on CRTs, random graphics, and real-time and stored graphics.

"Many approaches and accomplishments came about rapidly because the staff is skilled in electronics," Roberts says. "My own background in optics and microwave electronics [he was head of the optics and microwave division at ERC] I believe has been of value in providing alternative approaches to problems, resulting in solutions that might not have come about."

Alarm. One instance is the use of microwaves in telemetry and doppler systems for railroad grade-crossing signals. The directorate has also developed a laser oil-spill surveillance system to help the Coast Guard.

Roberts' section is also working in safety areas. "Analysis of blood samples shows that about 50% of highway deaths are caused by drunken drivers," he says, "so we were asked to try and develop instrumentation which could determine on the spot how drunk a driver is." It has developed a portable breath analyzer about half the size of a carton of cigarettes with a chemistry logic circuit and a digital readout.

Cars. Dealing with the same problem, but in a different way, are safety-auto-lock systems. TSC is investigating those being developed by industry. And TSC itself is working on a noncooperative system to measure the alcohol on the driver's breath.

"Obviously, yes, electronics are more important in transportation right now," says Roberts. But he cautions that growth will not be rapid. "NASA and DOD had vast amounts of money to spend," he notes, "but living here on the ground, there is just not that kind of demand. I think there is a horrible dearth of understanding on the part of business of how the transportation industry works and how we do things; we are primarily an assisting organization."

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superior readability that competitors can't match

One look at an operating SELF-SCAN® panel display and you will know why you should be featuring one in your system. SELF-SCAN displays are a new solution to the operator machine interface that provides advantages to the system builder, to the system user, and to the system operator.

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The 0.2" high characters are in the popular 5x7 dot matrix format and are made up of dots on .040" centers. The unit is ASCII compatible and displays a modified 64-character ASCII character set.

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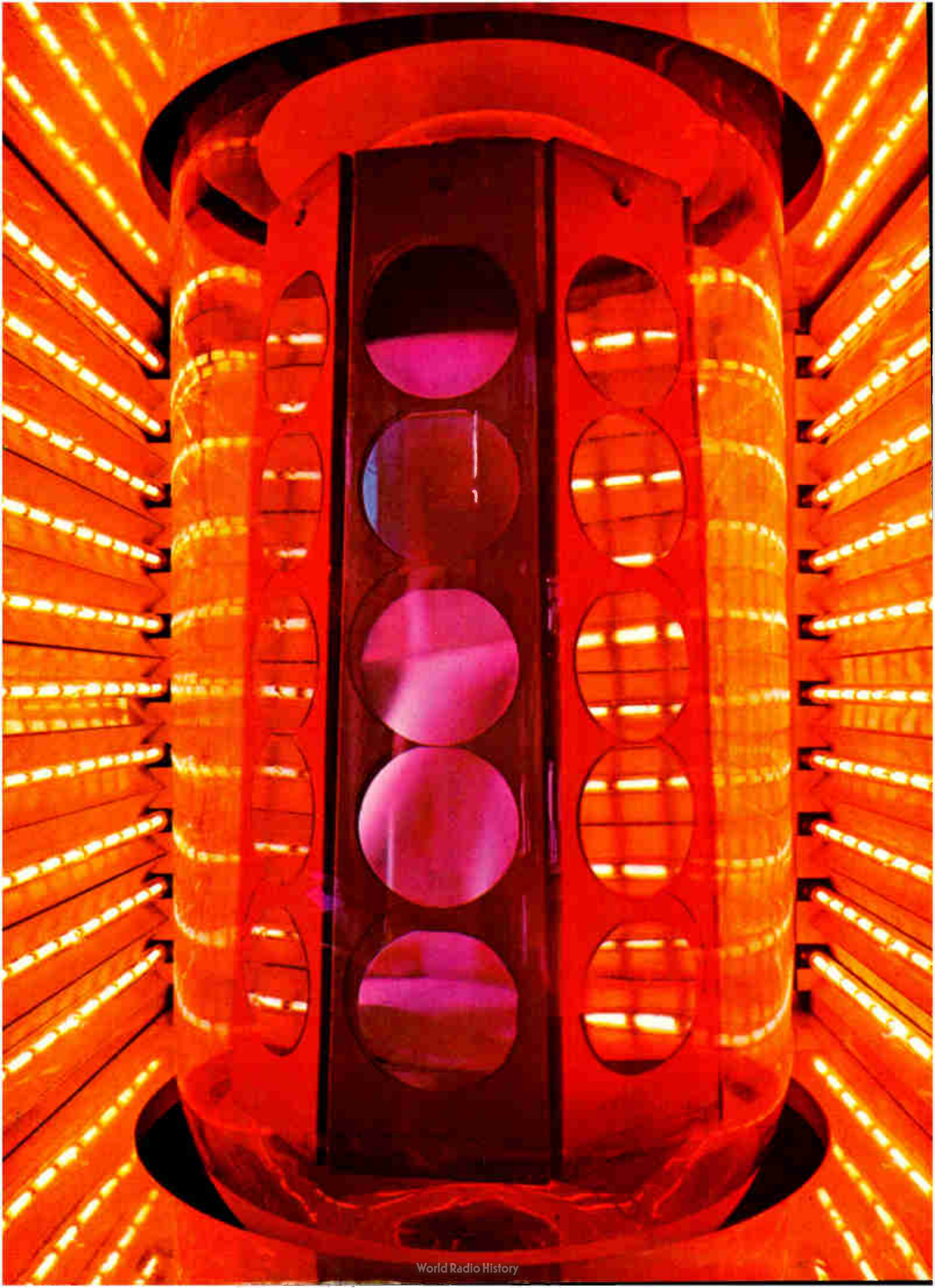
Burroughs

Circle 17 on reader service card



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*Applied Materials Technology, Inc. U.S. Patent No. 3,623,712

Circle 19 on reader service card

Announcing the rediscovery of the relay.

In an age when most people think solid state is the only way to go, some designers have rediscovered the good old electro-mechanical relay. They found relays still can't be beat when it comes to certain jobs. And when they're dealing with tight fisted cost control committees. Maybe you can save some effort and expense by rediscovering the relay whenever you need these things:

1. Simple logic:

Relays let you combine both power switching and logic functions economically. Memory can usually be retained, even after a power loss. And you don't need special power supplies or noise suppression techniques.

2. Easy troubleshooting:

Most relay failures (and they do occur occasionally) can be identified visually. You can see what's wrong. And fix it easily.

3. Heat resistance:

A relay shrugs off a short dose of overheating. Give a solid state device the same treatment while it's functioning near capacity and it's ruined forever. The amount of heat a solid state device can take is usually dependent on the heat sink used. It can take up all the room you expected to save with solid state in the first place. And finding the right heat sink design can become very involved.

4. Electrical isolation:

Relays have a natural isolation between input circuits, between output circuits, and between output and input control circuits. You can't get that with junction type semiconductors.

5. High insulation resistance:

Open relay contacts have an insignificant amount of leakage (10^{10} ohms or more). Semiconductors can't match this. And, their leakage rates vary greatly with temperature changes.

6. Wide operating power range:

Relays work with operating power anywhere from milliwatts to watts. And they usually don't require regulated power. Semiconductors do.

7. Transient voltage immunity:

Transient voltage doesn't bother a relay. But high voltage, short duration transients can be sure death to semiconductors.

8. Forgiveness:

Relays give you a little margin of safety should you want to change your mind. Maybe you find you need more contacts, or uncover a timing problem, or discover a need for absolute input-output isolation. You can change your circuit design a lot easier with relays.

If your project or product needs any of these things, just ask our salesman to help you rediscover relays. GTE Automatic Electric, Industrial Sales Division, Northlake, Illinois 60164.

GTE AUTOMATIC ELECTRIC

Circle 21 on reader service card

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WORLD'S BROADEST LINE OF MINIATURE CERAMIC FILTERS AND FILTER SYSTEMS

FIRST– in subminiature design capability

FIRST– in total in-house production capability

FIRST– in Quality and Volume Production

FIRST– to develop a complete line of subminiature EMI Filters

ERIE's stature as undisputed world leader in subminiature high performance Ceramic EMI Filters has been earned by our ability to apply 35 years of sophisticated ceramic and related technology to developing superior EMI Filters. Virtually all other presently known ceramic EMI filters are a copy of an Erie design. Yet no firm has been able to equal Erie's combined in-house filter capability and proprietary ceramic technology.

Today, these miniature filters do their thing in noise pollution control eliminating extraneous noises and emissions from airwaves.

There's an application for reliable Erie filters in your communications, aerospace, aircraft and industrial equipments. We'll be happy to help solve the problem.

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Circle 22 on reader service card

Meetings

International Switching Symposium: IEEE, MIT, Cambridge, Mass., June 6-9.

Society for Information Display International Symposium and Exhibition: SID, Jack Tar Hotel, San Francisco, June 6-8.

Consumer Electronics Show: EIA, McCormick Place, Chicago, June 11-14.

Spring Conference on Broadcast & Television Receivers: IEEE, Marriott Motor Hotel, Chicago, June 12-13.

Air Pollution Control Assn. 65th Annual Meeting: APCA, Fontainebleau, Miami Beach, June 18-22.

International Conference on Communications: IEEE, Marriott Motor Hotel, Philadelphia, June 19-21.

Joint Measurement Conference: ASQC, IEEE, ISA, NBS, et. al., University of Colorado, Boulder, Colo., June 21-23.

Conf. on Precision Electromagnetic Measurements: IEEE, NBS, U. of Colorado, Boulder, June 21-23.

International Symposium on Electromagnetic Compatibility: IEEE, Arlington Park Towers, Chicago, July 18-20.

Western Electronic Show & Convention (Wescon): WEMA, Convention Center, Los Angeles, Sept. 19-22.

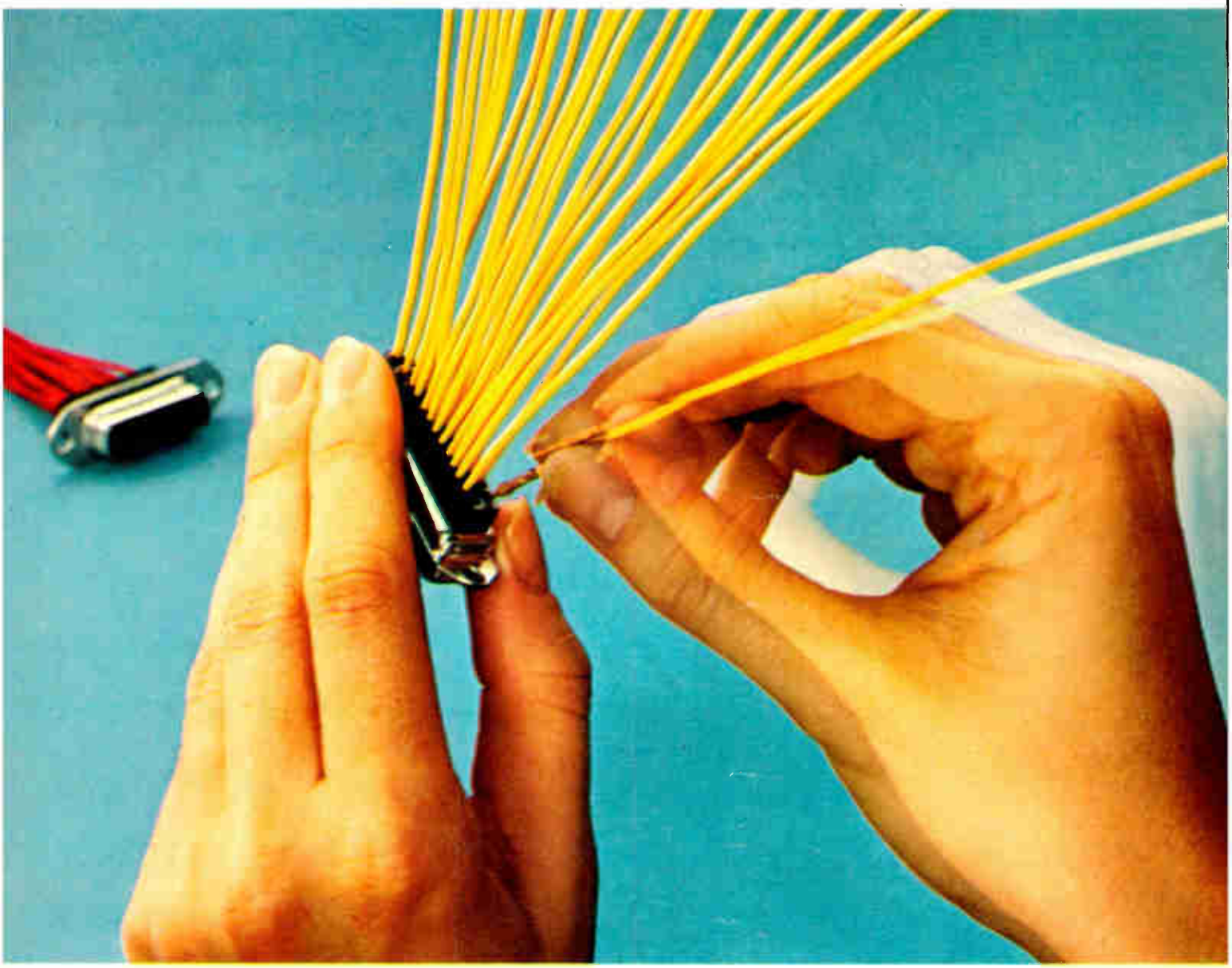
Engineering in Medicine and Biology: IEEE, Americana, Bal Harbour, Fla., Oct. 1-5.

International Symposium on Remote Sensing of Environment: U. of Michigan, Willow Run Labs, Ann Arbor, Oct. 2-6.

International Conference on Cybernetics and Society: IEEE, Sheraton, Washington, D.C., Oct. 9-12.

Conference on Display Devices: IEEE, United Engineering Center, New York, Oct. 11-12.

Make the simple move



to less assembly time.

Do it the easy way with Amphenol's 17 Series miniature rear-release connectors.

A gentle push from the back of the connector and the contact snaps securely in place. No tools or broken fingernails, just easy fingertip assembly. And to remove the contact for fast field servicing, insert a simple plastic tool in the back of the connector and out pops the contact.

You can have a choice of screw-machine contacts in bulk packaging, or stamped and formed contacts on a carrier strip. Semi-automatic crimping or hand tools available for either type of contact.

The Min-Rac® 17 Series connectors are available in 9, 15, 25, 37, and 50 contact configurations. All meet EIA Standard RS-232C for data communications input-output connectors. And all are intermountable and intermateable with other Min-Rac 17 Series connectors as well as competitive "D" type connectors.

Find out how simple it really is. Just write Dick Colt asking for the whole story on our Min-Rac 17 Series rear-release connectors. Amphenol Industrial Division, Bunker Ramo Corporation, 1830 South 54th Avenue, Chicago, Illinois 60650.

BUNKER RAMO AMPHENOL

Circle 24 on reader service card

Electronics newsletter

Army wants CCD tactical page reader

The first military application of Fairchild Semiconductor's linear photosensor array utilizing charge-coupled devices (see p. 29) comes from the Electronic Devices and Technology Laboratory of the Army Electronics Command at Ft. Monmouth, N. J. Under a $40,000-plus award, Fairchild's Space and Defense Systems division has a year to develop **a tactical page reader—a device for scanning documents newly captured on the battlefield** and transmitting their contents electronically to an intelligence center in the rear.

The laboratory's integrated electronics area, headed by Clare Thornton, is sponsoring development of the reader. It will consist of a 1,600-element linear array mechanically scanned across a page. **Other applications for the technology also are expected from the Thornton group.**

RCA forms data net for big users . . .

Armed with FCC approval, RCA is mapping plans to become a major factor in a new sector of the communications business. For the past 18 months, **company officials have been talking to 150 big users of domestic data communications carrier facilities about forming a joint users' network.** RCA would install equipment and manage the net in an attempt to offer better service at lower cost than can common carrier facilities already available.

RCA would lease voice-grade lines from phone companies and subdivide the spectrum available on each line into lower speed channels—say, 150 bits per second—fast enough to handle data traffic from teletypewriters. Under Federal regulations, RCA would also have to be a user. **Costs are allocated according to a prescribed formula.**

. . . and becomes big Datacom competitor

RCA's new service would compete primarily with Western Union's Datacom. Earl D. Hilburn, president of Western Union Telegraph Co., points out that the RCA move is one more indication that competition is becoming stiffer in the data communications business. He adds that Datacom will soon extend service to 2,400 and 4,800 bits per second, and that Western Union plans to "unbundle" Telex and TWX services by selling lines and letting the subscriber supply terminals.

RCA says that it will start work on its constantly monitored data net as soon as 25 users sign up, reaching on-line status in three to four months. The company says that it has letters of interest from 40 potential customers, including American Express.

Laser printers to be marketed

Laser beam printers may at last be moving out of the experimental stage and into production. **A spokesman for Zenith Radio Corp., Chicago, says the company is within two months of selling a model of its alphanumeric laser character generator** [*Electronics*, Sept. 27, 1971, p. 23]. And Datalight Inc., Bloomfield, Conn., which has an experimental laser-driven alphanumeric generator for a computer output microfilm system (see p. 38), **has also sold 50 character-illumination systems to be used in phototypesetting machines developed by Photon Inc. of Wilmington, Conn.**

The Zenith system scans nine laser beams across a "page" to write both upper and lower-case characters in a nine-by-seven matrix. A

tenth beam is included for control and positioning. **Initially, the unit will write 20,000 lines per minute on heat-sensitive dry-silver film but Zenith is also working on a system for writing on plain paper.** The Datalight unit substitutes a laser for a high-intensity xenon source.

National to sell LED displays

About two months after it entered the light-emitting-diode lamp business, **National Semiconductor Corp., of Santa Clara, Calif., has entered the LED display business.** Within the next few months, the firm will have available three seven-segment displays. Two are to be second sources to Monsanto's MAN-1, a 0.27-inch digit, and MAN 4, which is 0.19 in. The third product: a cluster of three or four digits in one package, similar to the Litronix Data-Lit 34, which has four 0.125-in. digits.

When National entered the lamp business [*Electronics*, March 13, p. 36], **the company said that "it will take the development of a dollar-per-digit device to get us into the display business."** Whether this goal has been reached the company won't say.

Macrodata doubles LSI tester rate

Macrodata Co. will soon announce a 10-megahertz LSI tester, about double the rate of models now available. The new MD-104 LSI tester, based on the MD-100 memory exerciser, includes expanded capability for testing bipolar and MOS "random" LSI as well as RAMs, ROMs, and shift registers. Unlike the MD-100, the 104 is completely software programable. The instrument, planned for September delivery, is priced at $25,000, including paper-tape reader.

Image intensifier uses IBM film

The deformographic film that IBM is using in projection CRT systems [*Electronics*, Jan. 17, p. 32] is being used in an image intensifier being put together at the White Sands Missile Range, N. M. **It's used as the output, or image-storage, plate in the intensifier, which in turn shows promise in night-vision devices and low-light-level cameras.** Its principal advantage is that it makes more efficient use of the energy in the electron beam, and therefore can be more sensitive than previous phosphor-output devices.

The new image storage plate is a monolithic array of diodes. Electrons representing the image strike the p side of the array, and back-bias the diodes, storing a charge in the diode capacitances. This stored charge deforms the deformographic film, which is deposited on the n side of the array.

Addenda

A two-year-old firm, Western Digital Corp. of Newport Beach, Calif., has received a $7 million order for calculator chip sets. They're to be used with display tubes made by Ise Electronics of Japan. . . . Optel Corp., the Princeton, N. J., firm that supplies watch makers Omega and Waltham with C/MOS circuitry and liquid-crystal displays, plans to make complete watches. Marketing plans haven't yet been defined. **Optel is the second kit supplier to decide to go all the way;** the other is Microma Universal (see p. 59). . . . GTE Sylvania has unveiled its version of a frame grabber for bidirectional cable TV. **Based on an electronic storage tube, the Sylvania model is said to have three times the resolution of a standard TV tube.**

nuts

Yardsticks named do not yardsticks make. And while their minicomputers may be good, they're not good enough to be OEM yardsticks.

They're not even close. Large gaps stand between their definition of an OEM yardstick and that of GRI's Functional Process Minicomputers*, the computers with the original Universal Bus System. Gaps consisting of the dramatic simplicity, ease and efficiency with which you integrate a GRI computer into your systems environment.

GRI's yardsticks: the cost of writing real-time software, of designing hardware interfaces, of debugging both the hardware and the software—the cost and effort it takes to get the total system actually up and running. Yardsticks!

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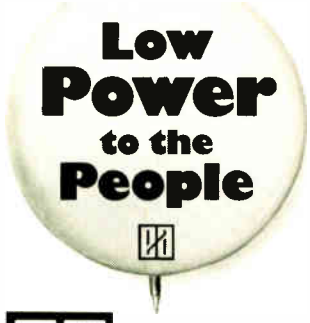
But, that's not all, folks. The EA1501 has *automatic refresh.* Memory timing and control are simplified by the elimination of precharge and refresh addressing. A single write pulse does it. Your memory system is refreshed "invisibly" and that cuts out memory busy signals.

And, don't forget, if you want a faster 1024 bit RAM, like 85 nsec worst case, ask about our EA1500.

Write for full scoop on both the EA1500 and EA1501—do it now!



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Buried channels point the way to solid state imager

Fairchild builds linear array that solves problem of charge-transfer loss blocking path to vidicon use

Competitors in the race to make the first solid-state video camera are nearing the finish line. Using charge-coupled device technology and a buried-channel structure, researchers at Fairchild Semiconductor's R&D center in Palo Alto, Calif., have built a 500-element linear array. Not only does it contain more image elements per unit chip area than other CCD imagers, but it apparently solves the problem of charge-transfer loss, which some feared would ultimately prevent the construction of CCD arrays large enough for vidicons.

Obervers close to CCD developments point out that it was this structure, conceived by James Early, head of Fairchild's R&D center, that persuaded the Navy to put $3 million into CCD research. [*Electronics*, April 10, p.39]. By making a 500-element linear device (television, for comparison, uses a 525-line element), Fairchild demonstrated a capability that Navy contract managers surely were seeking before recommending a commitment of that magnitude. Among others known to have the potential are General Electric Co., RCA, and Texas Instruments.

Bury 'em. The key to CCD imaging, says Early, is buried channels. First described in a paper by researchers at Bell Laboratories, buried channels reduce transfer losses as carriers move between electrodes. Ordinarly, the charge gets trapped in the surface at the oxide-silicon substrate interface. This occurs because there are no diffusions under transfer electrodes in a CCD element; instead, potential wells dug at the surface carry the charge. Charge entrapment means image error—the greater the transfer frequency and number of elements, the worse the error.

Staying put. However, if a lightly doped channel is buried in the silicon beneath the oxide-substrate interface, the charge will transfer in that channel, rather than at the surface. Like Bell Labs, Fairchild is using ion-implanting techniques to build the channels, implanting the n-type impurity in the silicon substrate about 1 micrometer deep.

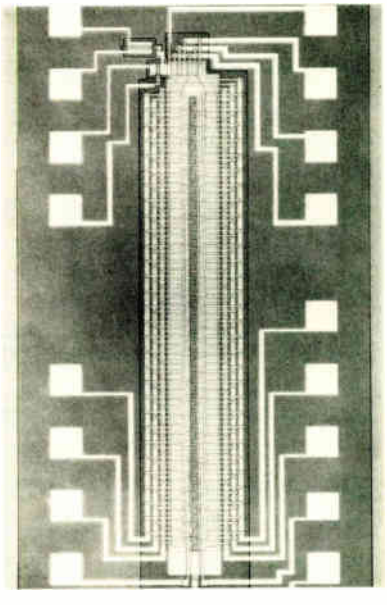
With buried channels, says Early, Fairchild's best measurements show 99.99999% transfer effeciencies at 2.5 megahertz. "Clearly," he adds,

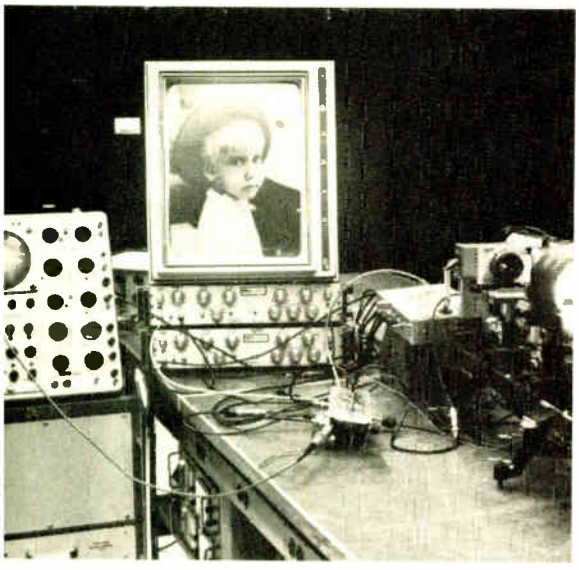
Going through channels

Fairchild's is an inventive structure (right)—the first large-scale imaging device to use buried-channel charge-coupled principles. The array is made up of three linear sections. First, there's a photosensing strip running along the central axis of the device. It's composed of 500 image elements defined by a meandering channel-stop diffusion. Then, there are two 250-bit CCD shift registers parallel to the central image area. The image area is built with silicon-gate techniques, while the CCD shift registers have aluminum electrodes shielding them from the incident light.

The picture to be imaged falls on the cells in the central imaging section where the light is integrated into packets of CCD charge. These packets are passed alternately left and right to the two shift registers. Their outputs are then channeled into a short two-element CCD, so that the output of this shift register corresponds to the sequential reading of the 500 image elements.

All the CCD shift registers have the conventional three-phase clocks—the photo elements with 1.2-mil center-to-center spacing and the shift registers' 2.4-mil separation. Significantly, the Fairchild structure minimizes the troublesome smearing of some CCD structures. Only one transfer needs to be made from the unshielded photosensitive central elements, and once this is made to the aluminum-protected shift registers, the charge is immune to the smearing effects of the new image.





Pretty picture. Camera at right uses the Fairchild imager made with charge-coupled technology and a buried-channel structure.

"with these efficiencies, a full-fledged CCD vidicon is well within our capability. This spells the death of raster-scan photosensing."

Gilbert F. Amelio, a key Fairchild CCD man who was at Bell Labs during the early CCD days, points to other advantages offered by the Fairchild buried-channel structure. Says Amelio, "not only is surface-state trapping eliminated, but the charge-transfer drift fields are stronger and the device is faster—a factor of 2 speed advantage over other CCD structures." This could be an important consideration. □

Space electronics

'Violet cell' raises solar power specs

Even as satellite builders seek more efficient solar cells to power sophisticated hardware aboard larger and more complex craft, silicon solar cells are stuck at a 10% to 11% efficiency rate. Now, Communications Satellite Corp. Laboratories claims more than 13% efficiency for a new silicon cell it calls a "violet cell." Moreover, the company says the new cell increases useful power by more than a third because it would degrade to only 11.5% efficiency in outer space versus 8.5% for conventional cells.

The violet cells get more of the sun's spectrum to work with. Through a subtle redesign of cell geometry and a new approach to the chemical composition of all parts of the silicon, the new cell captures the violet and ultraviolet rays as well as the portions of the spectrum caught by normal cells, says Joseph Lindmayer, manager of the solid state physics branch of the laboratories. This increases the amount of sunlight convertible to electrical energy.

A thinner n-type top layer permits the cell to let in the ultraviolet rays. But to counteract the resulting high resistance, Lindmayer and his colleagues also employ many more electrodes on the top layer—because they are closer together, they cut resistance. Here, Comsat got an unexpected dividend because the new surface geometry brought the resistance below that of conventional cells, notes E.S. Rittner, manager of the physics laboratory.

Same area. Using 60 to 100 thinner electrodes also took up no more cell area than the six thicker ones normally used, so they blocked out about the same amount of light. Contrary to expectations, Lindmayer says, the shallower junctions also resist space radiation, one problem with satellite solar cells. To

Bell looks to buried-channel RAM as GE takes different path

Researchers at Fairchild Semiconductor aren't the only ones using buried-channel techniques with charge-coupled devices. Work is going on full blast at Bell Laboratories in Murray Hill, N.J., where CCDs were born.

Bell's George Smith, first to report on the buried-channel concept (at the Device Research Conference last June), asserts that "the structure will have significant implications for both memory and imaging because it results in stronger transfer fields for a given drive voltage, as well as better transfer efficiency." Smith adds up the benefits: an order of magnitude boost in field strength pushing the charge, and 1,000 times better transfer efficiency.

With the buried-channel CCD memory devices currently in development, Bell has achieved hundreds-of-megahertz device operation, with gigahertz frequency possible in future devices. Also, buried channels could do away with the need for refresh circuitry—necessary with early CCD dynamic memory devices. Significantly, Bell now has formed a random-access memory CCD group under Smith, who has promised some significant developments in the next few months.

Meanwhile, at the General Electric Co. R&D center in Schenectady, N.Y., research workers are busily polishing their version of a CCD imager—one without buried channels. That route was considered, says Jerry Tiemann, a GE scientist, "but we're sticking to our parallel transfer structure," which employs a shared bus configuration. Tiemann explains that the GE structure solves the long-standing, annoying problem of blooming—a low-light-level vidicon phenomenon whereby a bright source in a dim room results in local overloading on the image surface, causing a black cloud to bloom across the face of the tube. GE's diffused runs can also be used to collect the excess charge caused by the bright source. □

which Rittner adds that the cell shows much sharper current-voltage characteristics.

With these and other touches, which Lindmayer declined to discuss because of pending patent applications, the cell preserves a desirable high, short-wavelength response over the entire spectral range of sunlight without damage from oversensitivity to infrared.

CaS and GaAs. In the quest for higher efficiencies, several companies are turning to other materials, such as cadmium sulfide and gallium arsenide. So far, cost considerations dictate silicon because the processing is the most advanced in the semiconductor industry. In fact, Lindmayer brought his semiconductor experience with Sprague Electric Co. to bear on the problems of improving efficiency of the silicon cells—essentially flat diodes.

Recently, however, IBM's Yorktown Heights, N.Y., research laboratories announced a gallium arsenide cell of 18% efficiency. Here, a layer of gallium-aluminum-arsenic alloy is grown on top of a gallium arsenide crystal and then doped with zinc. The process is technically sound. The question is whether or not the cell can be made economically enough.

Comsat's violet cell is targeted for the projected Intelsat 5 communications satellite and for the domestic communications satellite. Comsat has not decided whether eventually to license the cells for production or manufacture them itself. The cell would cost no more to produce than conventional cells. □

Industrial electronics

DuPont courts noise market

The Occupational Safety and Health Act of 1970, besides spawning entirely new markets for many kinds of industrial safety gear, gave new life to the market for noise-measuring equipment, which had already been opened up by the Walsh-Healy Act. While the earlier law was restricted largely to companies under Government contract, the 1970 measure added most of what was left, making an estimated total of 17 million or more employees needing protection.

The electronics industry at first responded with improved sound-level meters. But meters normally must be carried about by an inspector who makes random measurements for short periods, then moves on to other sites. Since sound levels often vary during the day and since hearing loss from too much noise not only is cumulative but also can be caused by sudden loud bursts, spot checks are bound to miss important data.

For all. Now, the Education and Applied Technology division of E.I. duPont in Wilmington, Del., is selling a device that could be applied to almost every one of the 17 million jobs covered by the new law.

DuPont developed the unit in-house to meet its own needs. About the size of a pack of cigarettes and weighing only about 8.5 ounces, it is small and light enough to be worn all day by a worker.

The mike is a simple omnidirectional unit with frequency response reaching 10 kilohertz. Its output is fed through proprietary electronics that monitor not only continual exposure but also transient events.

Electronically the unit operates much like sound level meters—rectifying, averaging, and weighting a microphone output according to established curves for hearing sensitivity. Thus its measurements are in dBa, a method of rating that parallels the ear's sensitivity with the a referring to the weighting scale. The electronics package has only about 0.5 decibel of drift per year.

At the end of a shift the worker removes the dosimeter to have its information observed and recorded. Unlike noise meters, it has no external readouts, but if the wearer has been exposed to sound of more than 115 dBa for as little as one-quarter to one-half a second—the maximum according to law—a light emitting diode inside the case glows.

Quiet touch. DuPont calls its wearable noise-measuring device an audio dosimeter.

For cumulative exposure, duPont uses the sort of chemical—or electrochemical—solution one would expect from that company. Noise above 90 dBa triggers a plating current across a small cylindrical cell, about ¼-inch in diameter and ¾-in. long, consisting of a silver sleeve with a gold pin down its axis. High levels cause the sleeve to be gold-plated in proportion to the amplitude and duration of the noise. After use, the cell is "deplated" in a small console, and the amount of deplating current needed is converted to the percentage of legal maximum sound exposure the worker has endured that day.

The company began marketing the device in December and can deliver lots of 100 or more off the shelf at $495. □

Packaging

Hot cap welder speeds IC sealing

The man who developed the dual in-line and diaphragm packages for ICs, Bryant C. (Buck) Rogers, has been at work again at his Diacon Co., in San Diego, Calif. What has emerged is a hot cap sealer that can seal a ceramic IC package to Mil-Std-883 specs in only 2 seconds and at a much lower temperature than present methods.

The sealer uses a small tabletop instrument that can be enclosed easily in a dry box or other means of controlling the atmosphere. This compares with furnace sealing at 550°C, which requires about 10 minutes and presents all sorts of opportunities for contamination from impurities picked up by the moving

belt. Nor does the sealer require jigging or boats—a package is simply placed on a metal block, and the top is automatically positioned and sealed at about 400°C. The speed of the operation also makes it possible to reduce water content to five parts per million from 23 ppm.

Transfer. Rogers says his sealer operates on the same principle as capacitive discharge welding, except that heat rather than electricity is stored before being dumped through a glass layer with high thermal resistance (because the heated mass is placed against a cooler area). The glass forms a hermetic seal.

The scheme was first considered by Rogers for large 24-pin packages, which are difficult to seal properly. But the first application will actually be in sealing ¼-inch flatpacks used on Poseidon missiles, and Diacon has just delivered its first four sealers to suppliers for this program. After the flatpack will come the eight-pin miniDIP now finding wide applications, with the 14/16 pin DIP to follow in about 6 weeks. Diacon will supply both the packages, which have the metal lead frame sealed in glass, and the sealing machines.

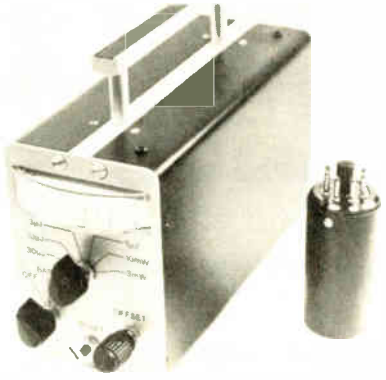
The sealers will cost about $4,000, compared to about $8,000 for a typical IC welder that requires more expensive metal packages. Rogers says that the sealer will give higher speed than metal welding now, and he expects to have an automatic machine capable of 3,600 parts per hour per operator by the end of the year for the 14/16 pin packages. For this, the packages will be supplied in strip form, not usable with ceramic. □

Instrumentation

Device warns of laser eye damage

Spurred by the controversy over safe limits for laser radiation, a West Coast instrument maker has built the first commercial device designed specifically to monitor laser light intensities capable of damaging the eye. The work was done by United Detector Technology of Santa Monica, Calif., on a contract from the Air Force School of Aerospace Medicine, San Antonio, Texas.

The portable laser energy evaluator is capable of measuring all continuous-wave and pulsed laser output in the spectral range from 400 to 1,060 nanometers. The evaluator is designed around a unique sample-and-hold technique that selects the maximum pulse of energy from a train of laser bursts—as many as 100 pulses per second. If only one shot is fired, the instrument displays its output level; for cw lasers, it displays the maximum power level. The evaluator stores data on maximum laser power or energy levels until reset.



Looker. Portable laser energy evaluator by UDT is designed to prevent eye damage.

A precalibrated plug-in detector head—it can be replaced easily if it is damaged by a high-power laser—with 7-millimeter aperture simulates the human eye. A computer-designed subtractive filter flattens the silicon photodiode response so that all wavelengths are equally sampled. The instrument weighs only 3 pounds and operates at least 70 hours on its self-contained battery.

Besides monitoring laser energies for eye damage, the evaluator also can be used to calibrate lasers—particularly pulsed lasers that are difficult to calibrate accurately. The pulse integration and maximum pulse height selection of the instrument is accurate to within 0.5%, and the silicon sensor is stable to within 2% in six months. A calibration technique has been worked out to transfer calibrations from a National Bureau of Standards standard lamp to the evaluator for both power and energy measurements. □

Consumer electronics

RCA Holotape lives —but in the lab

RCA researchers say that reports of the death of their holographic video playback system have been exaggerated, but confess that, as a practical home entertainment device, it's a long way from perfection.

In the first display of Holotape since the project virtually went underground some two years ago, the breadboard version showing vinyl tape cartridge recordings revealed that picture noise plaguing the first model has been overcome. In addition, the tape now has a stereo sound track, which it lacked back in 1969, when the concept was first publicized.

Admitting that the marketing arm of the company overplayed its hand in promising Holotape by 1972, William J. Hannan of RCA/David Sarnoff Research Center commented that there is no scheduled date for production—if at all. But the company's Consumer Electronics division had previously announced production of a magnetic tape home TV player/recorder for sale next year, which more or less let Holotape off the hook.

Dropout. One of Holotape's problems is an occasional dropout of color at 1-second intervals. This is caused in the tape production process, Hannan explained. When the tape is coated, the drying reels put kinks into the coating; this causes the color to flutter.

Picture noise, the earlier problem, was solved by greatly increasing the redundancy of the pictures per frame. Using a pinhole screen, researchers are able to achieve 200-picture redundancy per frame, with each picture spread evenly on the tape. The result is that noise has

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Circle 33 on reader service card

little effect on any one picture. The projected image is a composite of all 200 holograms. As for the sound, the two tracks are embossed on the tape in serpentine grooves. A playing needle seeks and follows the grooves when the cartridge is positioned in the player.

The manufacturing process involves recording color-encoded movies on black-and-white film, recording relief-phase holograms of the encoded movies on photoresist, preparing a metal master from the photoresist recording, and finally, embossing holograms on the vinyl.

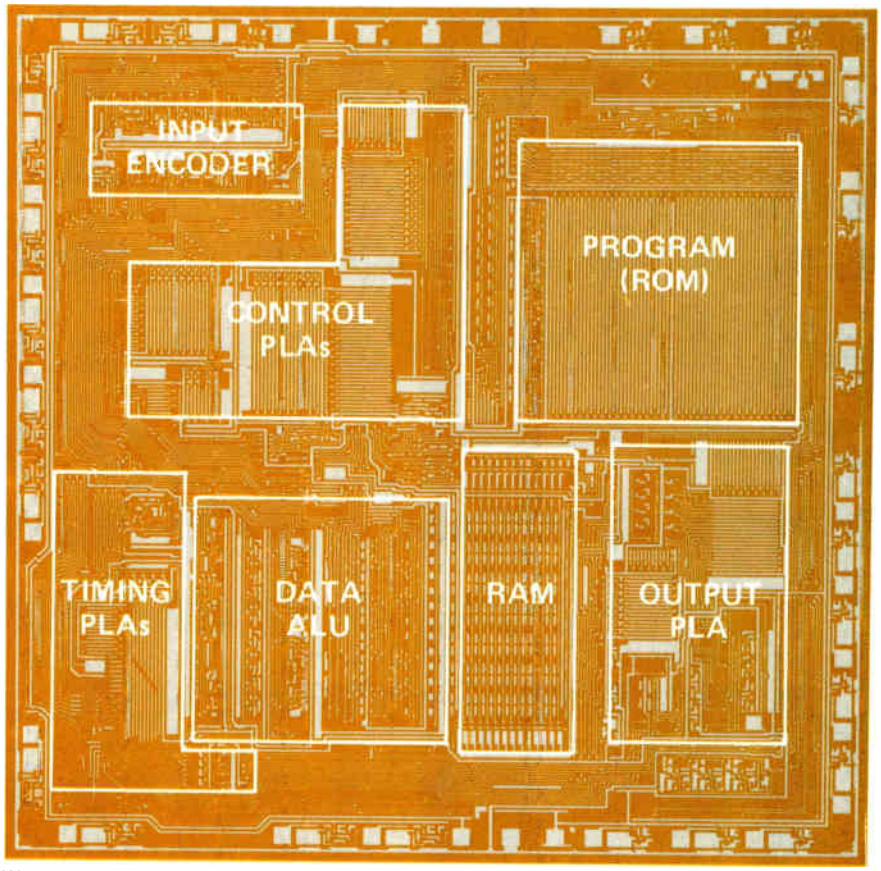
The player consists of a helium neon laser that projects the taped images into a TV camera. □

Integrated electronics

TI adds to line using 'host chip'

Taking advantage of its ability to "program" read-only memory segments of an MOS/LSI chip, Texas Instruments has broadened its one-chip calculator line to cover 23 variations, about half of which will be standard products, half custom.

Since the announcement of the basic host chip last September (TMS0102, formerly the TMS1802), some 20 U.S. and Japanese calculator makers have lined up to buy it.



Welcome. TI has broadened repertoire of its calculator host chip to include 23 variations.

Says Daniel Baudouin, MOS new products marketer, "This is the most successful standard product ever made by TI that I'm aware of."

The chip incorporates all logic and memory to perform three register calculator functions—add/subtract, multiply, and divide. To get a different characteristic in the calculator means changing only one mask. These economies make possible 100,000-quantity unit prices of well under $20, according to TI.

The two most recent additions to the TMS0100 series are the eight-digit 0101 featuring a plus-minus-equals capability as in accounting machines, and the 0106, which is a 10-digit version with no change in chip real estate. The 10-digit device will be 10% higher in price than the others.

The advantage of the plus-minus-equals feature of the 0101, Baudouin explains, is that a consumer can do calculations as he would write them, that is, A − B =, rather than the formula format of A + = B − =.

Thanks to the host chip concept, TI was able to add the two digits to the 0106 by optimizing its use of the present chip area. This was done by improvements to the software that programs the ROM and the logic arrays. Baudouin says the 10-digit version should form the basis of inex-

Pushing keyboards

Another division of TI, the Attleboro, Mass., Control Products group, is moving strongly into another component of low-cost calculators—the keyboard. With a unit based on one of the division's best known products, the Klixon snap-action disk, the keyboards are now being sold for about 15 to 17 cents per key position, and in their standard configuration, they interface with TI's host chip. The Attleboro plant is adding capacity, but now can produce a million keyboards a year, reports division manager Herb Greene.

The keyboard fulfills three important requirements, says Greene: it provides tactile feedback, has significant mechanical travel, and also clicks audibly when depressed. There's no contact bounce and little chance of inadvertently actuating the key with light finger pressure, Greene says. It's assembled starting with a one-sided printed-circuit board, into which gold staples, three for each key position, are inserted.

The disks are set in place, each contacting the two outer staples until depressed, when it contacts the center staple, too. The whole unit is sealed in Mylar to protect the contacts.

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Old Clichés Revisited

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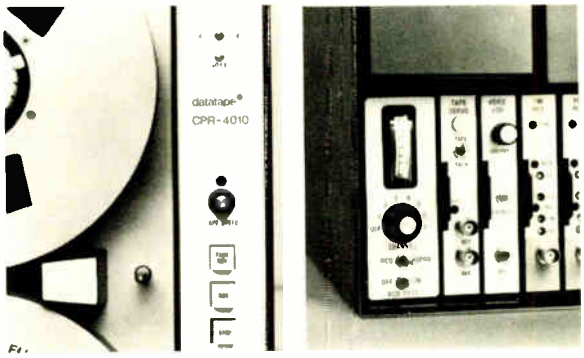

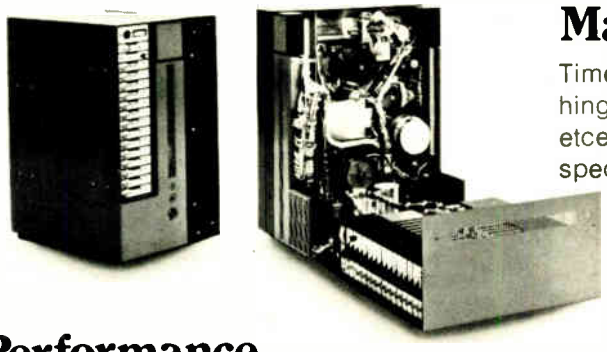

Maintenance and Servicing

Time for the annual P.M.? It's no big deal. The back panel's hinged. Just flip it down. All motors, power supplies, electronics, etcetera, are right there. (It even runs in this position.) Nothing special needed. How's that for simplicity?

Performance

Briefly, from the top: 7 speed transport, 15/16 to 60 ips; 7 speed direct, all automatically switched, 300 kHz at 60 ips; 7 speed FM record; 40/20 kHz, automatically switched. Any 2 speeds of FM reproduce; low tape flutter and TBE; isolation from reel perturbation via dual capstans and tension sensors. Low mass, closed loop IRIG servo system. The same electronics design as our top-of-the-line VR-3700B.

Bell & Howell & the CPR 4010

Get all the specs. Just ask Bell & Howell, CEC/Instruments Division, 360 Sierra Madre Villa, Pasadena, California 91109.

CEC/INSTRUMENTS DIVISION

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pensive desktop calculators rather than pocket-sized minis.

By single-level programing, any number of one-chip variations may be made, so that TI expects to find other applications for its calculator chip. For example, a timing device for the Olympic games includes a chip from this family. Gas pumps, machine tool controls, and point-of-sale terminals are other potential applications. □

Communications

OTP unable to sell CATV pilot project

A variety of Federal agencies are enthusiastic about the future of the wired city, but none of them wants to pay for it. That's the message received by the White House Office of Telecommunications Policy after a six-month search for funds for a pilot two-way cable TV demonstration system involving about 1,000 homes and 600 business and local-government users.

"It's a tight fiscal year," says one OTP official in explaining the failure to find money in such organizations as the Departments of Housing and Urban Development and Health, Education, and Welfare. And OTP can only point out the availability of technology, not require its adoption.

So OTP is taking another tack: releasing its 516-page study in an effort to excite interest. The study was completed last November by Malarkey, Taylor & Associates, Washington consultants.

Though the report doesn't spell out the total outlay required for its recommended pilot project, industry sources estimate it would take approximately $9 million. "The suggested pilot system," says OTP, "would involve two-way cable transmission facilities, terminals to control system services in each home, central information files and simple data processing accessible to home users, and facilities for local program origination."

Federal support—in addition to industry-funded experiments—would be required for a pilot effort employing a bidirectional system with a 4-megahertz return, or upstream bandwidth, plus a 32-to-35-channel interactive broadband communications home terminal. Bidirectional CATV would cost about $1,500 more per mile than unidirectional transmission, the consultant says, whereas the cost to provide interactive home terminals is on the order of $30,000 per mile using a formula of $300 per terminal, times 150 homes per mile, times 65% penetration. "The bottleneck is obvious," the study concludes.

But the cost bottleneck becomes more obvious when interactive home terminal costs for a small pilot system are detailed beyond the longterm forecast of an estimated $300 per unit in high-volume production. Specifically, the consultant estimates that it would cost $2,400 to design existing technology into a single home system. The higher figure is the sum of $600 for a special CATV receiver with monochrome cathode-ray tube monitor; $300 for a silicon storage tube and circuitry such as RCA's for capturing single frames; $500 for a facsimile printer, possibly in color; $800 for a transponder comparable to Theta-Com's SRS-102, and $200 for an alphanumeric keyboard.

"The cost tradeoff is clearly in favor of beginning with a broadband communications terminal designed around the silicon storage tube," according to the study, "since so many special modifications are necessary to use off-the-shelf equipment" now available. Putting together existing equipment to achieve the same terminal capabilities would run to $4,040, says the study. But, presuming successful design and packaging of the components in a $2,400 terminal, the study forecasts that mass production could drop the price to $680 by reducing receiver costs to $475; dropping the transponder price to $100; the single-frame-capture tube to $55, and facsimile printer cost to $50—a set of figures which the study concedes is the "theoretical ultimate." □

Microwave

'Microguide' IC fabrication promises advantages of both existing methods

Of the techniques for making microwave integrated circuits, microstrip has been the most popular, even though other approaches—such as slotline or stripline—exhibit better characteristics, especially above 10 gigahertz. The primary reason for the use of microstrip is its ease of fabrication, but a development at Stanford Research Institute, Menlo Park, Calif., may change this.

In a paper to be given May 24 at the International Microwave Symposium in Chicago by E. G. Cristal, A.S. Podell, and Don Parker, all of SRI, a new technique called microguide is described as offering the advantages of the others.

Parker says, "Sandwich line or stripline with high dielectric constant material has low loss and small radiation compared to microstrip, particularly at frequencies above 10 GHz. However, to prevent unbalanced modes from being excited and propagated, tight tolerances are required on the substrate surfaces. Another disadvantage is that solid state devices are not easily added."

Microguide, on the other hand, is said to contain the best features of microstrip—planar geometry, ease of fabrication, reliability, ease of mounting solid-state devices—plus the ability to handle higher power with lower loss and radiation. Parker has found that at 6 GHz, for example, an unloaded Q of 605 was measured with a microguide circuit; this compared to a Q of 200 to 300 for microstrip.

A cross-section of a microguide

As high as 20% of all op amp applications are still using more op amp, at higher costs, than necessary. The right economy/performance alternative wasn't available. It is now!

The Quad Op Amp— MC3401P...

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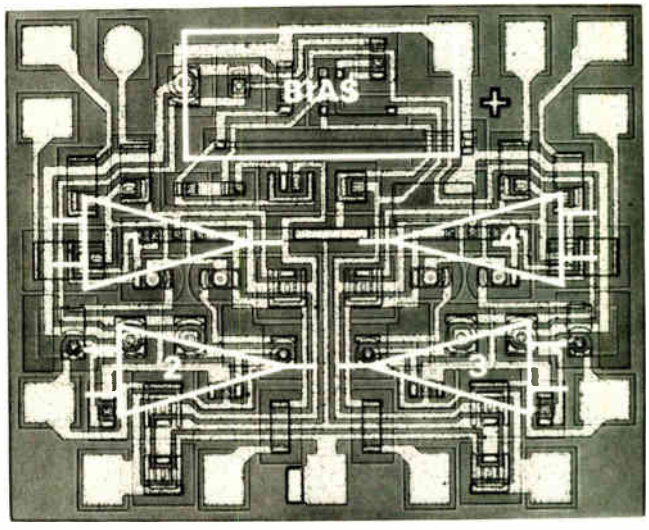


The MC3401P is four internally compensated op amps and the biasing circuitry common to all, on the same chip, assembled into a plastic dual in-line package. It's new. It's available. And it sells for only $1.75 in 100-999 quantities, making it the most economical op amp on the market. MC3401P is the alternative to using more device than necessary, and spending more in the process, in that pesky 20%.

Single-supply operation over a +5.0 V to +18.0 V range, means that digitally oriented systems offer excellent opportuinty for the MC3401 to lower costs further by eliminating the additional power supply previously required for linear functions. Perfect for industrial control systems. Single-supply operation also qualifies the MC3401 as ideal in battery operated systems. Or use it for such ac applications as active filters, multi-channel amplifiers, and oscillators, or as a simple gain block.

It's versatile.

Don't consider it for applications demanding extremely tight gain tolerance or highest gain. It wasn't designed for that, although if you need more gain than a single stage provides, connect two, three, or even all four stages in series for eye-popping increases.

The MC3401P is designed to provide all the performance ever needed at reduced costs in that awkward 20% of the total op amp applications.

That's what it does. That's why we call it the Saver. That's why it's great.

More information is available from Motorola Semiconductor Products Inc., P. O. Box 20912, Phoenix, AZ 85036, and your Motorola distributor has them in stock now.

MOTOROLA LINEAR
— Serving a greater range of analog designs

circuit looks very similar to that of a microstrip circuit—there is a strip conductor over a ground plane, separated from it by a material with a high dielectric constant. The difference: in the microguide circuit, the width of the conductor is larger than that in the microstrip circuit, and a different mode of transmission is employed. Parker explains, "The width of the line is about equal to one-half the wavelength of the signal. The principal transmission mode in microguide is not a quasi-TEM mode as in stripline, but is more like a waveguide-type mode."

TEM. In the TEM (for transverse electric and magnetic) mode, both the electric and magnetic fields are perpendicular to the direction of propagation, and the velocity of the wave is independent of frequency. But in the microguide mode—TE_{10}—there is a magnetic component that is in the direction of propagation, and the wave velocity varies with frequency. Another major difference is that, in the TEM mode, the electric field is uniform across the strip conductor, but in the TE_{10}, the electric field varies from a maximum at one edge to zero in the middle, and back to a maximum.

Parker says, "With the TE_{10} mode, you have a cutoff frequency, and so devices that make good sharp filters can easily be made." This also means that there's a limit to the frequency range. But in cases where this is not desired, the microguide can be coupled to a microstrip circuit that has no cutoff. □

Solid state

Nippon's depletion MOS is fast

Depletion-mode MOS devices are not new, but the payoff in speed is only beginning to be realized. In Japan, a development team at Nippon Electric Co. has made experimental thermal-diffusion circuits that are an order of magnitude faster than MOS circuits for calculators—in fact, the team's shift register has been operated at clock rates topping 30 megahertz. Comparable devices have turned in speeds higher than 10 MHz [*Electronics*, April 24, p. 85].

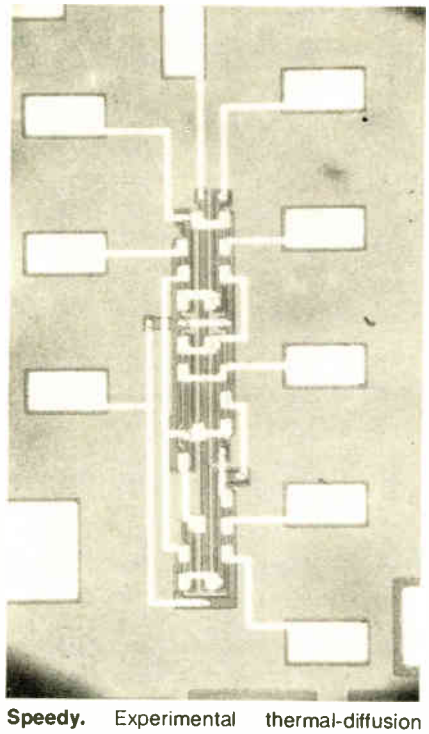
Nippon's work, based on a design developed at the Japanese government's Electrotechnical Laboratory, points up one trend and strengthens a second. The first trend is toward larger and larger TTL and ECL circuits; the second is toward speed. But the drive for higher speed may make continued enlargement of such bipolar circuits difficult, if not impossible, because of heat.

The typical speed-power product for each gate of today's TTL circuits is slightly more than 100 picojoules; for Schottky-barrier TTL and ECL, it is slightly below that. But the number for Nippon's new diffusion self-alignment circuits is on the order of 5 picojoules or less at speeds ranging from those of TTL to ECL.

These favorable characteristics are obtained because the diffusion self-alignment driver transistor has a short effective channel length, dependent only on the difference in depth between two diffusions, and completely independent of mask alignment precision. The channel length is similar to the base width of bipolar transistors, and can be controlled with the same precision. Control of the channel doping level makes it possible to set the exact value of gate threshold voltage.

The devices could be made by ion implantation, says a developer, but this would not eliminate the need for thermal diffusion. Ion implantation would be used to achieve desired surface density of p and n dopants, while thermal diffusion would be used to obtain two different depths of lateral penetration and, thus, with effective channel length equal to that difference.

The inverter transistors in the Nippon devices are similar to Signetics Corp.'s double-diffused MOS transistor that it calls D/MOS [*Electronics*, Feb. 15, 1971, p. 99]. The Yasuo Tarui team that did the spadework for Nippon's version reported in September 1969. □



Speedy. Experimental thermal-diffusion MOS flip-flop by Nippon Electric Co.

Peripherals

Film, laser bump COM chemicals

Eliminating the costly and cumbersome wet-chemical processing required with computer output microfilm equipment is a goal of both COM vendors and users. "It would get us out of the chemical business and leave us in data processing," is the way one user's rep puts it.

Dry film. To this end, Stromberg Datagraphix, San Diego, Calif., has developed an experimental COM unit that relies on a dry-process film exposed by the relatively intense beam from a laser. Once exposed by the beam, the film is developed by heat, rather than with wet chemicals. A laser is needed because the "dry silver" film is less sensitive than the conventional wet-process variety, and only a laser beam is intense enough to impress images on the film. In addition, the laser output can be focused down to the tiny areas required.

In its system, Datagraphix is using a modulated laser recording system developed by Datalight Inc.,

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"Some said: 'let's develop a computer system that will do all the design for us.' Others said: 'only the designer is creative and completely automatic systems would not provide an efficient working design.'

"Then along came Macrodata with the 'FEDIS' MD-170 LSI Design System, backed up by the unique 'CADIS' software packages. Here at last was the first truly original system designed to best utilize the creativity of the designer and the power of the computer. It was the first LSI design system available for outright purchase that offered transient analysis, logic equation simulation, logic equation generation, cross-talk analysis, and nodal analysis with design rule checks.

"Here was a system that could buy you calendar time, reduce your LSI design costs, eliminate subtle errors, and increase yield because you could be sure that your final artwork would be produced exactly as you designed it. The system houses were quick to see the advantage of such a turn-key, in-house capability.

"Here was the breakthrough. No one else offered so much. Now, you could control your own designs and assure yourself of a multiple sourcing capability. Here was a system totally compatible with all methods of artwork generation—both photo optical and rubylith. Here, at last, was the only system with the analysis packages necessary to produce error-free artwork."

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Electronics review

Bloomfield, Conn., a subsidiary of Andersen Laboratories [*Electronics*, Sept. 27, 1971, p. 23]. A low-cost helium-neon laser, with a light output in the 6,328-angstrom red region of the spectrum, is at the system's core. Under control of information stored on magnetic tape, the laser is deflected vertically—with an optoacoustic modulation—to write alphanumerics in dot matrix form on a standard 4-by-6-inch fiche that stores 204 frames. Horizontal deflection is by a mirror. Writing speed is in the range of 60,000 characters a second; size reduction is 42 times, though 48 times appears possible.

The company says that it has a problem with the dry-silver film, developed by 3M Co. Apparently, the film doesn't stabilize completely and continues to darken as it is exposed to heat—for example, from the hot lamp of a microfilm reader. Datagraphix finds this objectionable, although 3M uses the same type of film, exposed by an electron beam, in its COM unit.

Not content to rest on its laser-system laurels, Datagraphix is investigating other methods for eliminating these pesky wet chemicals. One technique involves a brighter Charactron character generator tube with which the company produces alphanumerics in its standard COM line. The tube uses a magnetic, rather than electrostatic, focusing and produces images roughly 10 times as bright as in the conventional tubes. The hope here is that the new dry-process film eventually will be made sensitive enough to be used with this tube. □

Commercial electronics

Premiums: gifts are big business

What's a premium? For many it's free merchandise from a savings bank, or an incentive for work performance, or the famous retirement watch from an employer. But for some electronics companies, premiums are a good source of sales to customers outside the usual distribution sources.

Electronics premiums range all the way from TV sets, stereo equipment, tape recorders, and radios to minicalculators, intercoms, and citizens' band transceivers. They also include some offbeat devices that survive on the basis of premium sales.

Broad. The range of premiums from trinkets to high-quality items was on display at a recent show in New York—several from electronics manufacturers. Big and small companies were on hand to get a share of the $3.8 billion giveaway market.

Few new products were shown, although Japanese companies Sharp and Busicom introduced new models. Sharp showed a portable TV with the new Toshiba Linytron slotted-mask picture tube, while Busicom exhibited a "Sub-mini Handy" calculator measuring 2.5 in. by 4.8 in. by 0.75 in. and featuring an eight-digit light-emitting-diode display.

Among the unusual products was a line of jewelry using holograms mounted on glass. Designed by International Holographics Corp., the holograms are made by McDonnell Douglas. The jewelry must be put under direct incandescent light to bring up the three-dimensional, black-and-white picture. And a novelty firm, the Wizard Works, is selling a Reactometer, billed as a device to measure emotional states. The user places his fingers on two poles from a black box and gets an audio response—it's done with a simple galvanometer that measures moisture in the skin and, in turn, controls the frequency of a beeper.

Also, Tasco Sales Inc. has Japanese-made binoculars with built-in transistorized radios, and Jetco Electronic Industries Inc. introduced a line of solid state metal and mineral finders that use a beat-frequency detector to distinguish between all types of metal objects and various minerals.

Typical of the enthusiasm over the premium market by electronics firms was the reaction of Floyd Devroy, marketing vice president for Triumph (radio headsets) division

of General Time Corp. "This market has made the difference for us this year," he explains. Stanley Glaustein, general manager of Busicom USA Inc., adds, "we were forced into this business, but it's doing so well we have had to add a premium-sales organization." □

For the record

Transpo '72. Sometimes the problem with looking into the future is getting there to take the look, but Transportation Department planners claim that Transpo '72, their all-transportation extravaganza, won't be plagued by the horrendous traffic jams of previous air-only shows at Washington's Dulles Airport. An extensive walkie-talkie network at various control points will allow a traffic control center to open and close access roads quickly to control the 50,000 cars expected daily.

Once inside, visitors will have to walk to get a look at such attractions as airplanes, avionics, cars, and a surface-effect vehicle. Visitors will be able to ride in four personal rapid-transit demonstrations by Dashaveyor, Ford, Rohr, and Transportation Technology Inc., but not to and from the parking lot, nor through the exhibit area.

Industry observers say that even if the show doesn't generate any direct sales, the exposure won't hurt. DOT, which envisions Transpo as part public spectacle and part sales show, expects 1.4 million visitors to see more than 500 exhibits by 300 companies and agencies—many from abroad—during the nine-day run, beginning May 27.

Shuttle passes. The start of the $5.5 billion space shuttle program survived a little flak and flew through safely as Congress approved NASA's $3.4 billion fiscal 1973 budget [*Electronics*, Jan. 31, p. 75]. Included are $540 million to begin the manned Skylab orbital space station and $128.7 million to wind up the Apollo moon-walk program.

Uni-Tote on Broadway. Uni-Tote division of General Instrument Corp., has signed a long-range contract with Broadway Department Stores of California to install point-of-sale registers in each new store as it opens and replace equipment in the 32 existing stores over the next few years. One hundred Uni-Tote Series 300 registers will go into the Northridge, Calif., outlet this fall.

Games TV sets play. Magnavox Co. has developed a system to make television interactive so that viewers can play ping pong, tennis, hockey, and even shoot moving targets by using a TV receiver and a new program box on sale in September.

Due to sell for about $100, Odyssey is a game simulator that hooks up via the antenna poles to any 18-in. screen or larger. A program box comes with 12 game cards and screen overlays and turns an unused TV channel into a CRT display by producing moving squares that represent balls and players or pointers. Control units allow players to move the squares around the screen. Optional "rifles" will be available to "shoot" the display squares.

Besides the basic 12 games to be sold with Odyssey, Magnavox will market seven additional games, including the rifle.

Influence. If there is any doubt about the worldwide interest in microwave technology, two meetings this month should dispel it. Taking place the same week, the meetings dramatize the increase in international participation in the microwave sector.

The first is the IEEE International Microwave Symposium in Chicago May 22-24. There, one out of three technical papers will be presented by authors from outside the U.S. On May 24, the scene shifts to Ottawa where the International Microwave Power Institute will hold its seventh annual three-day symposium. The proportion of papers originating outside the country will be even higher: fully half.

Cores. Ampex Corp., has developed a temperature-independent material for computer core memories. The company calls it the first breakthrough in ferrite material since it introduced 2911 lithium ferrite wide-temperature cores in 1962 to replace earlier magnesium manganese ferrite cores.

The new material consists of a proprietary combination of elements that permits a full operating range of −25°C to +100°C, reports Eugene E. Prince, vice president and general manager of Ampex Computer Products division in Marina del Rey, Calif. Present cores require temperature compensation, and Ampex says that savings as high as 25% in design and manufacturing can result from the use of the new material.

DD-963 deal. Honeywell's Marine Systems Center in West Covina, Calif., has been awarded a $17 million, multiyear contract by Litton Industries for development and production of antisubmarine warfare weapon control system elements for 30 Spruance-class DD-963 destroyers. The initial award, for $11 million, covers the systems for the 16 destroyers funded to date, plus one.

The system, known as the MK 116 Mod 0, will be an integral part of the shipboard electronics being designed, integrated, and tested by Litton's Data Systems division, Van Nuys, Calif. The ships, designed by Litton Ship Systems in Culver City, Calif., will be built in Litton's Pascagoula, Miss., yards. This is Honeywell's second award on the program. The first has a potential value of $36 million. It is for ASW systems engineering and related armament subsystems.

Reward. It appears that the Autonetics division of North American Rockwell has done such a good job with guidance and control sets for the Minuteman III ICBM that it will lose $42 million in orders of spares for the system. But it will get a $2.5-million incentive award to help soften the blow.

Samso, the Air Force Space and Missile Systems Organization in Los Angeles, has announced that the demonstrated reliability of the systems will result in a saving of over $81 million from 1972 to 1975. □

And if you need switches tomorrow, we'll be ready with still another 104,000. A *deluge* of switches. Brought about by demanding perfectionists like you, sir. Design engineers who specify Cherry switches . . . then watch their performance and reliability in application after application. Production men who try high-overtravel Cherry switches . . . and get easier, faster, less expensive installation on the line. Purchasing men who order Cherry switches . . . then get them where they want them, at the right price. With never a worry about delivery. Because tomorrow we'll produce 104,000 more. (Wow!)

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WORLD'S FIRST MONOLITHIC COMPARATOR SUBSYSTEM

Our new μA750 is news: A complete dual comparator subsystem that eliminates up to 17 discrete components other comparators require for equivalent function and drive capability.

Our μA750 is important news for system designers. Because it's a totally self-contained subsystem consisting of two high-current independent comparators on a single chip. Because it eliminates the external components, the board space and virtually all the engineering calculations necessary to make other comparators function safely and reliably in complex control applications. And because it saves money.

The μA750 uniquely provides all these features:

- 125mA per side minimum current handling capability, higher than any other comparator.
- Internal protection against short circuit and thermal overload.
- Subsystem voltage reference.
- Positive switching is assured by built-in hysteresis. (If hysteresis expansion is required for an especially noisy environment, an in-phase comparator output is available.)
- Independent input inhibit.
- Operates from single power supply.

Wide Applications

The μA750 comparator subsystem (instead of a comparator-plus-plenty-of-external-components) can save significant cost and time for the system designer in environmental controls, status indicators with priority override, go-no-go testers, phase meters, minimum frequency detectors. These applications are detailed in a comprehensive Application Note.

The Fairchild Family of Comparators

The Fairchild Comparator family is the largest available. In addition to the μA750, it also includes:

Super High Speed μA760 Differential Comparator with 16ns typical response time. Complementary TTL-compatible and matched t_{pd} outputs. Fanout of 2 TTL gate loads. Designed for use in phase encoding, tape readout systems, this is the most cost-effective, super-fast comparator on the market.

Precision μA734 Voltage Comparator offers maximum resolution through high gain, low input offset current and voltages. Ideal for high-accuracy low-level sensing and measurement in A/D converters and precision level detectors.

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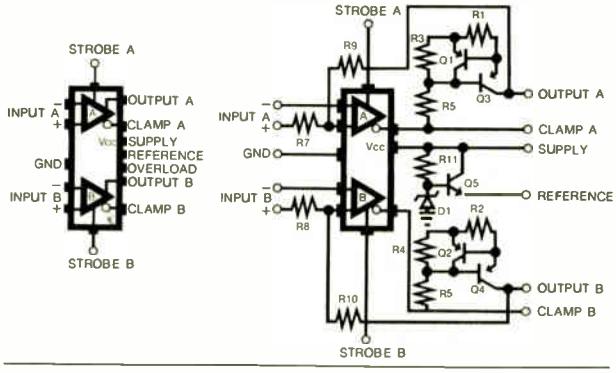

μA750 MONOLITHIC COMPARATOR SUBSYSTEM VS. COMPARATOR-PLUS-COMPONENTS

The best case competitive dual comparator we could find, even with the addition of 17 external components (to provide short circuit protection, hysteresis, high drive current and reference voltage), is still not the equivalent to the μA750 in functional capability or reliability. And, to provide the other comparator with the μA750's current overload indication output and thermal shutdown safety features, it would cost so much more in external components, board space, and design effort, it would be economically unsound.

FAIRCHILD SEMICONDUCTOR, A Division of Fairchild Camera & Instrument Corp., 464 Ellis St., Mountain View, Ca. 94040. (415) 962-5011. TWX: 910-379-6435

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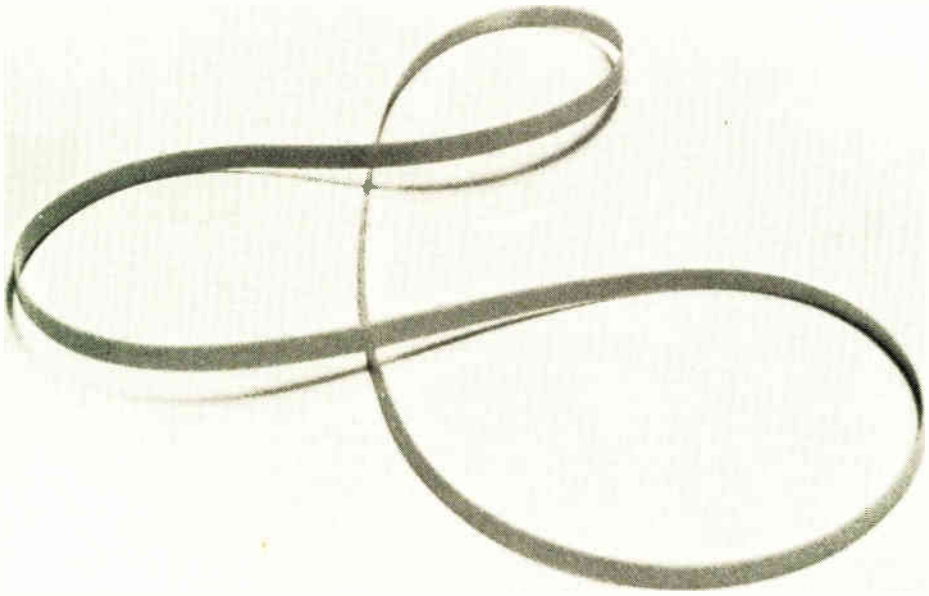
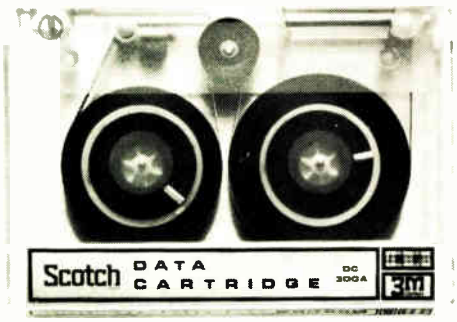
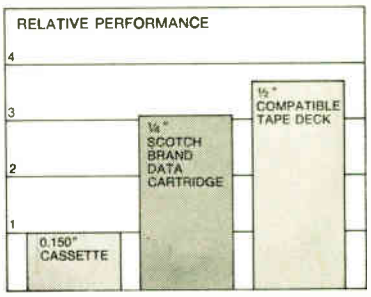


The 3M drive band. A new concept in tape handling.



Based on an entirely different, elegantly simple drive technique, the new ¼" Scotch®Brand Data Cartridge combines reel-to-reel performance with cassette convenience and price. The Data Cartridge functions as its own transport and needs to be driven at only a single point. There are no pressure pads, no pinch rollers, no capstans — tape handling is fast, accurate and precise with *no* external tape guidance.

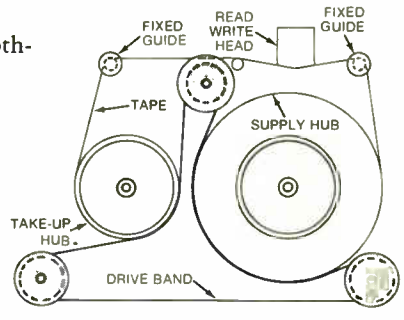


With our new technique, tape is handled — not just driven — in the Data Cartridge. The drive band travels around three tension rollers and is wrapped partially around the tape on both hubs, **making**

n of the paper clip:

"rolling" contact with the tape. Tape wear is extremely low since the tape oxide touches nothing else except the head. Compliance in the band provides controlled tape tension at all times. No machine operation can cinch, spill, stretch or break the tape.

A single external motor powers the drive band through contact with extended hubs on one of the tension rollers. Tape motion is easily controlled by starting, stopping or reversing this motor.



Since no external guidance is required, tape/head alignment is simplified and a variety of head and data configurations may be used with consistently high data reliability.

The end result is low cost digital data storage like nothing you've ever seen before. The Data Cartridge starts and stops within 25 ms at any operating speed, shuttles at up to 180 ips, stores up to 8 times as much data as the 0.150" cassette and has an expected lifetime in excess of 5000 passes.

Add to this a cost comparable to cassettes and only one quarter that of ½" compatible tape decks, and you have a breakthrough in digital tape handling for any application.

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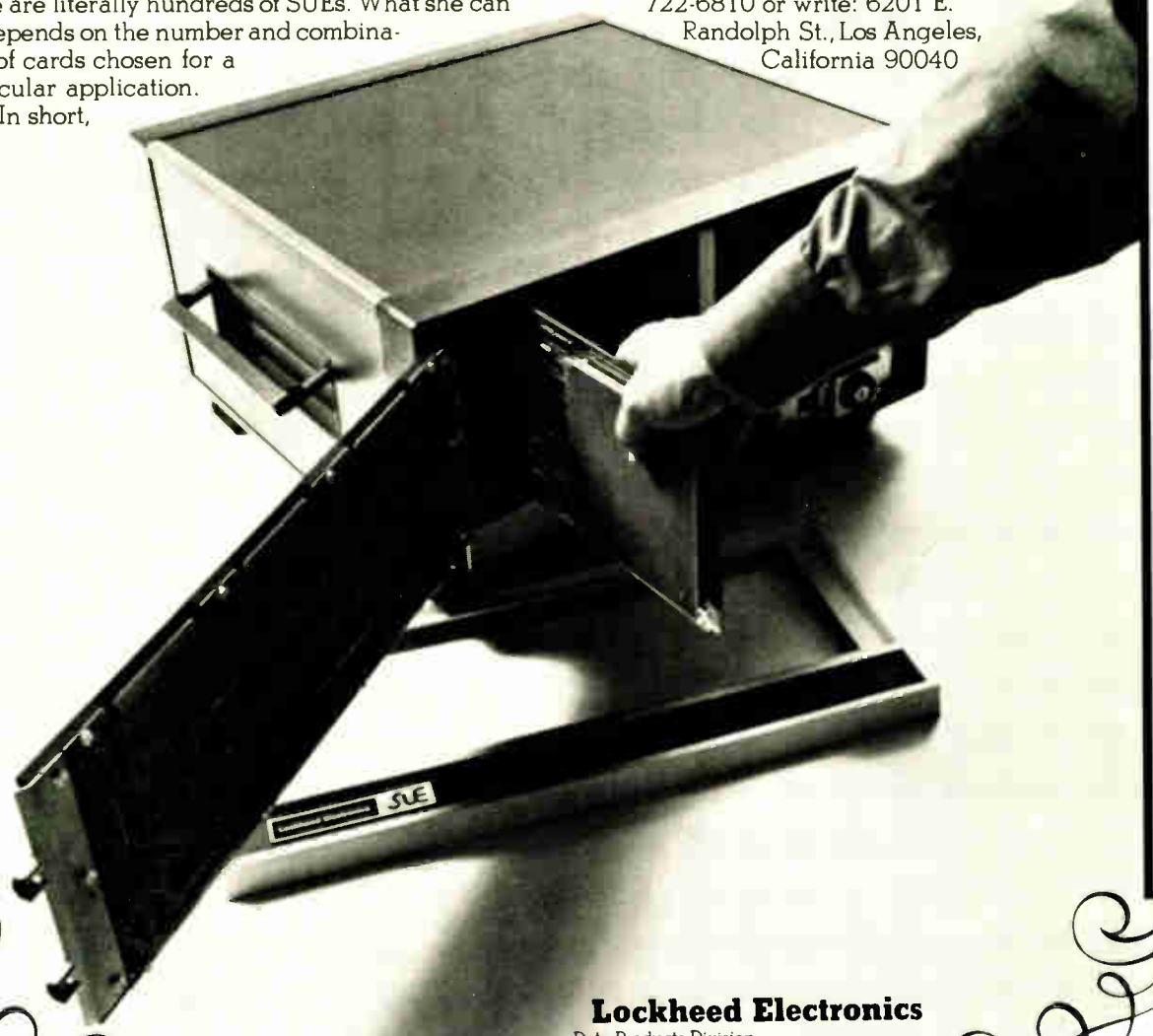

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Washington newsletter

Congress threatens project cuts to counter SEA costs

Defense electronics contractors are jittery and some Air Force and Army project chiefs furious over initial **congressional reactions to Pentagon disclosures that it will need between $1.5 billion and $2 billion in new money to cover increased Indochina war logistics costs.** Senate and some House committee staffers say their members want to counter the requested supplemental appropriation with matching reductions in the fiscal 1973 budget.

Congressional advocates of fiscal countermeasures are reportedly looking to economize on large new programs such as the North American Rockwell B-1 strategic bomber, Boeing's Airborne Warning and Control System, the LightWeight Fighter and A-X programs now entering prototyping, as well as army R&D funds for such projects as new tanks and attack helicopters. Some of these have already been cut back, and **what upsets the Air Force and Army is that much of the cost increase in Southeast Asia is being incurred by naval operations.**

DCA to award contract on speech squeeze

Award of a research contract designed to achieve several breakthroughs in speech predictive voice-compression systems is planned by the Defense Communications Agency, after a return of requests for proposals due in June. Philco-Ford, ITT, and GTE Sylvania are expected to bid for **the study and design of a hardware system that combines high speech compression with commercial voice-quality transmission** and calls for: real-time operation of speech analyzers and synthesizers together; a fixed-point processor; simplified algorithms, and a digital transmission speed of up to 4,800 bits per second. **If successful, the study could lead to the purchase of new equipment by the military.**

Navy doubles funds to expand Caesar

The Naval Electronic Systems Command's heavily classified Project Caesar—a chain of interconnected, upward-looking sonars mounted on the ocean floor that has proved one of the most effective submarine detection systems—has been **renamed Project Outgrowth Caesar, and its funds in the existing budget more than doubled from $42.5 million to $88.9 million** to expand the system. Operated by Navelex's Capt. J.P. Kelley, Outgrowth Caesar will reportedly spend about $10 million of the increase on Pacific Ocean systems, $8.4 million to extend the Atlantic Coast chain into the Caribbean and to expand installations in the Mediterranean, plus **$21 million for long-lead-time procurement items.** Western Electric, Whippany, N.J., manages and heads the Caesar R&D effort, while Control Data Corp. supplies the computers.

Nippon Electric may supply Datran

Nippon Electric Co. reportedly has made **"a most attractive offer" to supply equipment with financing to Data Transmission Co.,** Vienna, Va., for its nationwide switched digital special-service common-carrier network, according to nervous U.S. communications industry sources. Officials at Datran, a University Computing Co. subsidiary **reputedly in need of upwards of $200 million in funds to build its net,** say they are aware of the reports but will not comment further. Disclosure on vendors is expected within a month.

Washington commentary

Some misconceptions of electronics in medicine

Whatever became of the transfer of aerospace and electronics technology that was going to revolutionize the American health care system? It fizzled.

Technology transfer fizzled because technologists in industry and Government approached health care with a combination of misconceptions, insufficient market research, and just plain ignorance of the system's operation, economics, and requirements. This is the conclusion that must be drawn by anyone who listens to Leonard Laster, assistant director of human resources in the White House Office of Science and Technology, and the National Academy of Engineering's Charles Garrett. Both have been tracking technology in medicine from the capital.

Begin at the beginning

Effective transfer of technology cannot be achieved until at least four preconditions are met by industry and medicine, Laster contends. These include:

- Organization of health care services in a way that permits full-time use of equipment such as automated laboratories. U.S. medicine tends to operate as "a cottage industry," says Laster, and it needs to understand that technology is not a means of cost-cutting.
- Development of an "adequate knowledge base" of health care requirements before installation of sophisticated equipment such as automated multiphasic testing systems whose "cost benefits have yet to be determined."
- Rejection of industry efforts to "jump in" and eagerly begin "automating mousetraps when the problem is elephants." The tendency of engineers to automate everything in sight, says Laster, is almost guaranteed to generate unnecessary costs and, as a result, turn medicine men off the potential of electronics.
- Standardization of techniques and equipment maintenance for protection of the patient's health and the practitioner's peace of mind. Generally, hospital maintenance of its electronics leaves much to be desired. Confronting medical professionals, who may have no interest in engineering, with equipment engineered so differently that even plugs and connectors are not standard is certain to discourage increased use of electronics in medicine.

Equipment makers, counsels Laster, should have "someone in the corporation go to the nearest medical organization and establish a working relationship—but not at the Band-Aid level—to find out what is wrong" with individual instruments and their application in the total health care system.

And, like all of those who have gone before, Laster repeats the call for simpler hardware to encourage broader equipment usage.

Where Government failed

At the National Academy of Engineering, Charles Garrett faults the Government's technology transfer effort—and the space agency's in particular—for confusing transfer of information with the transfer of technology. NASA, which Garrett contends has "many solutions looking for problems," has largely failed because "the problems must come to find them." Moreover, organizations with problems get no more than technical information as a possible solution, rather than engineering assistance to implement a solution. Particular solutions offered to a single inquirer, Garrett adds, get no further dissemination throughout the user community. And these are rarely followed up to determine the success or failure of their application, if any.

Garrett's NAE Committee on the Interplay of Health Care and Engineering has found it may be worthwhile "to spend considerable time and considerable money" to achieve real transfer of technology. For example, he found that a group working with NAE on pulmonary care determined that a medical requirement for real-time data on blood gas could be met by combining an aeronautical flow meter with a mass spectrometer. The payoff: immediate readout of blood gases and elimination of the need to send individual blood samples to a lab for analysis.

Why have industries like electronics failed to accelerate the transfer of technology to medicine, education, and other areas of comparable fertility? Garrett contends the reasons lie in industry's inability to readily identify surrounding unresolved legal issues on the use of new equipment, and the competitive cost pressures which put the emphasis on "cash flow and not cash efficiency."

Both Garrett and Laster agree that some of these obstacles can be overcome by having engineers work more closely with medical professionals, particularly hospitals. But they also add that electronic-equipment makers who arm themselves with these solutions are also going to have to push harder to get their systems accepted by a wary medical community. That's the other part of technology transfer. It's called selling.

—Ray Connolly

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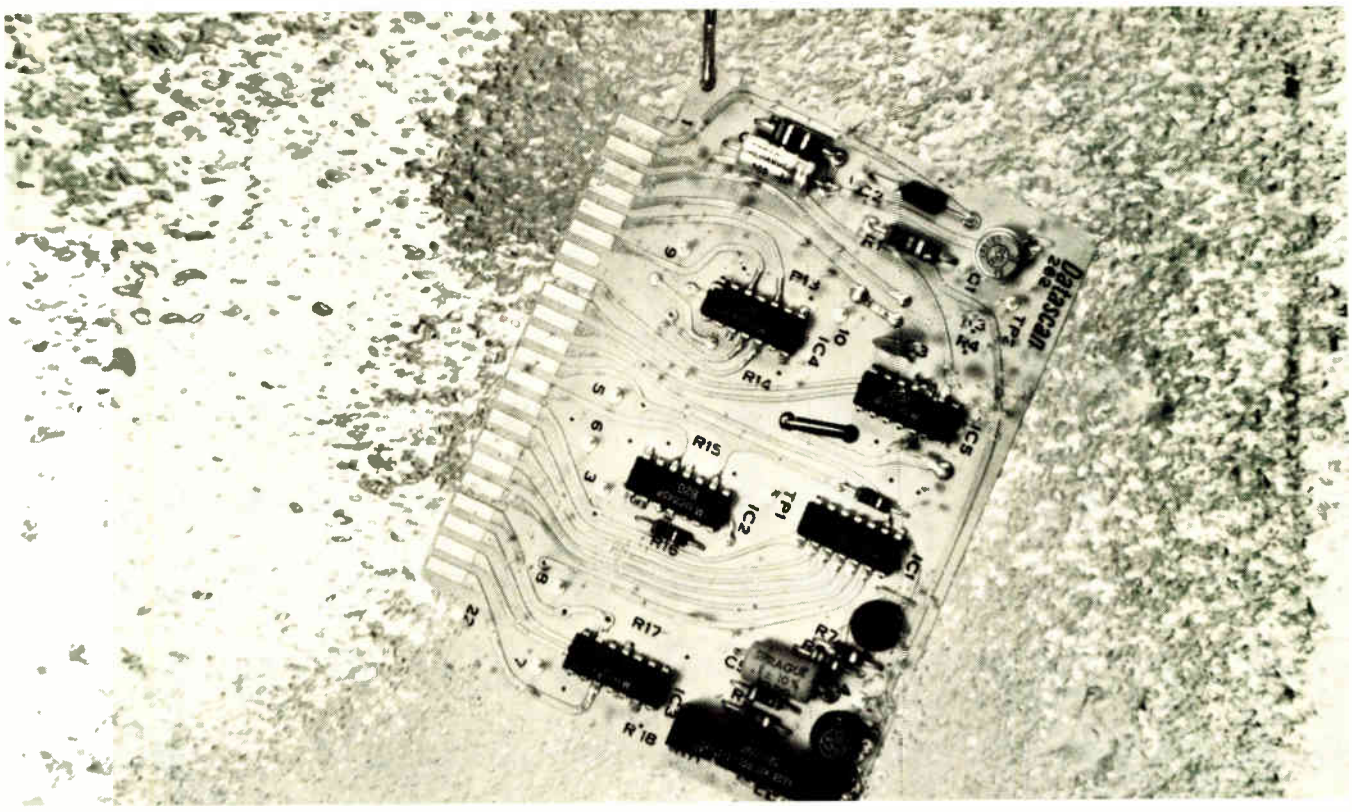

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Low-priced German wire tester uses operator's finger as probe

In test operations, finding the right wire from among the many that come out of a cable harness or a switchboard is a hit-and-miss proposition.

To those who don't want to spend a lot of money for automatic test gear, West Germany's Siemens AG will soon offer a tester to eliminate some of the drudgery.

Handy. The Siemens tester is a manual type. Instead of probes, the human hand is the contact to the wires. (The currents involved are negligibly small, and the measuring voltage is 24 volts dc—a harmless level for a human being.)

A digital display then shows whether or not the proper wire has been touched. The tester can also indicate the designation of any wire in a bundle that the technician probes with his finger.

The tester, manufactured at the company's facilities in Karlsruhe and designated the VD 36, will sell for about $300.

In a typical wiring check, the technician's arm is connected to the tester by way of a high-resistance strap around the wrist. The wires to be checked out are also connected to the tester. A closed circuit is established and indicated on the tester when the operator touches the free end of the wire. □

Great Britain

Advance moves into calculators

Britain has a new calculator manufacturer: Advance Electronics Ltd., a $15 million company best known for medium-priced instruments. At London's Instruments, Electronics, and Automation Exhibition earlier this month, Advance showed the first and smallest model in what by the fall will be a range of six calculators and an adding machine, all based around integrated circuits and featuring reliability.

Advance's approach to reliability has been to use high quality components, where necessary built to Briggs' own specifications, and in some cases with integrated functions, to push down the number of components used. The keys are sealed reed relays built initially by Alma Components Ltd. to an Advance spec. The clock circuitry contains a temperature-compensated multivibrator integrated with other functions as a thick-film hybrid, and the power input is solid-state regulated. The eight-digit-plus-sign readout is a single light-emitting-diode module, which for the larger machines is made with drivers by Fairchild and for the smallest machine with separate drivers by Texas Instruments. □

IR alarm challenges Gunn radars

Though intruder alarm systems based on Gunn-diode doppler radars are now well established, no system builder claims anything like 100% immunity to false alarms.

For one thing, microwave radiation penetrates many wall materials, particularly glass, so that legitimate movement outside the protected area can set off the alarm. And radar units working side by side can drift relative to each other by an amount within the alarm bandwidth—which will set off the alarm if there is mutual interference. The wizardry in the business is building in protection against false triggering, which costs money.

Now Microwave and Electronics Systems Ltd. has introduced a passive infrared alarm system that it claims is basically easier to protect against false triggering. MESL, of Midlothian, Scotland, has been established in the Gunn-diode radar business since its earliest days. In MESL's IR alarm, there's no transmission, so there's no mutual interference. Jim Charters, engineering manager, says radiation on one side of glass or wall material won't get through it in sufficient strength to trigger an alarm on the other side of the barrier.

Limits. However, its range at present is limited to 30 feet, reasonably unobstructed, compared with two or three times that with a Gunn-diode radar, which has few limits on obstruction. Therefore, though an IR unit costs about the same as a microwave unit, it will cost more to cover a given area with IR than with microwave.

Charters believes that eventual development of the IR system will equalize the difference. He adds in its favor that it consumes only 10–15 milliamperes against 200 mA or more for a Gunn diode. And, of course, it's not affected by regulations covering radio-frequency transmissions.

The IR receiver is mounted some 8 feet above ground level. It surveys the area bounded by arcs 120° wide and 45° deep, pointing toward the floor. It does not receive radiation from all this area; the fronting optics are arranged to look at 16 relatively small spots distributed over the area covered. An intruder must cross between the receiver and one of the spots. According to Charters, even if he dressed in asbestos he would still emit sufficient radiation to distinguish him from the background radiation level. □

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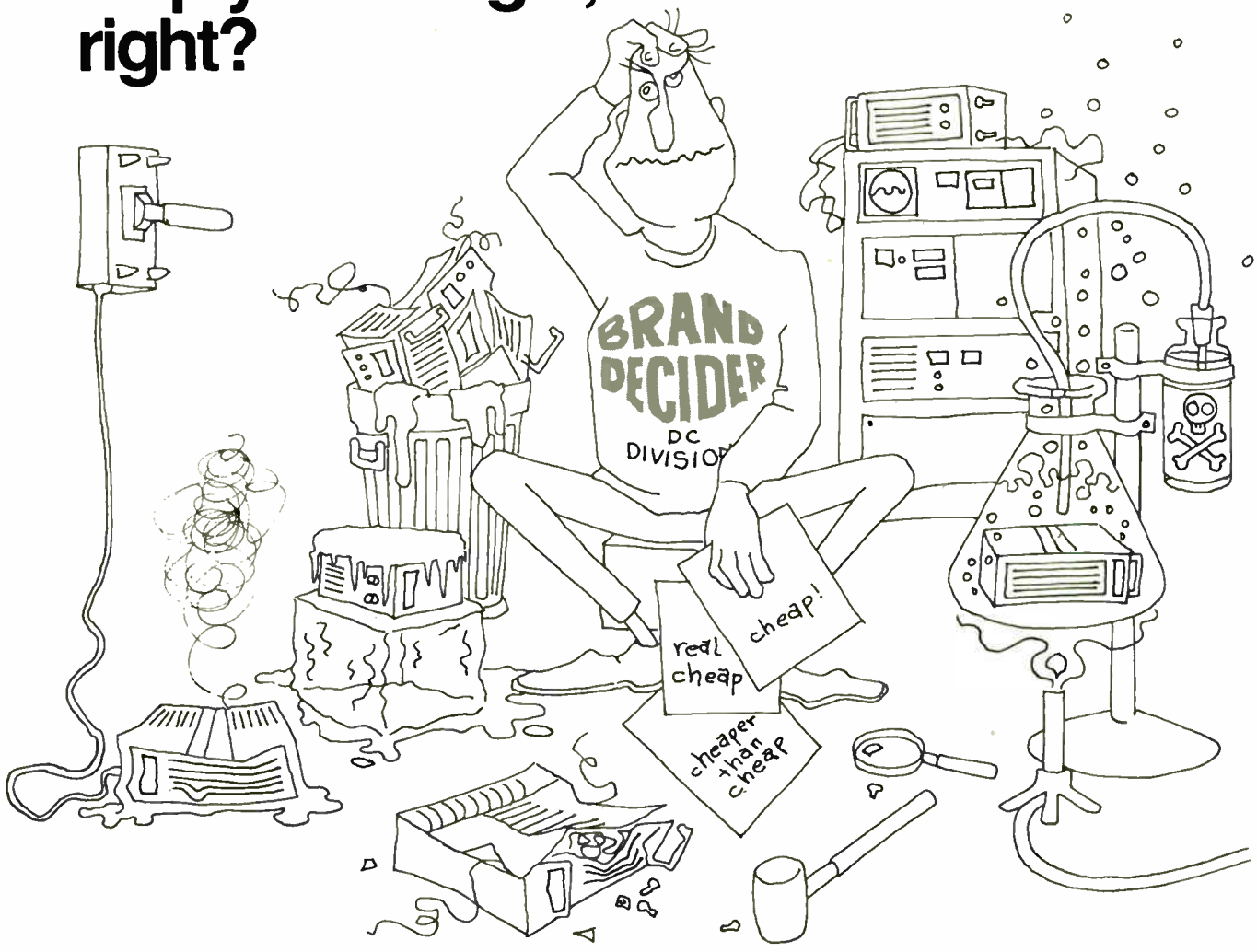

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French first with switched data network

France has moved to the forefront in data transmission in Europe. The country's postal officials this month put into service the Continent's first switched network exclusively reserved for communications between computers and peripherals. **The network, called Caducée, can handle up to 2,000 subscribers.** The four-wire lines in the net can handle transmission speeds of 2,400 or 4,800 bits per second nationwide. In the Paris area, special circuits boost the limit to 72,000 bits per second.

Posts and Telecommunications Ministry officials say that some 50 subscribers had signed up before Caducée went into service. **By year-end, they figure, the number will rise to 150. The total number of subscribers should match the network's capacity of 2,000 by 1975.** Caducée uses modified crossbar-exchange equipment, and the ministry sees it as the forerunner to an electronically switched data-transmission network that should be ready in 1977-1978. The upcoming network, Hermes, will cover a transmission-speed range from 50 bits per second to 2 megabits per second.

Ferranti sells IC know-how to Poland

The embargo on the sale of integrated circuits to Communist countries is being eased by the top-secret Cocom committee, the Paris-based trade supervision group that restricts the export of Western and Japanese technology to the Communist world. Cocom decided this month to allow Britain's Ferranti Ltd. to conclude a major contract for the sale of IC know-how to Poland. But neither Cocom nor Ferranti would spell out details or specify how advanced are the ICs involved.

Sources close to Cocom say the Ferranti deal will be treated as a precedent permitting other IC makers to enter into similar deals with Communist clients. Cocom is known to have other requests pending for export licenses for products using ICs, including some projects from the French Thomson group. The Thomson request, reportedly, was in competition with Ferranti for the Polish contract, but Thomson is not complaining publicly.

French-Russian joint space effort pays off

Franco-Soviet space cooperation is advancing in "exemplary fashion," say the French, after the successful launching last month of SRET-1 [*Electronics*, Electronics International, Jan. 31], the first foreign satellite ever launched by the Russians. The French space agency CNES, just south of Paris, is monitoring SRET's signals but says not enough data has been accumulated yet to judge the durability of the cadmium sulfide and cadmium telluride thin-film solar cells that are being tested in the experiment.

CNES officials are greatly relieved, however, to see that the solar cells are functioning at all. The Russians kept the French satellite in storage nearly 10 months before launching it, prompting fears that the cells might have deteriorated beyond use. But the word now is that "signals are coming in strong, and we're delighted."

Meanwhile, the procedure for organizing the electronic interface for the piggyback launch of SRET-1 is being followed again as CNES technicians work out details for the next joint venture into space—SRET-2, scheduled for early 1974. SRET-2 will test thermal and radi-

ation shielding devices for eventual use on the European satellite in the Meteosat series, due for launch in 1975 or 1976.

ICL tests Energy Conversion glass memory

At the research laboratories of International Computers Ltd., an experimental read-mostly store built from glass devices provided by Energy Conversion Devices is undergoing tests. It uses 12 40-lead dual in-line Ovshinsky packs, each containing a 16-by-16-device array, giving 256 words of 12 bits. ICL engineers say that by using TTL for most of the driving they get a read cycle time per word of 400 nanoseconds, a read access time of 350 nanoseconds, and a word write time between 30 milliseconds and 360 milliseconds depending on how many bits are changed. It rewrites on-line. **In two months' testing it has given 10^{12} reads on the whole store without error,** 10^{11} reads on one word without error, and the arrays tested have met Energy Conversion's claim of 600 write cycles without failure. Steady power consumption is 3 amperes at 5 volts, plus 1 A at 30 V while writing.

West German R&D spending to rise 12%

A hefty boost in government expenditures is in store for West German activities in various fields of research and development. **In its budget for 1972, Bonn's Ministry for Science and Education has earmarked close to $1 billion for such activities, roughly 12% more than last year's funding.** Expenditures for aerospace research are due for a 20% rise, to about $200 million. Of this amount nearly $70 million will be for research satellites and space probes, $30 million for the Franco-German communications satellite Symphonie, and $23 million for the German-American sun probe Helios. Contributions to international space organizations will amount to $65 million. Data processing is in for an even bigger increase than aerospace activities—40% over last year to nearly $100 million for 1972. Of this two-thirds will be for R&D alone.

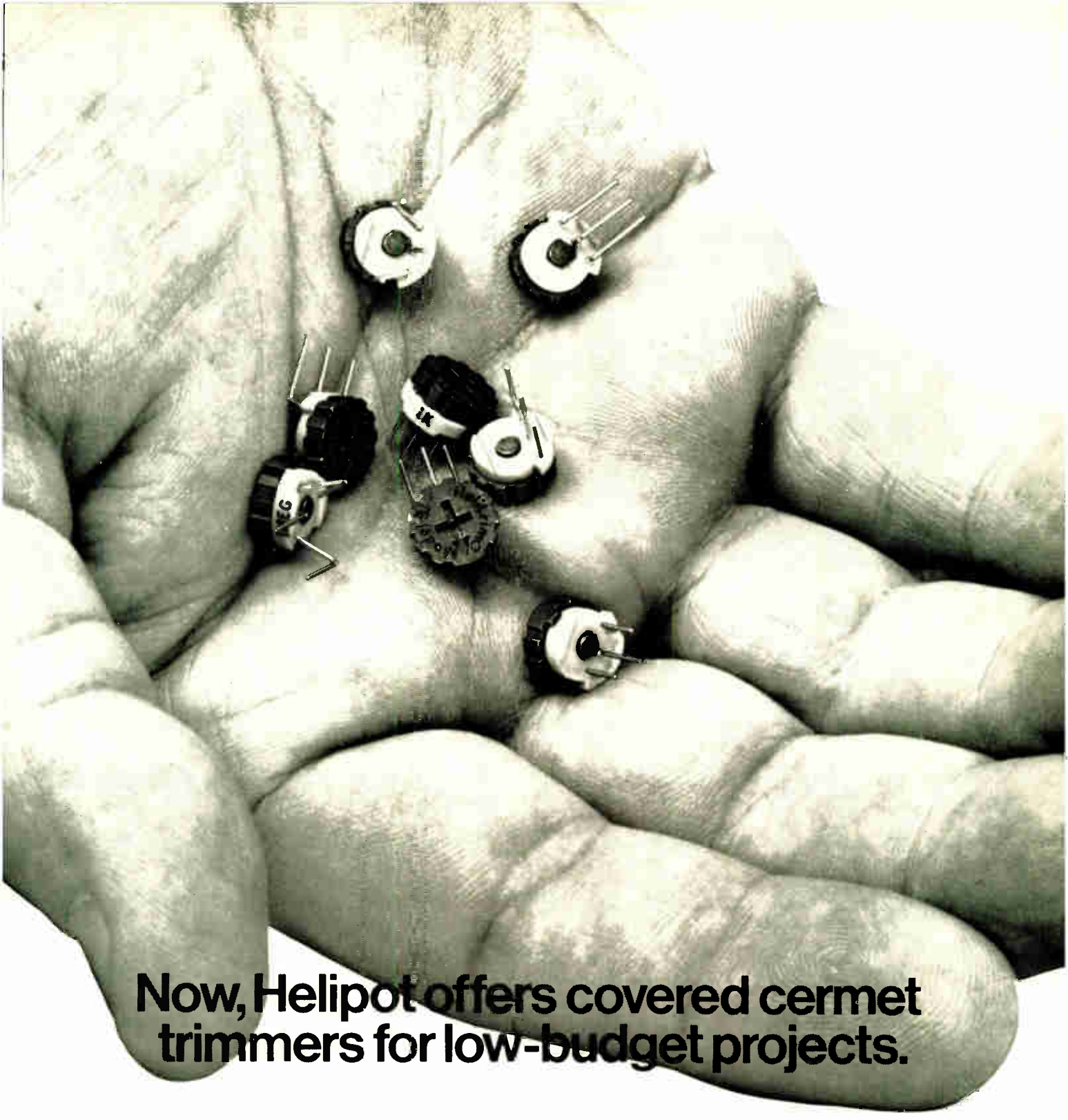
IBM, Leasco get computer help from BOAC

British Overseas Airways Corp. will cooperate—separately—with IBM and with Leasco to push sales of computer systems to airlines. IBM will offer BOAC's software pack for fare quotation and ticketing, now nearly complete, to its hardware customers rather than develop its own. Leasco will offer BOAC's reservations systems software to its customers; in return BOAC will quote Leasco terms for second-hand or leased IBM hardware to BOAC customers. BOAC has two proven reservation systems, one large and one small, both tailored to IBM hardware.

The Leasco deal is aimed particularly at smaller airlines not willing to buy from IBM direct. BOAC is also talking with Raytheon and Incoterm about similar deals with displays made by U. S. companies.

Russia buys reed contact production line

Winning out over heavy competition from U. S., Japanese, and European firms, a small West German company, Willy Guenther KG, has landed a contract for the delivery to the Soviet Union of a complete automated production line for reed contacts. The $2 million deal, signed with the Russian foreign trade organization Technopromimport in Moscow, **includes the installation of manufacturing and test equipment, as well as the supply of the production know-how required.** Participating is a British firm, Badalex Ltd., which will supply test gear.



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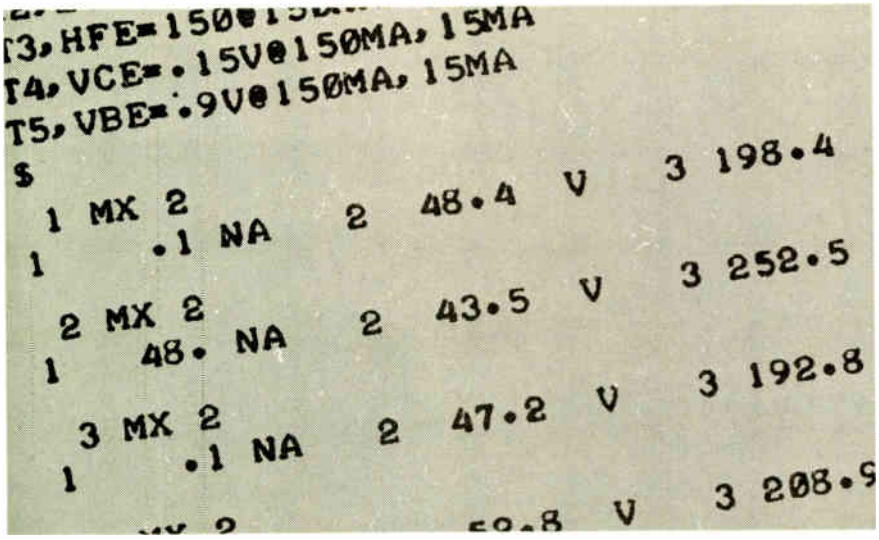

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TERADYNE

A case for new watchmakers

Watch manufacturers are already getting competition from electronics companies who may find it as easy to make the watch as the components

by Marilyn Offenheiser, Assistant Editor

It may be time for electronic component suppliers to move into the nascent electronic watch industry. One company is already committed to the step, and others—on the assumption that it's just as easy and more profitable to make the whole watch as it is the components that go into it—are likely to follow.

What makes the prospect tempting is the future market for electronic watches—projected at 100 million timepieces by 1980, with the largest share going to the United States. Conventional watchmakers, however, are firmly convinced that their electronics suppliers are doomed to failure for lack of marketing know-how in the jewelry field. Industry sources insist that it's not performance that sells watches, but the case and styling—a capability that electronics firms don't have.

The impetus for the systems approach to electronic watches has been development of the watch "kit"—a module containing the quartz crystal, integrated circuitry, and, in some cases, the display—liquid crystal or light-emitting diode.

Microma Universal Inc., Mountain View., Calif., is prepared to drop its kit into its own case. Other companies making kits—and therefore potential watchmakers— include Motorola Inc., Phoenix, Ariz., and Optel Corp., Princeton, N. J. Companies supplying individual components include Intersil, Inc., Cupertino, Calif.; Hughes Microelectronic Products division, Newport Beach, Calif.; RCA Semiconductor division, Somerville, N. J.; Texas Instruments, Dallas, and Micro Power Systems Inc., Santa Clara, Calif.

Microma is outspoken about its role in the electronic watch game. The company is marketing circuits and modules; it is even selling modules in a case to Sears Roebuck & Co. and various discount chains across the U.S. Microma's marketing manager, Donald Rogers, says, "We are working with several Swiss and American companies now on a plan whereby we will eventually sell directly to retailers."

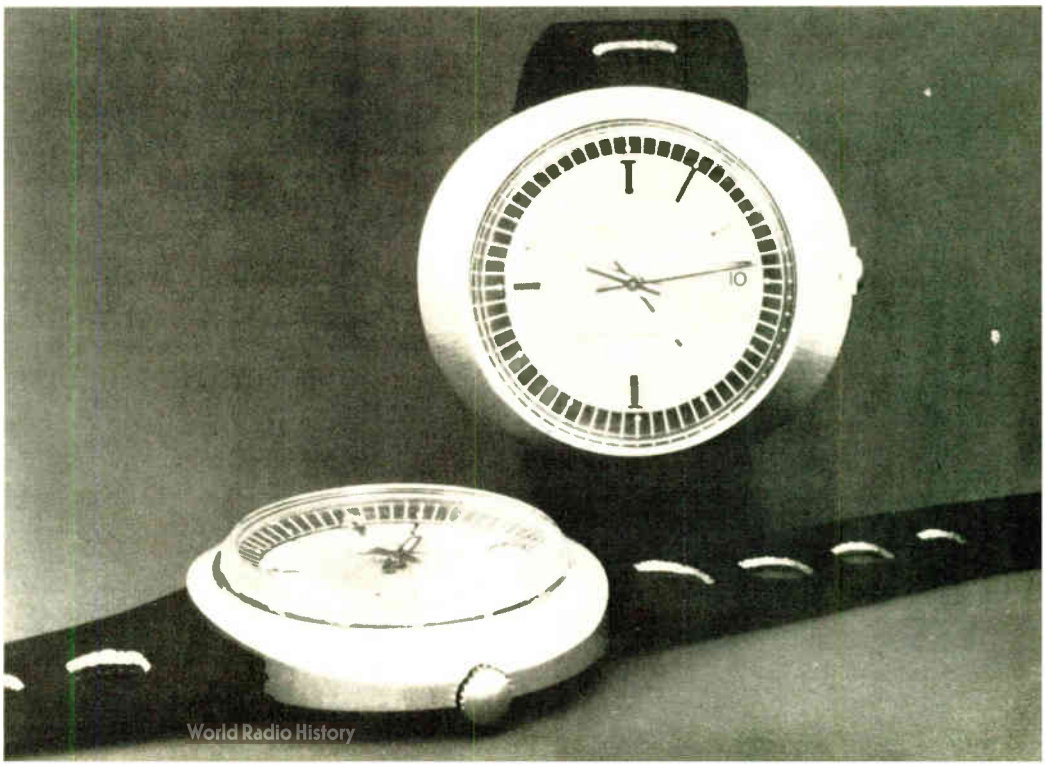
"The word is around that Motorola has lost a lot of contracts," says an industry insider, "because watch people are afraid they'll go into the business at any moment." Motorola provides a kit that includes complementary metal-oxide-semiconductor circuitry, a stepper motor, and a quartz crystal.

But Charles T. Johnson, world marketing manager of the quartz electronic timepiece program, insists that Motorola's role is that of component manufacturer: "I can see where some people may have thought we would become watchmakers, because in the beginning of the project, we made studies to that effect, but we decided not to do so."

Optel, which also supplies kits, is already committed to a second generation of electronic liquid-crystal watches. The company's next step will be to mount the entire electronic package on the display substrate. The company says this will allow the production of watches retailing for under $100.

Intersil, reputed to be the largest supplier of electronic watch components is supplying Japan's Seiko Watch Co. The company does not yet make a kit, but has plans to do so in about a year. David Bingham,

Timely developments. Quartz watch is from Microma Universal, a watch components supplier now manufacturing its own timepiece. A liquid crystal display is also available.



manager of Intersil's micropower products, acknowledges, however, that "many watch companies are not interested in kits. They want a bit of action for themselves." And at RCA, COS/MOS marketing manager Andrew Bosso says the company has "no plans to be anything other than a component supplier."

TI supplies liquid crystal displays and bipolar drivers for Switzerland's Ebauches S.A. watch movement. The whole package will be marketed in the Swissonic, a Longines electronic watch [*Electronics*, April 24, p. 42], but TI may follow the same path the company took in the calculator market. TI had been manufacturing calculator chips for some time before deciding to make the calculators now being test-marketed. About watches a spokesman says, "TI has no plans to manufacture or market watches at this time, but we are continuing to review this option."

Watchmakers' rebuttal. Reaction from the recipients of the components and kits—the watch manufacturers—is unanimous: "They can't do it." General Time Corp., Mesa, Ariz., for one, expects the trend toward kits to continue, but the company will do most of the assembly.

Dale Koehler, manager of the advanced research laboratory at Bulova Watch Co, New York, says, "The kits satisfy the needs of certain manufacturers. The watch industry has always been divided among those who build the watch from the ground up, those who start further along the line, and those who are, in effect, just packagers." Adds Bulova's director of marketing, James Brown, "there's no reason electronics suppliers couldn't go into the business if they want to put the time and money into it. But these electronics companies would have to develop a whole new marketing technique, and they don't understand the needs of the consumer."

Hamilton Watch Co.'s John Bergey, director of watch development at the Lancaster, Pa., headquarters, says, "Those electronics companies that became calculator manufacturers probably regret it now. Electronics firms don't understand they are no longer selling technology; they are selling to the consumer, and they don't have the expertise to understand the whims of styling."

WHAT'S WHAT IN ELECTRONIC WATCHES

Company	Supplier	Circuit	Display	Price
Benrus (U. S.)	Undisclosed	C/MOS	Conventional	To be announced next month
Bulova (U. S.)	Intersil	C/MOS	Conventional	$250 – $1,200
General Time (U. S.)	RCA	C/MOS	Conventional and digital	To be announced in the fall
Hamilton (U. S.)	RCA, Amperex	C/MOS	LED	$2,100
Microma Universal (U.S.)	In-house, Motorola	C/MOS	Liquid crystal	To be announced
Timex (U. S.)	Hughes, RCA	C/MOS	Conventional	$125
Ébauches/Longines (Switzerland)	TI	Bipolar	Liquid crystal	$300
Girard Perregaux (Switzerland)	Motorola	C/MOS	Conventional	$250
Omega (Switzerland)	Eurosil, Intersil, Optel, ITT	C/MOS	Liquid crystal	$185
Waltham (Switzerland)	Optel	C/MOS	Liquid crystal	$185
Smith's Industries Ltd. (U.K.)	In-house	C/MOS	Conventional	Developmental
Seiko (Japan)	Intersil	C/MOS	Conventional	$400 – $600

And Victor Kiam, president of Benrus Corp., New York, puts forth another point: "Over 50% of all watch sales occur between November 15th and Christmas. That makes the watch business a financing business, too. The main thing is that the watch is jewelry, and the channels of distribution are much different."

Timex Corp., New York, the largest U.S. watch manufacturer, echoes the same opinions. Says a company spokesman, "Technologically, there is no barrier. However these companies will face a major marketing problem." Timex manufactures and assembles its watches—except for the circuitry and quartz crystal. It also maintains an extensive research and development facility.

Shakeout in technology. A problem that both suppliers and watchmakers have to face together is settling on a viable technology. The competition is between C/MOS and bipolar for the driver circuitry, while the three competing displays are conventional hands, liquid crystals, and LEDs. With the exception of TI and Microma Universal, electronics firms have elected to use C/MOS circuitry to drive the electronic watches because it meets the power requirements of quartz crystals and digital displays most efficiently. Microma uses bipolar to drive conventional displays with quartz crystals and C/MOS for the all-solid-state watch. The company will eventually switch to all-C/MOS, according to marketing man Rogers.

Running counter to this trend is TI, which supplies bipolar circuitry for the jointly developed Ebauches/Longines watch. Ronald Johns, product manager for bipolar custom products says TI "accomplished two times as much on two chips as C/MOS people have. C/MOS still has a problem with threshold overlap. We feel that with clever design we can get lower power out of bipolar, and bipolar could reduce costs by allowing integration of all the elements on a single chip."

Many companies are sticking with the conventional face-and-hands display, but some have gone to liquid crystals, and Hamilton has opted for light-emitting diodes. However, Hamilton, the marketing arm of Electro/Data, Garland, Texas, expects eventually to come out with a liquid-crystal timepiece. The reason for changing is that LEDs consume too much power for continuous operation, and the wearer must push a button to show time.

Other watch companies plan to switch soon from conventional displays to liquid crystals. Among them, Bulova's Koehler says, "We began the electronic watch program when liquid crystals were not available, and the cost of LEDs was prohibitive." Timex, now using a conventional display, is "busily working on liquid crystals." The company says that after more reliability and readability tests are run, it will be ready to introduce a solid-state display—perhaps in a year.

Motorola plans production of

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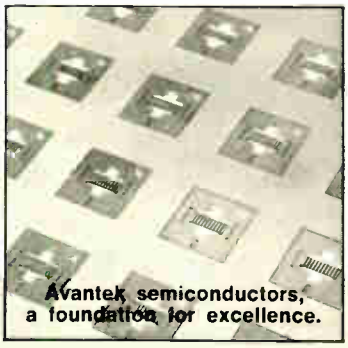

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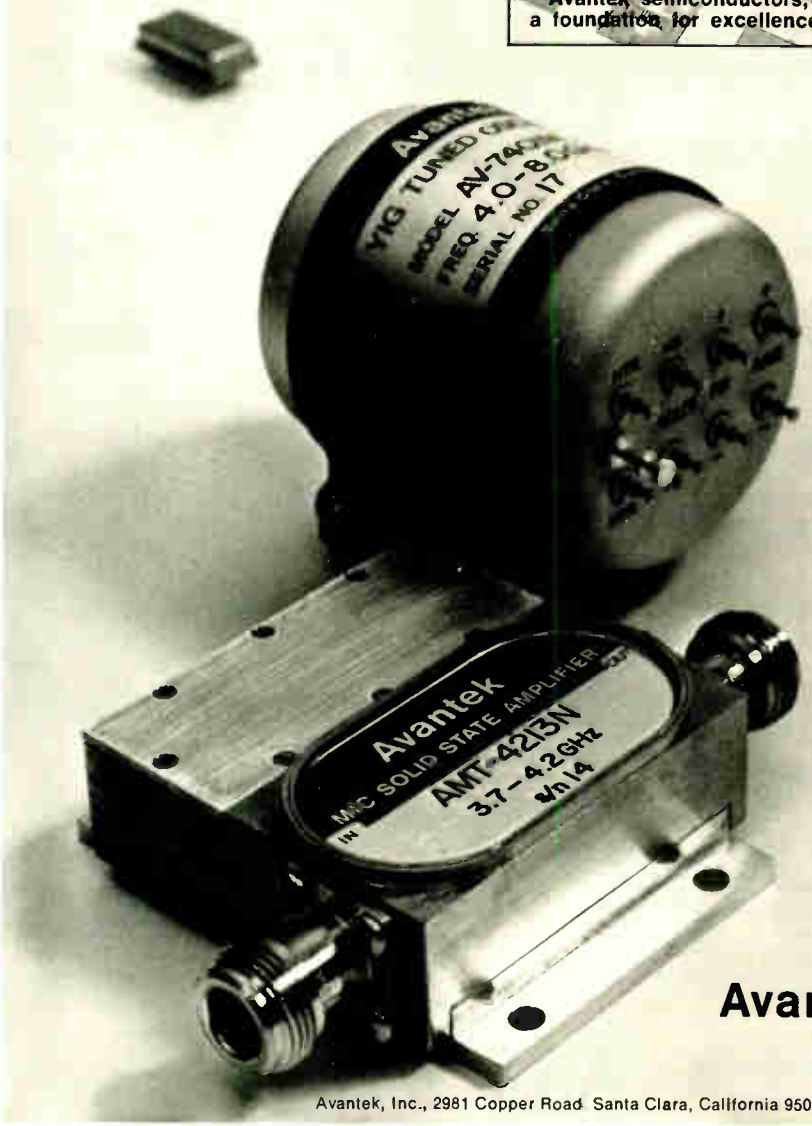

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Probing the news

liquid crystals by the beginning of 1973, starting first with a four-digit display and then moving to an eight-digit unit. "We're not ready yet, though," says Johnson. "I noticed at the Basel Fair that none of the liquid-crystal displays there worked perfectly; so there are still problems."

In the United Kingdom, ITT Components Group is developing a liquid-crystal package, and so is Smith's Industries Ltd., for in-house use. In Germany, Eurosil, an independent subsidiary of Intersil, is also working with liquid crystals and LEDs. And in Japan, Hitachi is vying with Oki Electric Industry Co. Ltd. and Tokyo Shibura Electric Co. Ltd. to second-source Intersil, supplier of Seiko watch circuits.

The main problem with liquid crystals is that they have a life expectancy of about five years only. Waltham, among others, claims that the display is easy to replace. Some suppliers have packaged the components together in a module, making the parts useless when the display expires and replacement expensive. Meanwhile, the industry is banking on inexpensive displays when the time comes.

Presently, 44% of world watch production is Swiss, 11.8% Japanese, and about 13% is Russian; until now the total United States percentage has been 11%. Of the U.S. share, 47% is owned by Timex. Timex estimates that it controls about 80% of the battery-powered watch business in the U.S., but admits that the market is difficult to measure.

Motorola's Johnson thinks that "the electronic watch market is up for grabs." The Swiss are trying to maintain their lead through the consortium, Centre Electronique Horloger. But U.S. watchmakers and electronics companies feel that the U.S. will be the future leader in the watch market, a view that prompted one industry insider to say: "It'll be goodbye, Switzerland and hello America."

But a wary note was struck by a spokesman: "Don't underestimate the Japanese. There's talk that Seiko has been buying up circuits like they're going out of style." □

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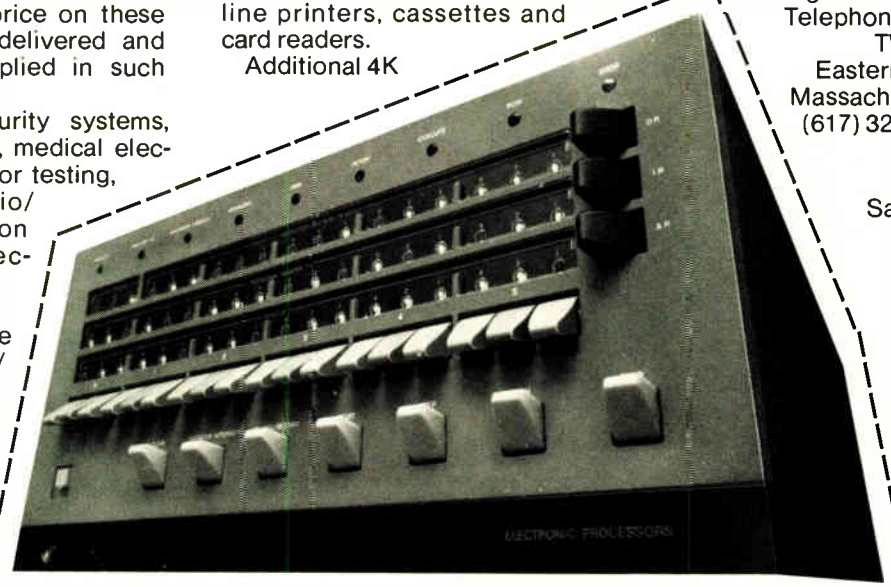

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Memories

Cores fight back

Competition with each other and the semiconductor suppliers will keep core manufacturers on top of the memory market for a few more years

by Paul Franson, Los Angeles bureau manager

Despite all the prophecies of victory by semiconductor memory makers, the core manufacturers are not surrendering their hold on a huge majority of the computer mainframe market. They're cutting costs with better packaging and production schemes, with improved core materials, and with aggressive entries into such new markets as end-user enhanced memories. Paradoxically, semiconductor houses have contributed to lower core system costs because the price of devices like sense amplifiers and drivers also continues to drop.

Compared with a few years ago, the core industry is being eminently successful at lowering prices. Then, cores were about 5 cents per bit. Today, they're closer to 1 cent per bit for main core systems of 8,000 words by 18 bits, running at about 600 to 900 ns and selling in 1,000 quantities or more, says Victor Sell, senior core product manager at Ampex Computer Products division, Marina Del Rey, Calif.

However, a direct comparison of this figure with semiconductor memory prices is difficult, because semiconductor manufacturers usually specify the price per part, not per bit. For instance, the widely discussed Intel 1103 1,024-bit silicon-gate MOS random-access array can be bought for about $5, or about ½ cent per bit. But it's estimated that the other electronics, printed-circuit board, etc., will double that cost.

Narrowing profit margins. But core makers, striving to hold onto their share of the market by driving down prices, are flirting with unprofitability. Ralph Gabai, marketing manager for Data Storage Products at Lockheed Electronics Co.'s Data Products division, which supplies a lot of OEM and end-user core memories, says such pricing practices "make it look as if some semiconductors and some core companies are in a race to see who can lose the most money the fastest."

Gabai adds, however, that the Los Angeles-based Lockheed division has been profitable since 1965. Ampex Corp. and Electronic Memories & Magnetics Corp. also claim to have profitable core groups, but all three have suffered severe financial problems on the corporate level, making it difficult to envision what effect the money pinch might have on core operations.

If you can't beat 'em. . . They are also hedging their bets. Ampex bought part of Varadyne Corp.'s former semiconductor operation, and Electronic Memories & Magnetics, Hawthorne, Calif., invested heavily in Semiconductor Electronic Memories Inc., Phoenix, Ariz., and then bought the remains of the company after it went bankrupt.

Back of the price war are some significant advances in technology. There's general agreement that the biggest single change has been adoption of the planar stack over the past year and a half. This change, with the accompanying reduction of core sizes to the current 18-mil standard, plus much higher densities, means that an entire 8,000-word-by-18-bit or even larger memory can be put on a single 8-by-11-inch circuit board, whereas it previously would have been constructed of a stack of 18 circuit boards with many more wires and connections. Gabai says this gives a better than three-to-one improvement in labor and manufacturing cost, plus a reduction in testing.

The reduced length of drive wires pays off in simpler and cheaper drive circuitry, too, since less energy is required. It's largely to this that Philip Harding, director of commercial marketing at EM&M's Electronic Memories division, attributes the order of magnitude savings in power of the newly introduced EM Micro 6000 memory.

The reduced core size also means greater speeds, and core makers feel that the present 600-ns cycle-time systems could even now be up-

Beating the heat in cores

Temperature contributes significantly to the cost of core memories by restricting density to hold down heat dissipation and by requiring compensating networks to change core sensing levels or turn on blowers as temperatures change. A remedy to this is Ampex Corp.'s new temperature-independent core material. The material permits operation from −25 to + 100°C without temperature compensation. Victor Sell, senior core product manager at the Computer Products division, says, "Temperature-independent materials will permit savings up to 25% in the design and manufacture of core components. We believe this material will replace temperature-sensitive cores as the industry standard. With temperature-independent cores, you can forget that temperature exists; it's as important to cores as if a semiconductor maker said 'forget about dissipation!' "

graded to about 500 ns. But, as Harding says, "though we can get to greater speeds, the industry doesn't seem to need them." Lockheed's Gabai adds, "We can probably get to the 300-to-400-ns range in a few years, but the semiconductor price should be below anything we can envision by then."

Another price reduction has come from the elimination of one wire through the cores. Standard now is the three-wire system rather than the earlier four. As it is, stringing three wires through 18-mil cores is near the limit—the sense wire goes through up to 16,000 cores in one unbroken length—and if there is a movement to cores in the 14-mil range, it will likely be with a two-wire system. One advantage of the two-wire system is that it makes automation feasible. Univac is already using automatic stringing of two-wire systems, and IBM strings two automatically and wires one by hand.

Taping the process. The major memory manufacturers make their own cores, and have attempted to hold down costs. Lockheed has developed a method of stamping out cores from a tape rather than using molds. The core material is suspended in a thin plastic slurry, which hardens as a large flexible sheet. The sheet is cut into strips about an inch across, which are then fastened together into a long tape, and the cores punched out like donuts in automatic equipment.

The fact that semiconductors account for much of the savings in modern core memories is surely little comfort to the semiconductor companies who are trying to displace them. Gabai says, "They've had a dramatic effect. Component prices have dropped dramatically in the past few years. And the increased integration has permitted lower labor costs." In fact, Lockheed's newest memory, the CC-150 (see p.141) uses low-drive cores that permit integration of virtually all components.

Partly as a result of all these advances, the presently available 1,024-bit semiconductor memories such as the Intel 1103 and Mostek Corp.'s 4006, are hardly a threat in the mainframe market. Such diverse people as Gabai of Lockheed and Berry Cash, marketing manager of Mostek, Carrollton, Texas, feel that the 4,096-bit memories that will appear later this year are the real enemy, with the major impact coming in 1974. Mostek's entry in this fight—an n-channel, single transistor-cell RAM using a unique process—will appear in prototype form in late summer, with production by the end of the year. Intel's 4096-bit RAM appears to be on a similar course.

Richard J. Egan, marketing vice president of Cambridge Memories, Inc., Newton, Mass., grants that in smaller memories the two types are probably equivalent in price now, but in mainframes price equality is a couple of years away. As for speed, he feels that cores can never catch up with bipolar memories, "but many cores are faster than MOS memories." Comparative density depends on application, Egan thinks, and he hesitates to make generalizations about it.

But cores have another big advantage: the fact that they are magnetic. Semiconductors, says Egan, have to be continually refreshed. In comparing them, "you have to consider volatility, power, and in some cases, size," he points out.

At Fabri-Tek Inc., Minneapolis, Minn., Jerry Larsen, national sales manager for OEM products, sees the semiconductor impact only in small, fast buffer memories. But core memories are going to get still faster, he says, with the introduction by Fabri-Tek as well as others of small 14-mil-diameter cores. These are available from the company only in sample quantities so far.

In fact, the near future holds the promise of greatly increased volume in the core industry, particularly for add-on memories and virtual replacement for moving memories in many applications. Ampex, for example, has doubled its core output every year since 1968, and if major adoption of core by telecommunications companies comes, the volume will be staggering.

And core prices continue to drop sharply—Harding of EM&M says the rate has been 20% per year, "and I think it will continue." But the core companies will continue to use their ingenuity to compete for the market they now control. □

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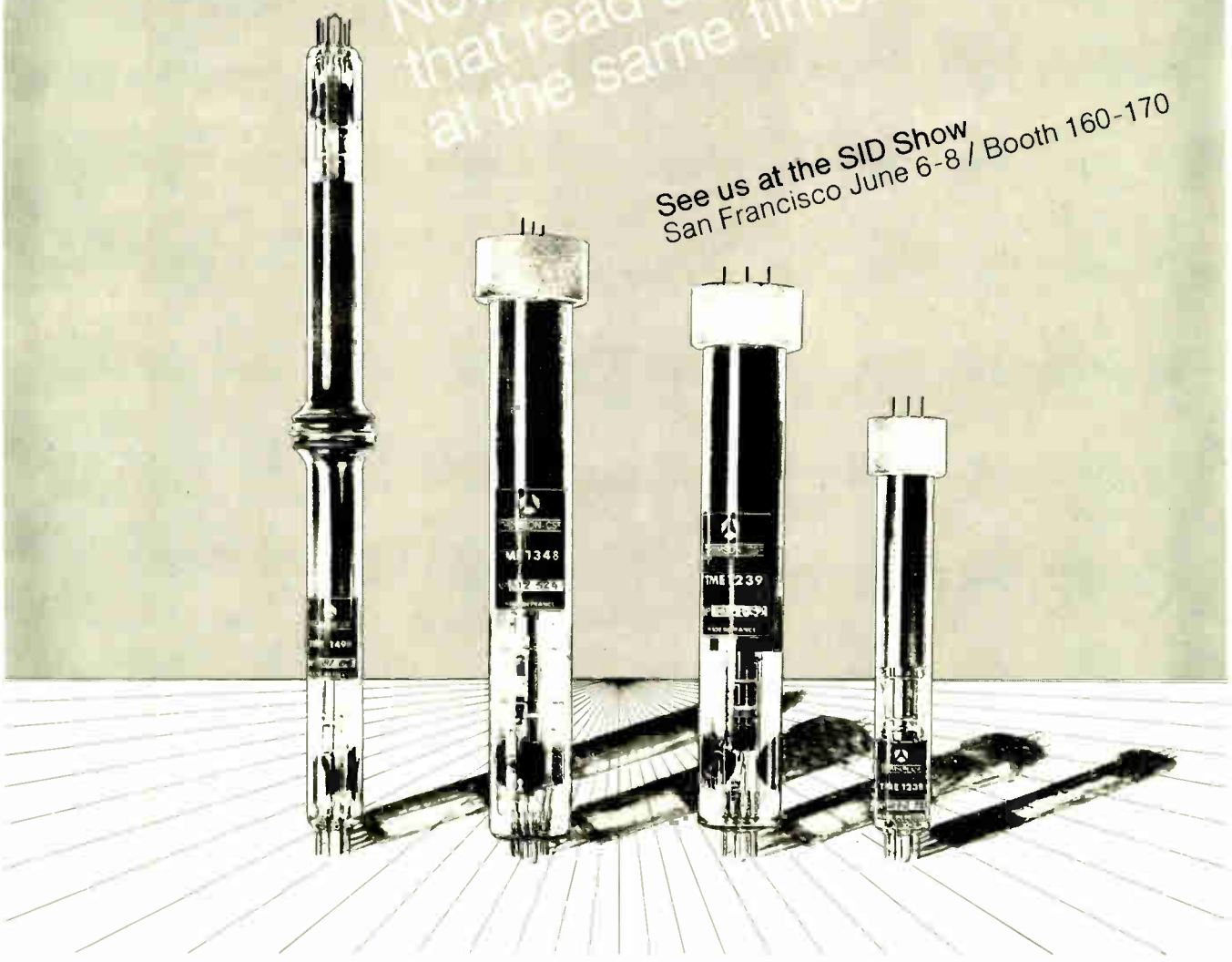


Solid state

Will solar cells shine on earth?

Power shortage may provide impetus for Government R&D fund allocation; semiconductor makers are likely to adopt the technology when feasible

by William F. Arnold, Aerospace Editor

Despite their bright promise in converting sunlight into electricity, solar cells have until now achieved measurable success only in powering Air Force and NASA satellites. If this technology is to become a major market, it will have to find its future on the ground as a pollution-free source of power, prophesy industry spokesmen

The nation's threatening power crisis should provide that thrust, particularly when conventional power sources such as coal, gas, and nuclear fuel become more scarce and expensive. Then, solar cell advocates say these second cousins to semiconductors could help fill the power gap. Even though there have been some recent improvements in technology, it will take Government-supported research, they say, to push solar cells past their two biggest technical problems: high cost and low efficiency.

"If the Government is willing to pump $30 to $50 million a year into the technology, it'll take off," says K.S. Ling, engineering and marketing manager of space products for Centralab, of Globe Union Inc., El Monte, Calif., whose company splits most of the annual $5 million market with Heliotek division of Textron Inc. Confirming Ling's estimate of needed research money, William Cherry, a leading solar cell authority from NASA Goddard Space Flight Center, says that a White House Solar Energy Panel will submit its recommendations in July.

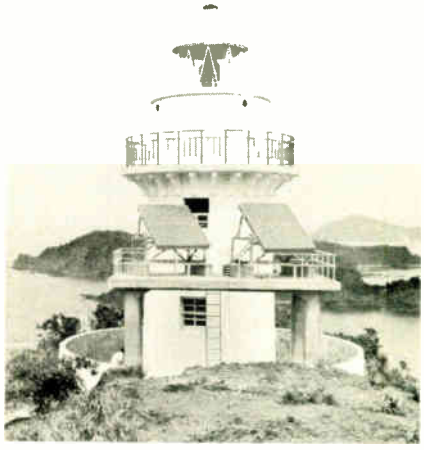
While solar power won't supplant conventional power, Cherry says the panel visualizes three major areas where it could be supplemented:

- **Heating and cooling homes.** This is the largest potential use, Cherry says. "Solar energy can eventually account for more than 50% of the space conditioning in houses," he claims.
- **Producing fuel.** Here, solar energy would serve double duty by consuming wastes and by generating methane or hydrogen for power, Cherry says. He estimates that a few square miles for use as a solar plant could supply cooking gas for a city of 40,000.
- **Generating electrical power.** Right now, solar power is three to five times more expensive than conventional means, but in the future, solar cells should become cheaper and conventional fossil fuels more expensive, Cherry predicts.

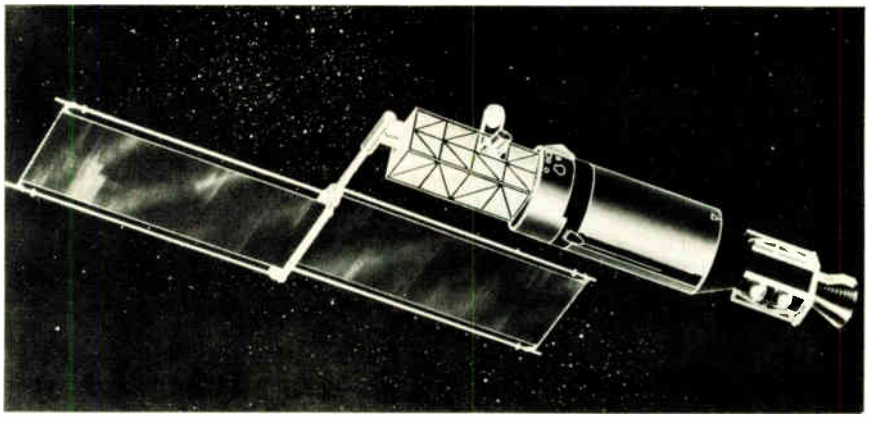
"The terrestrial area is the one we're all watching," says Ling, who adds that if solar energy is used on the ground, "the semiconductor manufacturers will jump in because the technology is so similar." Already an impressive roster of the major aerospace companies, electronics systems manufacturers, NASA, and the Department of Defense are doing solar cell work in-house, or funding research.

Solar cell developers encounter many of the technical and materials problems faced by the semiconductor industry. But, while integrated circuits have compressed more and more functions into smaller space, the trend in solar cells is to make them larger.

Other problems include purity,



Diverse applications. Solar cells are being used in Japan to power lighthouses, while in the U.S. windowshade-like panels of solar cells are being developed for satellites, and terrestrial uses are being researched.



photoetching, junction formation and interconnections—just as with semiconductors. Since fabricating solar cells is nearly a handcrafting process, making 2-by-2-centimeter cells and mounting them by soldering or welding into a typical spaceborne array is also a meticulous and expensive process.

It takes more than 80,000 welded connections to make a 1-kilowatt solar array, explains John V. Goldsmith, group supervisor for photovoltaic power sources, Jet Propulsion Laboratory, Pasadena, Calif. And since cells cost about $4 each, plus another $4 to $6 for assembly, solar array costs match the precision it takes to manufacture them.

Recent developments. Meanwhile, several recent developments have helped solve some problems of cost, efficiencies, and weight. Lockheed Missiles and Space Co., Sunnyvale, Calif., has developed a 100-kilowatt solar array that employs new cell and bonding technology. The four-section unit unfolds from a compact 14-by-50 foot package into a 10,000-square-foot array.

Larry G. Chidester, program manager, solar array technology program, explains that assembly can't be automated because most solar cells have both front and back contacts—one for each electrode.

Solar energy activity abroad

While the United States continues to develop more efficient solar cells for spacecraft and ponders the uses of solar cell technology for terrestrial applications, Russia, Japan and Europe are pushing its development.

The Soviet Union "is working on practically everything you can think of in this field," says Paul Rappaport, director, process and materials applied research, RCA's David Sarnoff Research Center, Princeton, N.J. Rappaport is a solar cell expert who had a rare opportunity to inspect Russia's solar-cell technology late last year. Russian scientists told him that they've flown over 400 spacecraft with solar cells and have operated solar-cell-powered pumping stations. During his visit, he saw experiments toward large-scale solar-cell energy farms.

Rappaport says the Russians told him they've flown four space vehicles using gallium arsenide solar cells in the 300-to-400-watt range. Soviet scientists claim 15% efficiency on laboratory cells and 9% on arrays.

In Japan, Nippon Electric Co. Ltd., Sharp Corp. and Matsushita dominate a fledgling solar cell market directed toward pollution- and maintenance-free power sources for lighthouses around the island nation. Both companies also make some solar cells for Japan's slowly developing space program. The Japanese companies report that they don't foresee large-scale applications of solar power to generate pollution-free electricity because it's economically unjustified with present silicon-cell technology.

European companies seem to be concentrating their R&D efforts in areas U.S. companies are neglecting, thus being able to enjoy the benefits of both U.S. R&D and their own. Europe appears to be hitting development of cadmium sulfide and gallium arsenide techniques. For example, France's space agency, CNES (Centre National d'Etudes Spatiales), Société Anonyme de Telecommunications (SAT), and La Radiotechnique-Compelec (RTC) have worked together on experimental cadmium-sulfide and cadmium-telluride cells which are being tested on the Russian-launched French satellite SRET-1 [*Electronics* International, Jan. 31].

In other spaceborne arrays, Germany's AEG Telefunken has fabricated large solar-cell arrays for the Helios sun probe and Britain's Ferranti Ltd.—in the forefront of silicon-cell technology—has operating cells on the Intelsat-4 communications satellites. In earth applications, France's RTC, a Philips subsidiary, has produced a silicon-cell-powered 50-watt air navigation beacon that has worked since 1968 with no breakdowns. The company also has in operation a 12-watt telecommunications relay station and is pointing toward educational television power sources with installation of some units in Latin America, India and Africa. RTC prices its peak output 8-watt unit at $50 each in small quantities and $20 in large quantities. Overall, "what we're working on are ways to get the cost of existing technology down to the lowest possible level," says an RTC spokesman.

But Lockheed has invented a technique whereby both contacts are on the back of the cell and can be induction-soldered automatically to a printed-circuit board.

An edge-defined, film-fed growth (EFG) process, developed by Tyco Laboratories, Waltham, Mass., promises to lower silicon solar cell processing costs about 300-fold, says C.G. Currin, manager of solid state research and development, Dow Corning Corp., Hemlock, Mich., which is continuing development of EFG under license. EFG is a proprietary ribbon-crystal growth process that would actually make cell production cheaper in small volumes, rather than obtaining lower unit costs through mass production.

The Hughes Aircraft Co. flexible rolled-up solar array (Frusa), built under an Air Force Aero Propulsion Laboratory contract, has been flying successfully since its launch last October, says program manager George Wolff. Frusa's importance is that the two 5¼-by-16-foot solar panels extend from a single 8-inch-diameter drum, thus making a new step in reducing the weight of satellite solar arrays, he says.

A fully operational system would be capable of providing 1,500 watts of power, which means that compact, lightweight solar arrays of 20 kilowatts and beyond are now achievable, he says.

By far the most startling proposal to generate solar power for earthly uses is the satellite solar power station (SSPS), which would use two 25-square-mile arrays to produce a massive amount of power spot-beamed by microwave to the earth, where a station would convert the energy into usable current. Proposed by economist Peter Glaser of Arthur D. Little Inc., Cambridge, Mass., the concept is being studied by a team of ADL, Raytheon Microwave & Power Tube division, Waltham, Mass. (microwave systems); Grumman Aerospace Corp., Bethpage, N.Y. (hardware); and Heliotek (solar systems).

The bold proposal calls for SSPS to collect solar energy efficiently in atmosphere-free outer space, use practically no land (compared to ground-based systems), consume no diminishing fuels, and direct power to where it would be needed. □

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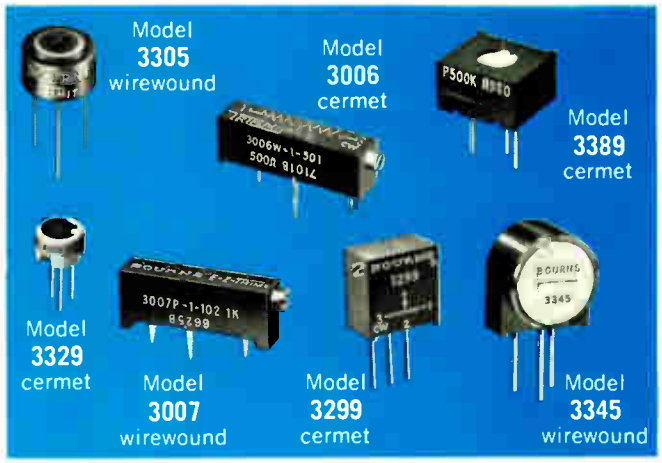

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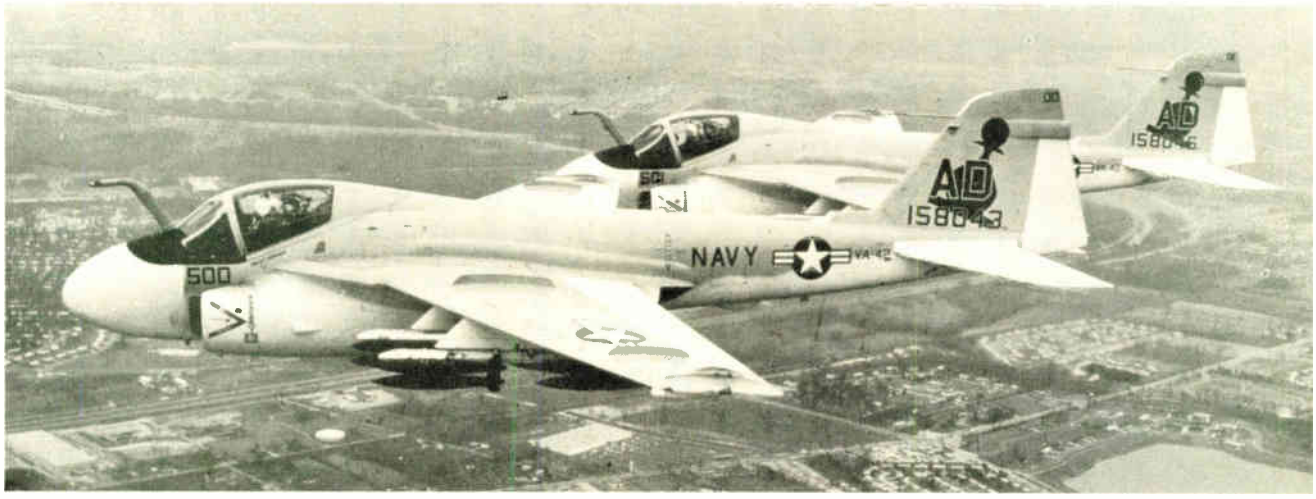

Avionics

Electronics rejuvenates aging A-6

Performance and reliability are improved by multimode radar, solid-state computer, and armament control unit; test circuitry pinpoints faults

by Alfred Rosenblatt, New York bureau manager

An avionics face-lift for the Navy's 14-year-old subsonic A-6 all-weather attack aircraft will provide it with one of the most modern attack/navigation packages in the air. The first squadron of A-6Es, the latest version of the Grumman Aerospace Corp. Intruder series of carrier-based planes, will be deployed this fall.

Two radars in the nose of the earlier A-6A have been replaced by the AN/APQ-148 simultaneous multimode radar, and two critical subsystems—the digital computer and the armament control unit—have been redesigned. The latter system governs the computer-directed and manual release of as many as 60 different weapons.

Replacement of the old avionics package was prompted by the poor mean-time-between-failures record and difficult maintainability typical of the circa-1958 avionics in the original A-6A aircraft. Although no figures are available, it is believed that the MTBF of the radars and digital computer in the A-6A was in the low tens of hours.

To aid in fault diagnosis, the new equipment is laced throughout with "more built-in test circuitry and software than in any other tactical aircraft," says Daniel T. Collins, deputy director for A-6 development at Grumman's main plant in Bethpage, N.Y. This system pinpoints faults, using the aircraft's digital navigation displays and special built-in test lights in the cockpit for readouts. Faults are isolated to individual aircraft-replaceable assemblies. MTBF has also been increased substantially through solid-state design of the armament control unit as well as the computer and its interfaces.

Two in one. Perhaps the most advanced element in the aircraft is the AN/APQ-148 radar, which has a reflecting dish mounted above a phase-interferometer array. The system is used for search, target tracking, terrain following/avoidance, and mapping. The Ku-band radar combines in a single unit both the search and track radars that weighed about 800 pounds and were mounted one above the other in the nose of the A-6A. The APQ-148 weighs 300 pounds less than its predecessors. But in addition the radar has track-while-scan capability and a beacon mode (for cooperative bombing directed by a forward air controller), as well as the moving-target indicator of the earlier radars. All three radars were designed and built by Norden division, United Aircraft Corp., Norwalk, Conn.

The new radar provides the pilot both with a ground map for aircraft guidance and maneuvering and with a display of terrain-following/avoidance manuevers. The bombardier/navigator in the A-6E also has a direct-view radar indicator with a ground-map display for navigation and target tracking. This is the only single radar with this simultaneous capability, according to Norden, of mapping, tracking, and terrain avoidance.

Interferometer goes to war. Norden is particularly proud of its development of the phase interferometer for the radar. "We're the only ones doing it," declares Leo Boiwin, engineering vice president, who says the interferometer aboard the A-6E is essentially two generations ahead of the four-year-older

radar Norden built for the C-5.

The unit can provide elevation angles to ground points at every azimuth and range point. By measuring the relative phase shift between the signals reflected back to the two rows of horns, this information is obtained electronically, rather than mechanically. "Effectively, we have an electronically scanned antenna in one dimension—elevation—while we have mechanical scan in azimuth, and this may be the most practical compromise between a mechanically scanned and an electronically scanned antenna," Botwin says.

The armament control unit, besides being designed with solid-state components, has its electronics packaged in a single box with a single control panel for the bombardier/navigator. On the A-6A, Collins says that equipment to perform the weapons release function was "shoehorned" under different panels in various parts of the aircraft. And it relied on relay assemblies, rather than more reliable solid-state components.

A reliable memory. Instead of updating the A-6A's unit, Grumman preferred to apply a new 4-Pi-class computer from IBM, the CP-3. The computer, designated AN/ASQ-133, has 250,000 bits of core memory to replace the relatively unreliable drum memory in the Litton Industries computer in the A-6A. Solid-state analog-to-digital and digital-to-analog converters replace the shaft encoders in the older computer, which now relies on cold-plate, rather than forced-air, cooling. Its arithmetic unit is similar to the one incorporated into the Mark II avionics system aboard the Air Force's F-111. The CP-3 computer can carry out the same programs as did the A-6A computer with half the bit-memory capacity in one-fifth the time, Collins points out.

Thus far, Grumman is scheduled to deliver 36 A-6Es, which use the original A-6A airframes, to the Navy. For fiscal 1973, the Navy plans to purchase 12 more aircraft. Altogether, Grumman delivered 488 A-6A-series airframes, a good percentage of which are expected to be retrofitted with the A-6E avionics. □

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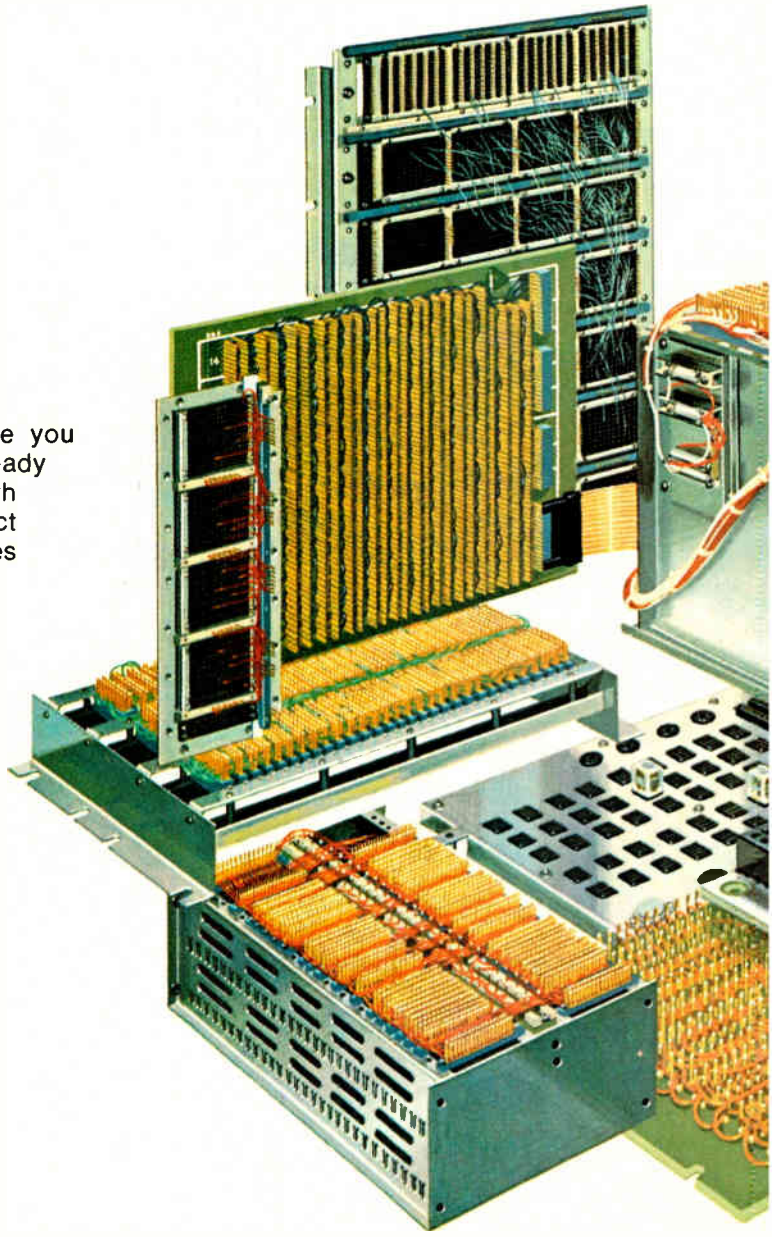

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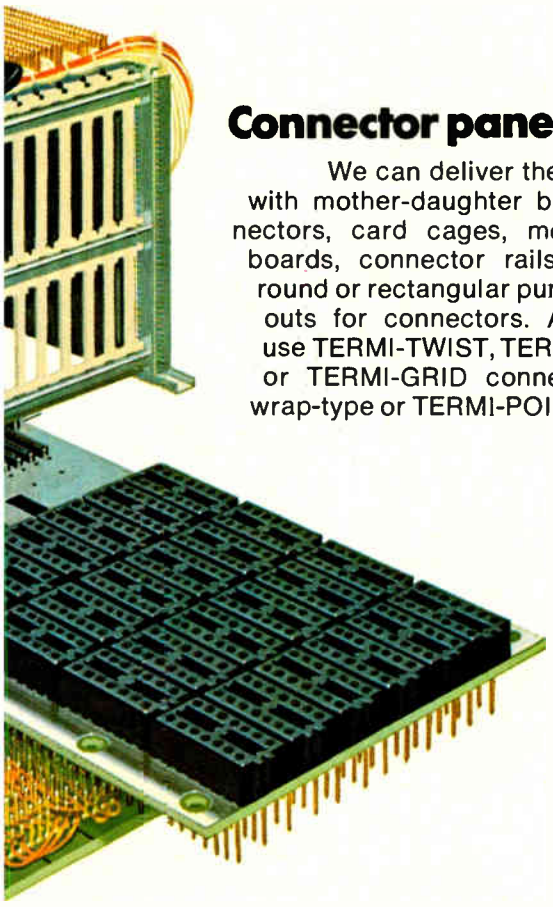

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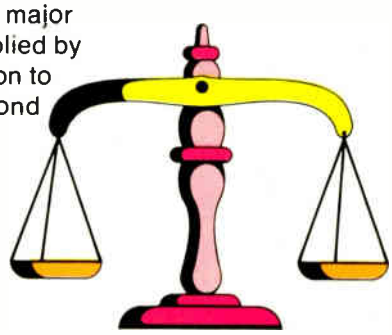
Circle 77 on reader service card

SPEED vs.

The one-nanosecond conundrum.

Schottky or ECL 10,000? How should you commit your engineers, your plant, your production, to get the faster logic that your next system will require?

It's a tough choice. Both major logic families volume-supplied by Signetics can be counted on to boost speed levels far beyond standard TTL. With each offering its own unique advantages, each with built-in drawbacks (sometimes more psychological than real).



PARAMETER	TYPICAL VALUES	
	74S/82S	ECL 10,000
Propagation Delay (per Gate)	3ns	2ns
Power Dissipation (per Gate)	20mW	25mW
Positive Volt. Supply (+V)	+5V	0V
Negative Volt. Supply (−V)	0V	−5.2V
Logic "1" Level	+2.7V	−.9V
Logic "0" Level	+0.5V	−1.8V
Output △V/△T	1V/ns	.25V/ns

Hands down, ECL 10,000 beats out Schottky 74/82 in performance—delivering the best high speed/low power tradeoff yet. But the crucial question facing users: just how critical to your individual designs is that one extra nanosecond knocked off by ECL?

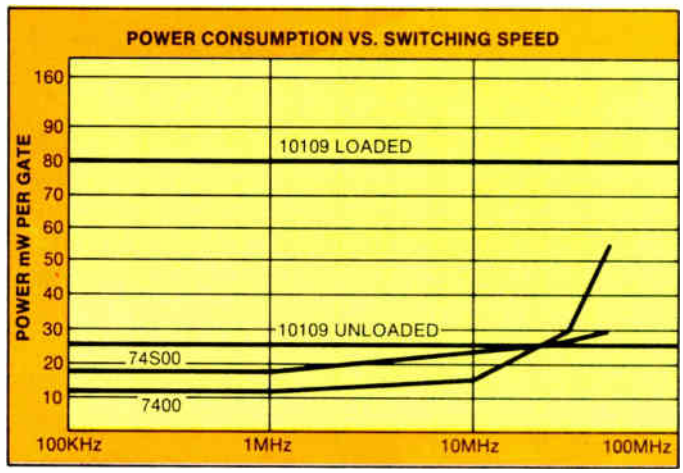
Unless you're into super scale or large scale computers, which have always utilized ECL's maximized performance, there's no pat answer to the question. You have to balance where you've been, and where you're going, with a careful probing of both technologies.

For all practical purposes, 74/82 Schottky is third generation TTL enhanced to allow the designer to increase his system speed by replacing present TTL circuits with their Schottky equivalents. Signetics uses a 3 micron epitaxial film thickness to produce extremely small geometries. Combining small geometries with Schottky diode clamped transistors results in optimized T^2L performance plus remarkable high-density MSI capability. Since gold doping is no longer required, you get higher betas—making PNP transistors available for innovative circuit ideas. All Signetics 82S circuits use PNP transistors to reduce input loading, to insure that fan-out rules are not violated when upgrading existing systems.

Schottky TTL is compatible with standard TTL circuits, with logic rules familiar to the vast majority of engineers. That's the good news.

The bad news: wiring rules may become more stringent due to the sharper signal edges of Schottky TTL compared to standard T^2. Careful attention must be paid to PC board geometries and line terminations, as with 74H type circuits. And, of course, there is that one nanosecond difference in gate delay.

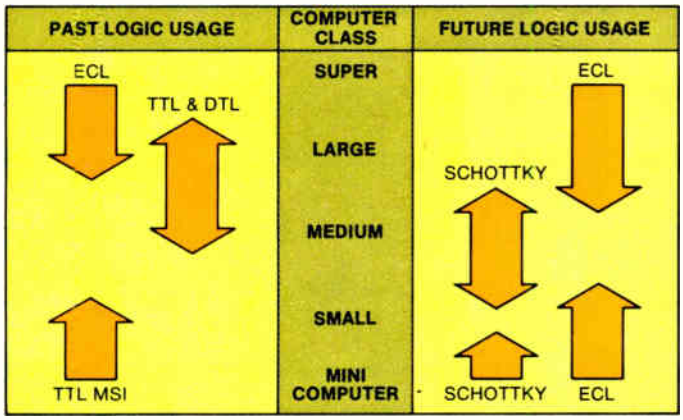
ECL 10,000 will drop propagation delay from 3 to 2ns per gate. With MSI frequently twice as fast. But it takes more than speed to make 10K so desirable.



SPEED

The constant current nature of ECL 10K is obvious. Properly loaded ECL gates show very flat power dissipation. This flat power curve means greater ease of power distribution. And the difference between loaded and unloaded curves offers termination freedom: this choice of resistor helps immensely in reducing internal dissipation to allow higher functional densities. ECL combines remarkable design/function flexibility with significant savings in gate and package count.

A fear of the unknown appears to be the key stumbling block to ECL. Probably the prime concern is the relative unfamiliarity with the NOR/OR logic. The system engineer or manufacturer often feels he has enough on his hands mastering the new usage techniques of 74/82 Schottky, where the basic logic is still TTL. Learning to cope with the sharp edge speeds of faster logic is one thing. Being forced to learn a whole new logic besides... that's often the last straw. Is one extra nanosecond worth it? Only you, the user, can tell.



Put yourself in this picture. Match usage to computer category. Match speed requirements to your own best interests, recognizing that the entire industry is trending toward ever-higher speeds. And before you commit to either Schottky TTL upgrading, or a switchover to ECL, consider both alternatives carefully.

74/82 Schottky. Or ECL 10,000. Signetics gives you both ways to go.

SCHOTTKY 82S MSI

82S30/31/32	8-Input Digital Multiplexer
82S33/34	2-Input, 4-Bit Digital Multiplexer
82S41/42	Quad Exclusive-OR/Quad Exclusive-NOR
82S50/52	Binary-to-Octal/BCD-to-Decimal Decoder
82S62	9-Bit Parity Generator and Checker
82S66/67	2-Input, 4-Bit Digital Multiplexer
82S70/71*	4-Bit Shift Register
82S90/91*	Presettable Decade/Binary Counter

SCHOTTKY TTL 74S

74S00	Quad 2-Input NAND Gate
74S03	Quad 2-Input NAND Gate (Open Collector)
74S04	Hex Inverter
74S05	Hex Inverter (Open Collector)
74S20	Dual 4-Input NAND Gate
74S22	Dual 4-Input NAND Gate (Open Collector)
74S112*	Dual J-K Edge-Triggered Flip-Flop
74S113*	Dual J-K Edge-Triggered Flip-Flop
74S114*	Dual J-K Edge-Triggered Flip-Flop
74S40*	Dual 4-Input NAND Buffer
74S140*	Dual 4-Input NAND Line Driver

ECL 10,000

10101*	Quad 1-Input OR/NOR Gate
10102	Quad 2-Input NOR Gate
10105*	Triple 2, 3, 2-Input OR/NOR Gate
10106*	Triple 4, 3, 3-Input NOR Gate
10107	Triple 2-Input Exclusive OR/NOR Gate
10109	Dual, 4, 5-Input OR/NOR Gate
10110	Dual 3-Input 3-Output OR Gate
10111	Dual 3-Input 3-Output NOR Gate
10112	Dual 3-Input 1-OR/2-NOR Gate
10113*	Quad Exclusive -OR Gate/Comparator
10115*	Quad Differential Line Receiver
10116	Triple Differential OR/NOR Line Receiver
10117	Dual 2-wide 2, 3-Input OR-AND/OR-AND Invert Gate
10118	Dual 2-wide 3, 3-Input OR-AND Gate
10119	4-wide 4, 3, 3, 3-Input OR-AND Gate
10121*	4-wide 3, 3, 3, 3-Input OR-AND/OR-AND Invert Gate
10131*	Dual D-Type Master-Slave Flip-Flop
10161	1 of 8 Demultiplexer/Decoder (Low)
10162	1 of 8 Demultiplexer/Decoder (High)
10170*	9 + 2-Input Parity Circuit
10171*	Dual 1 of 4 Demultiplexer/Decoder (Low)
10172*	Dual 1 of 4 Demultiplexer (High)

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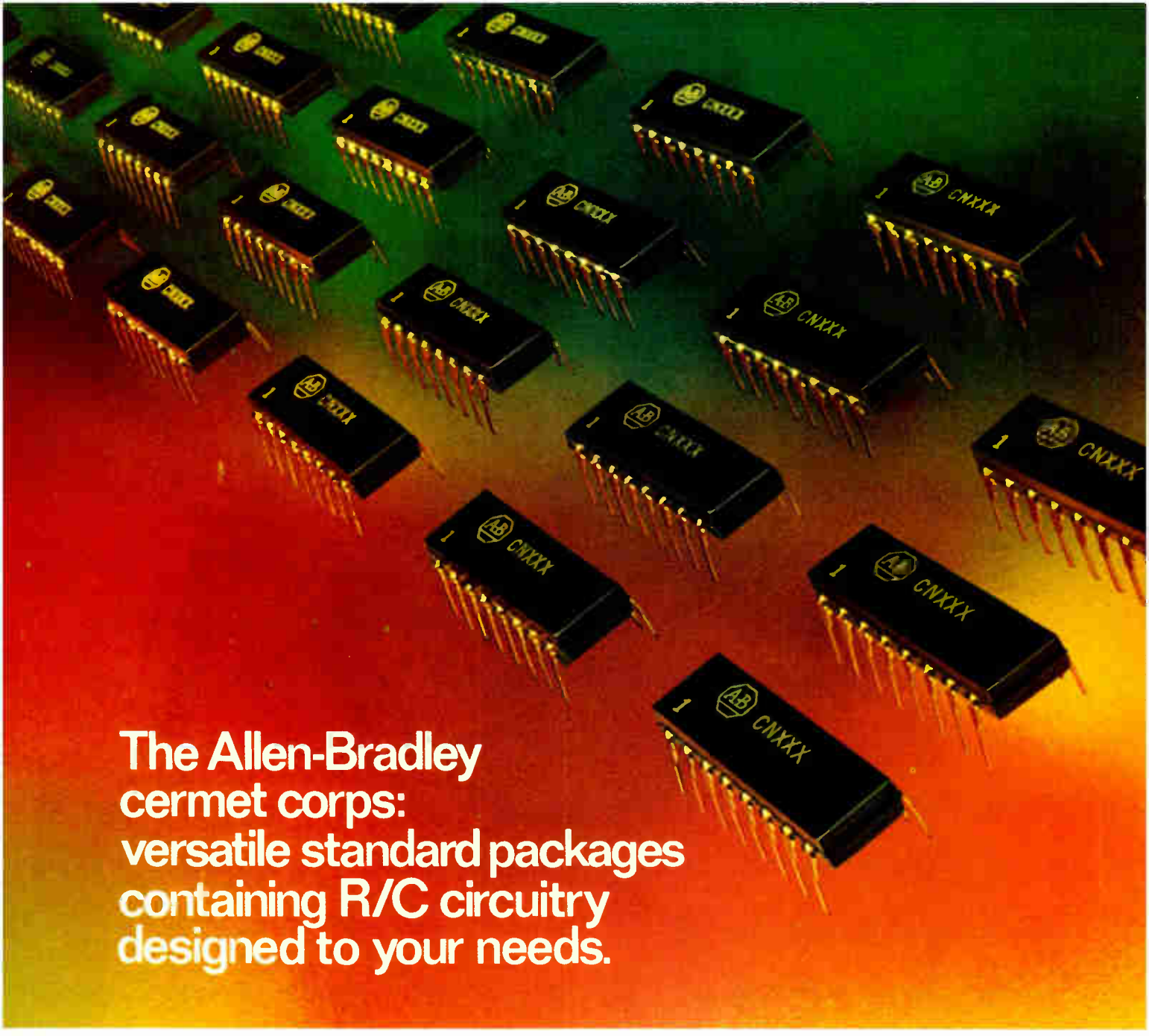

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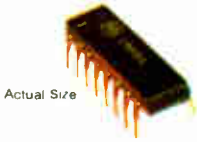

NEW DIMENSION ELECTRONICS

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A-B QUALITY

Report from

EAST EUROPE

A country-by-country assessment of electronic technology and its impact on prospects for expanding trade with the West

Soviet Union

Nixon is expected to open the gate to fast-growing electronics market, but the path to sales is thorny

☐One of President Richard M. Nixon's trump cards for easing tensions with the East bloc of nations is a sweeping liberalization of the embargo list of strategic materials. The list has long throttled trade by Western companies in high-technology products with the Soviet Union and its six East European partners in the Warsaw Pact. So there's no doubt that easing up on the embargo will make the going easier for electronics hardware sales teams plying the Socialist bloc.

But there's no chance they'll be overwhelmed by new business. The embargo ranks only second among the obstacles. "Money is the biggest problem in selling to the Socialist bloc. East Europeans just don't have enough of the hard currency demanded by Western manufacturers," says Ralph R. Stafford, who's in charge of IBM World Trade Corp. activities in the area.

Stafford's statement, or something like it, pops up invariably in conversations about East Europe with knowledgeable marketers. So does the embargo, and so do a trio of other major obstacles. The East-West political climate is always a factor, of course. Then "There's a natural reluctance in the East bloc to have to depend on the West for technology," points out Ralph Land, an executive at International Computers Ltd. headquarters in London. Or, as a seasoned Western diplomat in Moscow puts it, "The most important concept to Soviet planners is self-reliance, a deeply rooted feeling of wanting to do it all by themselves." Finally, there's the red tape involved in closing sales. With a dozen or so government agencies sometimes involved in the buying country, and both export licenses and NATO approval needed before delivery, it takes from six months to two years to work out contract details.

With all these drawbacks, then, East Europe does not yet rate as a major market for Western electronics hardware producers. Over-all figures for electronics sales to the seven-country Comecon bloc simply don't exist. (Comecon stands for the Council for Mutual Economic Assistance of the Warsaw Pact nations—the Soviet Union, Poland, East Germany, Czechoslovakia, Hungary, Rumania and Bulgaria.)

The growing East Europe market

The best available figure for American-made hardware sold to the bloc comes from sources at the U. S. Department of Commerce, and this is far from precise. The nearest categorization available is for "electrical machinery and apparatus" shipped to the Comecon nations plus Albania. These exports jumped from $7,925,000 in 1970 to $9,255,000 for only the first nine months of 1971. Commerce says this category covers telecommunications equipment, measuring and controlling instruments, accelerators, and machinery "not elsewhere categorized."

From Britain, exports totaled about $20 million, and from France roughly $10 million. The Germans checked in with $55 million in sales—mostly communications and measuring equipment. Japan's exports to the bloc were worth about $16 million. Payments for knowhow and licenses add to all this, but so far, many companies have found the available business in East Europe hardly worth the effort it takes to sell there.

What's the potential?

However, there's so much potential in the seven-nation area with its population of some 350 million and its fast-industrializing economies that few big companies dare ignore it. Siemens AG, largest among West Germany's export-conscious electrical/electronics producers, logs only between 3% and 4% of its export sales in East Europe. "Despite this relatively small share, the East is interesting, and we want to keep in touch with those countries," says Helmut Hoffman, coordinating manager for sales to the bloc. Eugene Van Dyck, vice president for the region at ITT Europe, thinks there could be an explosion in sales of communications equipment in three years or so "if things keep going as they have during the past three."

Other sales executives would find Van Dyck's assessment overoptimistic. An AEG-Telefunken spokesman cautions that Eastern markets will remain small in the near term, despite the current upward trend. But near-term or long-term, everyone agrees that there are plenty of ifs involved in East-bloc business. Accurate assessments of upcoming markets elude even old hands. Says Dennis Skinner, who has helped propel ICL to the top spot among Western producers in computer sales to the Soviets with 20 systems worth $31 million over the past four years, "The object here is satisfying Soviet needs competitively. But we can only guess, estimate, and intuitively feel those needs as best we can."

Skinner directs a staff of 30 Britons and 14 Russians based in Moscow, an operation that dwarfs other on-the-scene operations. From his small suite of offices in the Leningradskaya Hotel, Siemens' man in Moscow, Sigmund Hamann, sizes up chances for getting meaningful market data somewhere between "extremely difficult and hopeless."

There's no question, though, that computers and communications equipment are the most promising sectors. Spectacular orders keep popping up, and more will follow if Nixon opens significant channels for trade in electronics hardware. IBM, for one, has just won clearance for the sale of a model 360/50 first displayed at the Leningrad computer show last fall.

Symbols. On previous page, Bulgarian Communist party initials are enfolded in perforated tape on sign in Sofia's Mausoleum Square.

Honeywell-Bull last month confirmed a $5-million order from the state bank for a pair of Honeywell 600s. Control Data Corp. seems poised to nail down a near-$2 million order for a CDC 6200 system intended for the nuclear research institute at Dubna, near Moscow. There's apparently a lot more to come. The word around Moscow is that IBM stands a chance of getting the job of putting a data-processing system in the upcoming $2-billion Kama River truck plant.

ITT apparently is also angling for a major communications project with the Russians. ITT affiliates in France have already scored in the USSR with a $1.2 million message-switching system for the Soviet airline Aeroflot and with hardware for the Moscow inquiry center of the Soviet telephone system. IBM and ITT are not alone, by any means, in their quests for big business in Russia. Nearly all the major U.S. and West European electronics companies are probing for business. France's Thompson-CSF, for example, has a near-$1 million contract to equip a color-TV studio in Armenia.

These deals apparently are merely a few grains spilled from a huge bowl of caviar that the Soviets will ladle out to East bloc producers of communications and radio-TV broadcasting gear. These two sectors have been put down for priority attention by Soviet planners. The 1971-75 plan includes, among other things, a 90% increase in trunkline channels through "development and better use of the cable and radio relay network," a gain of 50% in rural and small-town telephone stations, and expansion of the radio-TV network with at least two TV channels available for major Soviet cities.

As far as the Soviets and their partners are concerned, buying computers, communications and other sophisticated electronics hardware from the West is a stopgap. Their long-range goal is self-sufficiency—across the board. And their production targets for EDP are staggering—if not completely beyond reach.

Russia: leading the bloc

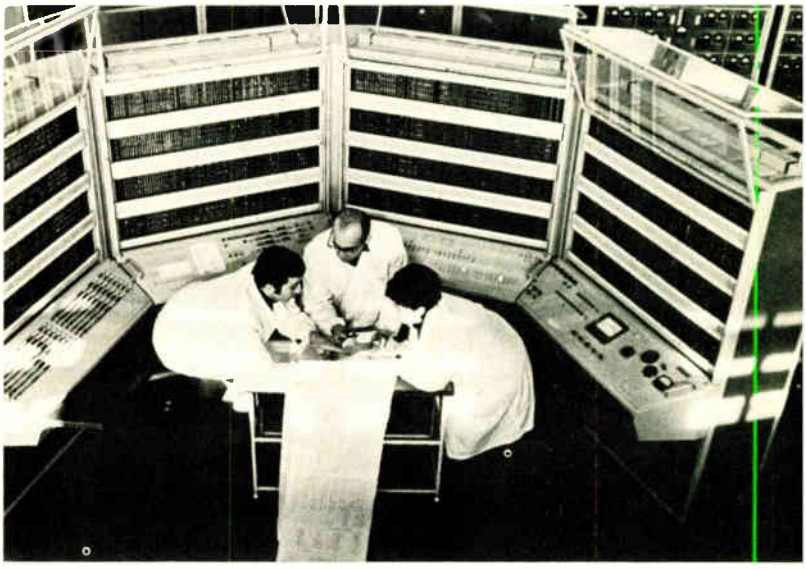
Russia, of course, dominates the bloc. And the Russians have big plans for their economy. By 1975, they say, the national income will have increased by 37% to 40% higher than the 1970 level. The climb in industrial output is pegged from 1970's 373 billion rubles to between 528 billion and 540 billion rubles ($655 billion at the official rate of 1.22 rubles to $1). To keep tabs on this growth, the idea is to get more than 4,000 computer centers in operation throughout the USSR, presumably backed up by an extensive data-processing network. If, as they hope, they do it all themselves, the Soviets will be producing between 12,000 and 15,000 third-generation computers yearly by 1975. The figures come from pronouncements by Mikhail Rokhovsky, deputy chairman of Gosplan, the USSR's national planning organization. It's impossible, of course, to get a precise fix on Russian computer output. But many Western observers are skeptical and even the Communist Party newspaper *Pravda* early this year took the country's computer men to task for falling behind.

In "management" computers there are high hopes for the "RJAD" [pronounced ree-yaad] project that the Soviets have set up with their Comecon partners—Rumania excepted. The project aims at a compatible line of data-processing machines, ranging from minicomputers upward to a machine comparable to IBM's 360/60. East Germany and Hungary are geared up to produce the 2010 minicomputer. The USSR, Bulgaria, and Czechoslovakia have 2020 machines either in production or close to it.

Further down the pipeline are the larger machines. They include the 2030 class that will be built in the USSR, Czechoslovakia, and Poland, and the 2040, assigned to East Germany. All have transistor-transistor logic. Then there are the 2050 and 2060 large machines, based on emitter-coupled logic that the Russians apparently feel only they among the Comecon countries can build. The last two digits in all these designations, from 2020 on up, correspond to the IBM 360 equivalents.

Turning out computers on a large scale, in fact, seems a troublesome problem for the Russians. But they and their partners aren't about to buy anything but the latest machines, even though their own computers fall mainly somewhere between the second and third generations of Western producers.

It's a matter of prestige, rather than performance. And prestige pops up in communications-hardware deals as well. East European countries buy licenses and knowhow, rather than hardware outright, whenever possible. Lately, they've been trending toward joint-research arrangements, reports ITT's Van Dyck. He says ITT is looking at some deals that will involve a reverse flow of technology from East to West. "I can imagine a situation," he says, "where an East European country might develop a handset, and we might put it into production." The East European work would become a partial payment for knowhow supplied from the West.



Large-scale calculation. Scientists at the USSR's Tbilisi Applied Mathematics Institute make calculations on BESM-6 computer.

A posture of prestige in electronics, coupled with an acute shortage of hard currency to pay for imports, precludes any meaningful business in consumer electronics for outsiders. Although waiting lines form daily in the Moscow shops that sell portable radios and hi-fi equipment, the USSR and its partners feel they can take care of themselves. Last year, the USSR produced a record

5.8 million television sets and 8.8 million radios and record players. Throughout the Socialist bloc, "made-in-CCCP" portables abound in appliance stores.

As for components, Russia isn't as good a market as the smaller countries in the bloc, says Noel Shepherd, export sales manager for ITT Components Group Europe. That's because the Soviets produce nearly everything they need except advanced semiconductor products, which are on the embargo list. Indeed, if the Soviets believe the message they put forth on one of their two stands at the Paris Components Show last month, they think they're the biggest producers of electronics equipment and components in the world.

The smaller countries generally can do the job for consumer-electronics components, but often have to turn to suppliers outside the bloc for advanced items such as crystals, power tubes, special ferrites, and specialized semiconductors.

As Shepherd sees it, demand from East Europe generally falls into two categories. First, there's a fairly steady market for items where there's little or no technology—high-frequency power tubes, for example. The second category consists of "opportunity" markets for products that East Europeans can make, but not in sufficient volume to satisfy demand. These markets last only two or three years.

Components companies have all the difficulties of equipment suppliers, plus one. The parts people do best when they can get their hardware designed into equipment. But in the bloc, sales are made through foreign-trade organizations, and component suppliers generally get in to see end-users only when there's a serious problem with a product that's been bought. □

East Germany

Electronics output is scheduled to double by 1975, despite technological weaknesses in IC production

□On East Berlin's Alexanderplatz, not far from the famed Brandenburg Gate, stands the "Haus der Elektroindustrie." The striking red-paneled structure is one of the decision-making centers for East Germany's electrical/electronics industries, and it somehow symbolizes their vitality.

Official figures and some seat-of-the-pants forecasting for the year ahead show the industries' rapid growth. Since 1960, production of electrical/electronic equipment has nearly tripled—in 1970 reaching 13.6 billion marks ($4.35 billion at the official rate, which puts East German marks at par with West German Deutsch Marks). Electronics alone, which has enjoyed an even more spectacular rise, has shot up to about 5.75 billion marks ($1.8 billion) and is expected to climb this year to around 7 billion marks ($2.18 billion)—not bad for a country half the size of Kansas with 17 million people. This performance, Western experts say, clearly makes East Germany the second largest electronics producer in the East European bloc.

Although over-all growth of the East German economy will slow down a bit, the 1971-1975 economic plan calls for the output of the electrical/electronics industry during the five years to rise by 107% to 120%. Some sectors are slated for even more. The electronic components area, for example, is targeted for an increase of around 200% by 1975. For automation equipment, the goal is a gain of 54% to 61%; for communications and medical electronics combined, it's roughly 50%; and for consumer electronic products, from 43% to 45%.

In a planned economy, growth like that doesn't come by accident. Rather, it's triggered largely by necessity. Conscious of what electronics and automation can do to spur productivity and keep industrialization on the upswing, central planners are giving them top priority.

Still another reason for pushing electronics and automation is that they're the main pillars supporting East Germany's export business. And exports are vital for the country—lacking, as it does, important mineral resources. Of total production of communications equipment, about one-half has gone abroad in recent years. For many other electronic products, the export share is even higher. Most of what's shipped abroad goes to other Socialist countries—the bear's share to the Soviet Union.

The industry's large export volume suggests that East German electronics technology is well advanced, at least by Soviet-bloc standards. "There, most East German electronic products rate second to none," says one sales manager for the area at West Germany's Siemens AG. With many products, the East German electronics industry can even compete on Western markets. Electronic-optical gear from VEB Carl Zeiss is one example. Equipment from this Jena-based enterprise has found its way into many laboratories and institutes in the West—even in North America. (The "VEB" in the company's name are the initial letters of the German words for "people-owned enterprise".) The Siemens man gives especially high marks to East German communications equipment. Increasingly, it is turning up in developing countries, as well as in some places in Western Europe.

Attesting also to the industry's expertise, East German electronics gear has been used in the Soviet-made satellites of the Interkosmos series. For Interkosmos-1, for example, East German engineers developed a continuously operating transmitter for data communications and a Lyman-Alpha photometer for scientific investigations in the ionosphere. Three subsequent Interkosmos satellites also carried East German-made equipment. Developed at the Heinrich Hertz Institute

in East Berlin, the equipment was fitted with components from VEB Werk für Fernsehelektronik, also in East Berlin.

However, the industry has a soft underbelly. One weak spot is mass-production techniques for integrated circuits. Although East German components people stoutly maintain that the problems that initially plagued device production have now been overcome, shortcomings apparently still exist, even though they may not be as acute as they used to be. As one East bloc expert at West Germany's Intermetall, an ITT subsidiary, expresses it, the main problem has been that the industry was trying to come up with too large a spectrum of semiconductors "without really getting a good grip on volume production techniques for any one device." As a result, he says, equipment makers have heavily relied on foreign ICs, supplied mainly by Czechoslovakia's Tesla conglomerate.

In plastic devices, however, the Intermetall expert says that East Germany has already become self-sufficient. And in the metal-oxide semiconductor area, it is starting to develop its own capability. Because of this—and of other cases of Eastern self-sufficiency in certain component categories—Western European companies are now clamoring for a revision of embargo lists so that they can enter Eastern markets while they still have a leg up in technology. In some special component sectors, the East Germans are hard on the heels of their Western counterparts. East German engineers, for example, have readied liquid-crystal displays for desk calculators, measuring equipment, and similar gear. The displays, shown operating at the Leipzig Fair this spring, are now being offered as samples to prospective customers, according to East German components people [*Electronics*, International Newsletter, March 27]. The displays come from VEB Werk für Fernsehelektronik in Berlin: they are IC-compatible and consume less than 100 microwatts per digit.

Looking at East Germany's over-all components activities quantitatively, 1970 output reached about 900 million marks ($282 million), 14.7% higher than in the previous year. The rate of growth of semiconductors, though, has been less dramatic—around 10.7%—probably because of the problems of getting into mass production. Industry officials are confident, however, that semiconductors will pull ahead of over-all components growth, which is pegged at up to 15% annually for the next few years. For special devices, growth rates of up to 40% are expected.

Clearly the heavyweights of East Germany's electronics are its communications hardware makers. In 1970, the latest year for which official figures are available, their output was more than 1.6 billion marks ($500 million). This year the figure is likely to read about 2 billion marks ($620 million).

There's strong demand at home, where the government plans to expand telecommunication services by 35% to 40% by 1975. But it's mainly from foreign countries—notably from those in other East-European countries—that the communications makers expect to get the bulk of their business. Some industry experts peg the export share already at 60%, a figure that's likely to go up.

With such export markets, the communications producers can expect to remain among the world's biggest suppliers of communications equipment to foreign markets. Over the last five years, the industry has sold to 15 countries carrier-frequency equipment for a total of 100,000 transmission channels. Thus far, it has delivered and set up in foreign lands more than 120,000 miles of microwave links. And in the teletypewriter equipment field, officials claim, the country has become Europe's largest exporter.

The 30,000-man communications sector carries out production in 15 enterprises scattered primarily over the southern part of the country, with Leipzig the chief manufacturing center for transmission equipment. The sector, technically supported by the "Institut für Nachrichtentechnik" (Institute for Communications Engineering) in East Berlin also handles measuring and test instruments, as well as certain medical electronics gear. East German production of such gear, including X-ray equipment, reached 96 million marks ($30 million) in 1970—11% more than the year before.

If communications is the mainstay of East Germany's electronics industry, it is also the most advanced technically, Western observers say. The most prominent example is the development several years ago of East Europe's first semielectronic telephone switching center. East German engineers managed the seven-nation project. Another example is a receiving system for weather and cloud-distribution pictures taken by Soviet meteorological satellites of the Kosmos series. Unlike conventional systems, the East Germans' WES-2 equipment can do without complex helical antennas. Instead, it uses two linearly polarized antennas in a cross-dipole arrangement, a configuration which makes the system suitable for ships. Still other examples of prowess in communications are pulse-code-modulated transmission systems for short-haul telephone traffic, and wideband microwave links with maximum capacity of

Videotape. For the communications sector, mainstay of East Germany's electronic industry, magnetic tape video storage unit QR 302, for studio use, was made by PGH Elektroakustik, Leipzig.

1,800 telephone channels that operate in the 4- and 11-gigahertz ranges.

The knowhow in communications isn't yet matched in computers, where designers don't have as long an R&D tradition to fall back on. As a computer builder, East Germany for a long time did not have much to show for its efforts. The second-generation Robotron 300, for example, wasn't ready for delivery until a year after its scheduled debut. Since, it has become the country's workhorse machine, with 300 to 350 of them in operation now. The domestic demand for the R 300 has been so great that exports weren't considered.

Determined to make up for lost ground, the industry has of late been showing more muscle in computer design. Evidence of this is the introduction this year of East Germany's first third-generation machines. With them, the computer industry has marched into a front-line position in the Eastern bloc.

And the East Germans plan to hold their place in line. Within the next five years, output of computer hardware is scheduled to triple. To cope, the industry is feverishly putting up new plants, expanding its training facilities and pushing educational programs on TV to lure personnel. Of the 300,000 participants in this educational scheme, about 40,000 are said to have received their diplomas so far.

East Germany's computer activities center around Dresden, where the technical university makes that city the mecca of the country's aspiring electronic engineers. Four manufacturing facilities, combined into the 20,000-man VEB Kombinat Robotron, are now responsible for East Germany's computer-building activities. The quartet work in close cooperation with VEB Carl Zeiss, the optical equipment producer, which supplies peripherals for the industry.

But cooperation also extends beyond the borders—intra-bloc borders, to be sure. East Germany is a partner in the RJAD project, an approach to assure compatibility of all computers built in Comecon countries. For example, the Robotron R 21, a third-generation computer for jobs in economic planning, documentation, and R&D, uses peripherals from the Soviet Union and Poland. The R 21's central processing unit has a 64-kilobyte ferrite core memory with cycle and access times of 875 and 520 nanoseconds, respectively. The microprogramed machine handles 143 instructions and can be used with exchangeable disk stores for direct data access. There are two other East German third-generation machines: the PRS 4000 for process-control applications in industry, and the KRS 4200, a small process controller that can function either as an independent machine or as part of a computer hierarchy.

No newcomers to foreign markets are East Germany's producers of small office equipment and terminals. A large export volume, increasing annually by 15% to 20%, is typical for them. Again, the Soviet Union is the prime customer and will continue to be for quite some time. The guarantee is a deal made last year whereby 150 million rubles worth of equipment will go to the Soviet Union between 1971 and 1975.

Despite big efforts in the industrial-commercial field, East Germany's electronics industries haven't let consumer electronics slide. The consumer sector, which has grown by leaps and bounds, now accounts for some $470 million worth of business, according to West German sources. East German industry people, however, will maintain that this figure is twice as high.

Be that as it may, East Germany's 16,000-man consumer electronics sector is hopping and can expect continued expansion in the future. The five-year plan insures it: This year, the output of table radio receivers will increase by 14.5%. For black-and-white TV sets, production will increase 40% annually through 1975. By that year, TV set density will be 75% to 80%, compared with 69.1% in 1970.

As for color sets, there are now about 15,000 in use after some 30 months of color broadcasting. A more rapid growth rate is counted on as color coverage goes beyond large cities like Berlin, Leipzig, and Dresden, to include the less-populated western and southwestern districts of the country. From 12 to 14 hours of color

East German support. Chief of state Erich Honecker and Politburo members approve display of nation's EDP equipment at the Leipzig Fair.

programs are now broadcast weekly. East Germany uses the French Secam transmission system, as does the Soviet Union.

At present, East German consumers can choose from three color models: two Russian-made sets—the partly transistorized Raduga and Rubin models—and East Germany's RFT Color 20, which is said to be fully transistorized. The latter sells for around $940—somewhat more than the Russian imports. The RFT Color 20, for domestic consumption only, uses a picture tube from the Soviet Union.

In the black-and-white realm, 16 different models made at VEB Fernsehgerätewerk Stassfurt are now being offered—among them, five models are also exported. One set from Stassfurt's production lines is the new Luxomat 110, a set with which the industry has introduced a new receiver generation in East Germany. The partly transistorized set boasts a 24-inch, 110° tube and a linear integrated circuit. But the IC, designated ZTK 33, comes from Czechoslovakia's Tesla. This IC is essentially an Intermetall TAA550 circuit, a relatively simple device. □

Czechoslovakia

Supercharged growth in microelectronics and computers paces ambitious industrial expansion plan

□A decade of forced-draft advance lies ahead for Czechoslovakia's electronic industries—if the plans now on paper metamorphose into hardware and software.

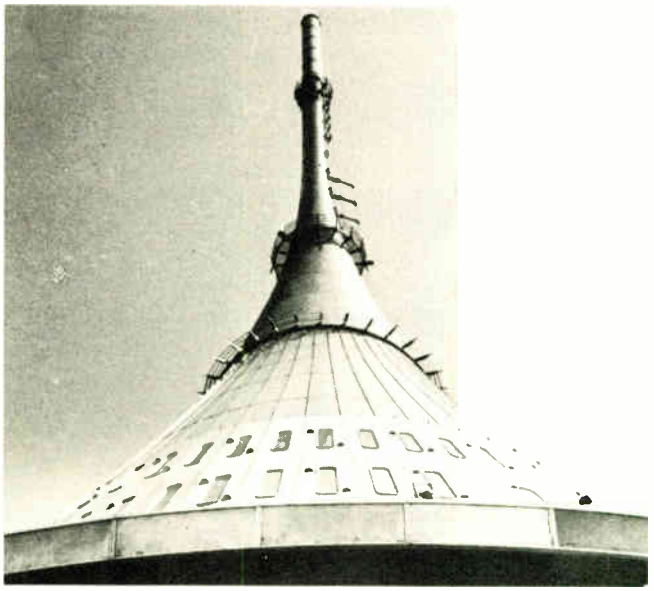
Like the other Comecon countries, Czechoslovakia has a 1971-1975 plan for economic development, and it gives top priority to development of electric power and electronics. Czech planners foresee these two sectors as the twin bases for expanding other industrial sectors. Thus, the plan exhorts the men who manage the state-owned components industry to quintuple output of semiconductors and microelectronic components by 1975. Over the same period, computer production is scheduled to be tripled, and numerically controlled machine capacity is slated to rise by 50%.

In the longer-range 10-year plan, microelectronics is programed to register a 26-fold increase by 1980. For automation, the multiplier in the decade is 15.5; for conventional components, 3.6; for radio communications and television transmission, 5; for instruments, about the same; for air-traffic control and signalling, 3.5. These spurts, Czech planners hope, will boost the country—a late starter in electronics—to the level of its neighbors. The total share of electronics hardware in Czechoslovakia's engineering industries amounts to 6.3%—about half that of Poland.

The burden of catching up with the neighbors falls mainly on three state holding companies, Tesla, ZPA (for the Czech expression meaning "Instrumentation and Automation Enterprises), and Zbrojovka.

By far the largest and oldest of these conglomerates is Prague-based Tesla, which does some 10 billion crowns of business yearly ($1.5 billion at the official rate of 6.60 crowns per $1). Tesla controls 28 autonomous "national enterprises" with some 50 factories and six research institutes throughout the country, together with a management engineering firm, a computer and data service center, and its own separate sales company with a national chain of 40 retail outlets. Of Tesla's 82,000 employees, 12,000 are in R&D, say its managers.

ZPA, also based in Prague, controls a dozen factories in its field, plus two in-house research organizations, a sales company, and the country's three main servicing



Czech TV. Test color telecasts are to begin this year from tower (above) equipped by Tesla and already operating atop Mt. Ještěd. Inside, transmitter controls (below) are in electronically neutral zone.

and systems setups for electronic equipment: Aritma, Kancelářské Stroje (office machines) and Datasystem in Bratislava.

Zbrojovka (the name originally meant "arms factory," and it is the birthplace of the historic Bren gun) is a Brno-based trust only peripherally involved in electronics. It is the sole Czech manufacturer of computer peripheral equipment.

All exports of electronic goods are handled for Tesla, ZPA and Zbrojovka by a single foreign-trade corporation, KOVO, which also takes care of imports.

Czech computer people have their work cut out for them during the current plan. Not only do they have to triple production, they have to integrate one of the weirdest mixes of computers anywhere. When the Czechs counted computer hardware at the end of 1970, they found they had 333 computer installations and no less than 49 makes of hardware.

Frantisek Michel, who heads a parliamentary committee for electronics, attributes the mix to a late 1960s computerization binge. The spree ended in early 1970, when officials at the Ministry of Technology announced that they intended to rely primarily on the RJAD program—the joint computer-compatibility venture of all the Comecon countries except Rumania. In the official words, "By the end of the five-year plan, except for certain special-purpose equipment, this joint output should cover 100% of our needs. The biggest problem will be for firms that now have computers from capitalist countries to switch over to the Comecon system: reprogramming is not a simple matter."

In Comecon's scheme of things for developing the RJAD series, Czechoslovakia has been assigned the role of general contractor for peripherals. It is also responsible for producing two middle-range central computer units, the ZPA 6000/20 and ZPA 6000/30. The first two of these third-generation computers will be delivered this year. Series production of the 20 is scheduled to start by the beginning of 1973, with its larger counterpart to follow a year later. The machines are built around Czech-made transistor-transistor logic.

Starter from the West. The Czechs, who put this CDC-3300 in the Federal Bureau of Statistics in 1970, plan to build own computers.

Czech components. Operator controls thermocompression contacting of C logic in Tesla's Roznov microelectronics factory.

To meet needs at the lower end of the spectrum until 1975, when Comecon's series should be fully available, Aritma has just built and installed its first A-1010. This is a small decimal computer costing about 8 million crowns ($1.2 million). Meanwhile, Tesla has been updating its T-200, which is basically the French Bull/GE 140/145, for which Tesla acquired a license in 1968. This is a medium-capacity digital computer of unit construction with five tape drives, one printer, and two card readers. Starting this year, the T-200 will be equipped with an off-line magnetic disk memory.

All told, Czech planners have earmarked 1 billion crowns (nominally $150 million) for the country's computer buildup during the current five-year plan. This covers manufacture of 120 second-generation models (mostly Aritma 1010s and Tesla 200s) plus 160 third-generation ZPA 6000/20s and 30s. The rest will be imported from the USSR, except for "certain types" from the West. Production figures will be boosted by exports—mostly peripherals—to the USSR.

In communications, too, Czechoslovakia and the USSR have long-range development projects and delivery programs. Direct subscriber dialing to Moscow was introduced last year, as well as to Berlin and Warsaw. Inside the country, most major cities and towns can now be dialed direct. Tesla's Strašnice plant this year began production of carrier equipment (type KNK-12) which has double the message capacity of installed equipment.

Rudolf Richter, general manager of Tesla's factory in the Slovak town of Liptovský Hradok, announced late last year that by 1975 his plant would be turning out semielectronic exchanges. This changeover from elec-

tromechanical hardware, he emphasized, could be accomplished only through large-scale cooperation among the Comecon countries. "To speed up the development of this new technology," he added, "our enterprise plans to avail itself of the possibility to procure foreign know-how under license agreements—especially for the crucial gating components." Tesla already has licenses from ITT for exchange equipment.

When it comes to consumer products, the Czechs have some of the problems of their capitalist counterparts in Western Europe. The radio market is supersaturated, and last year production sagged to 384,500 sets—32,000 below the 1970 figure. There are some 3.2 million TV sets in service for a population of 15 million, and that's enough to cause a TV sales slump. A second network is spurring sales of tuner-converters; but there appears to be little hope for a brisk market until color comes.

Early this year KOVO signed a 4-million-ruble contract with the Soviet Union for color transmission equipment, promised before 1975. And Tesla's Orava plant is now tooling up to produce color receivers using 23-inch Soviet picture tubes. Tesla expects to turn out some 2,000 to 3,000 of these during the year. The sets can pick up both Secam and PAL colorcasts.

There's static to be picked up, too. Some has come from Josef Kempny, a member of the Communist Party's Central Committee and therefore, a top political leader. He's on record as being against funneling electronic components into TV sets—a glut on the market—when there's a crying need for them in machine-tool control equipment and computers. □

Bulgaria

Most of the economy is to be computer-controlled by 1975 as EDP and electronics production triples

□ It's poorly lighted, but nonetheless, the central corridor of the executive floor in the headquarters building of Bulgaria's largest electronics conglomerate has been fitted out as a photograph gallery of sorts. Along one wall is what Westerners half-expect to find in a land where all business is controlled by the state—a row of portraits of the men and women who make up the central committee of the ruling Communist Party. The other wall, though, holds a surprise for anyone who thinks of the country as mainly a collection of old-world villages.

The portraits look onto a lineup of photos of Bulgarian-made electronic hardware that ranges from pocket radios to riverboat radars. And nestled among these photos is a chart that brings considerable satisfaction to the people who sat for the portraits. The chart shows some of the main goals for electronic hardware production during the current five-year plan—Bulgaria's sixth—which runs through 1975. During the half-decade, the Bulgarians figure they'll at least triple their output of electronic and data-processing hardware.

Like the Russians, whose lead they follow closely, the Bulgarians keep secret the global target for electronics output, but the specific goals on the chart give an inkling of the job state planners expect from Resprom, the organization that groups the state-owned consumer electronics, telecommunications, and medical equipment enterprises in Bulgaria. Output of telephone headsets is scheduled to shoot from 1970's 380,000 units to 550,000 units by 1975. The rise in TV-set production over the same period is pegged from 193,000 units to 240,000; for radios, it is 160,000 to 200,000.

Peter Ovtscharov, Resprom's general director, insists his group will achieve its goals. The same confidence reigns at IZOT, the producing union for calculators and computers. Michni Michnev, deputy director of IZOT, says his group will triple its output during the sixth plan. Between them, Resprom and IZOT account for practically all of the electronics equipment production in Bulgaria, and both topped their fifth-plan goals. A third producing union, Electronum Elementi, handles components.

Overall, Bulgarian planners have pegged a sixth-plan rise of 47% to 50% in national income over the 1970 figure of 10 billion leva ($9.4 billion at the official ex-

Confidence. Michni Michnev, IZOT deputy, insists that Bulgaria can produce most of computers needed to control economy by 1975.

change rate of 1.08 leva per dollar). This rise won't lift Bulgarians to the levels of affluence that West Europeans enjoy, but it will continue to narrow the gap.

The country's planners are counting heavily on computers to help them reach their goals. After culling reports in the Bulgarian state-controlled press, one Western diplomat figures that some 70% of the country's economy is slated to be under computer control by 1975. "There'll be 16 major national systems," he says, "and about 400 installations all-told, including smaller systems." The investment, predicts this diplomat, will run some 500 million leva ($450 million) during the sixth plan.

IZOT's Michnev won't trot out precise figures about the country's data-processing plans, but he makes it clear that Bulgaria is thinking big for a country of 8.5 million people. He says Bulgaria will be fairly well served by regional computer centers by 1975. The major producing unions—which generally group between 30 and 50 factories—will each have systems, and there'll be national systems for keeping tabs on materials, on investments, on labor, and on the over-all progress of the economy. Four hundred terminals would be a minimum, Michnev says. To man all these systems, IZOT has launched a massive training campaign that's intended to turn out 18,000 to 20,000 computer-center personnel by 1975 or shortly thereafter.

Ambitious as the plans are, they won't turn Bulgaria into a burgeoning market for Western computer makers. Michnev insists Bulgaria can satisfy most of her own needs for computers. So far, that's not been the case. A computer head-count made last fall by a Western diplomat turned up some 40 installations. Only 10 used Bulgarian machines, ZIT-151s (roughly equivalent to IBM 360/30s) made under a license from Fujitsu Ltd. Outnumbering the domestic computers were a dozen Russian Minsk 22s, nine IBMs, five Fujitsu Facoms, and three ICLs.

Tough target. Peter Ovtscharov, head of Bulgaria's Resprom, is charged with doubling output of the radio-electronics union by 1975.

But this year, IZOT will phase out the ZIT-151 and put the EC 1020 into production. This is one of the RJAD series of third-generation machines that the Warsaw-pact countries are building jointly. The EC 1020 actually is a stripped version of the EC 2020 that the Russians are producing. IZOT plans to make fewer than 100 this year, but after 1972, its sights are set on "several hundred" yearly.

Counting on calculators

Even that number of computers wouldn't be enough to keep IZOT busy. The union groups 32 enterprises and five research institutes, employing a total of 23,000 people. Another major line for IZOT is desk calculators. As Seraphim Popov, head of the Department of Electrical Industry at the State Committee for Science, Technical Progress, and Higher Education, puts it, "The accent during the sixth plan is going to be on computers, and we'll specialize in small calculators."

IZOT currently turns out some 50,000 desk calculators yearly and plans to triple that figure by 1975. At that time, IZOT's Michnev says, there'll be a range running from eight-digit pocket calculators up to "almost-minicomputers." About one-third of IZOT's desk calculators are earmarked for export.

The first pocket versions—the ELKA 100 series—will go on the market next year if IZOT's plans pan out. The calculators will sell at $80 to $100, says Michnev.

That price, of course, implies a one-chip metal-oxide semiconductor machine. Although the mainstay of the country's sole semiconductor plant at the moment is germanium transistors, the State Committee has put out the word to the components group to get ready to produce MOS as soon as it has mastered silicon technology. France's Thomson-CSF, which still does considerable business in Bulgaria, supplied the germanium know-how. But Popov says the silicon technology is coming from Russia. The under-$100 calculator could even turn up with a liquid-crystal readout. If they can't get their own ready in time, the Bulgarians expect to find a source in another Comecon country; East Germany is the most likely candidate.

Another of IZOT's specialties is high-speed printers for calculators and computer peripherals. The group has developed a "floating" printing technique that spews out numerics at a rate of six lines per second. The technique uses a fixed printing head that works with a moving pressure roller that shoves the printout paper against the head. The wheels on the printing head change positions for succeeding lines as the pressure roller moves back and forth. This is inherently faster than conventional line printers that have the printing head move against the paper after the type wheels have taken their new positions.

As IZOT's 23,000 workers toil to equip Bulgaria where it counts, another 24,000 people in the 30 factories and

four technical institutes of Resprom will be pressing to bolster Bulgaria in telecommunications, consumer electronics, and medical electronics. "We'll double our output by 1975," says Peter Ovtscharov, Resprom's general director. Evidences of strong growth ahead abound at the organization's compound on the outskirts of Sofia. The most striking one is the concrete skeleton for a new 20-story headquarters building.

The upward bound in output will bring with it a change in Resprom's product mix, Ovtscharov points out. Right now, radio and television sets account for about half of the organization's output. Telecommunications hardware comes next at about 30%, and medical equipment—albeit little of it electronic at the moment—covers the balance. During the sixth plan, telecommunications will become the kingpin category, moving up to 50%. There'll also be a surge in medical electronics. Resprom is now negotiating with France's Thomson-Medical-Telco toward a deal for cooperative production of patient-monitoring equipment.

Resprom, of course, will update the technology of its product line between now and 1975. The group's telephone equipment plant currently turns out between 250,000 and 300,000 lines of exchange hardware yearly. The bulk of it uses crossbar switching, but Ovtscharov says the transition to a quasielectronic exchange has begun under a license from West Germany's Siemens. Another newcomer this year to the telecommunications lineup will be multiplex equipment. Here Resprom's partner will be France's Compagnie Industrielle de Télécommunications (CIT), a subsidiary of the Compagnie Générale d'Electricite (CGE). Resprom already has a strong position in telephone handsets, producing 500,000 yearly, and telephone relays—six million a year. The relay plant, Ovtscharov maintains, is one of the most efficient anywhere. Another Bulgarian communications specialty is uhf mobile radios—Resprom turns out 50,000 a year. And it makes navigation radars for rivercraft and Loran gear for sea-going vessels.

Changes are being wrought in consumer electronics, too. So far, TV sets use hybrids, but an all-solid-state portable is going into production. It will have an integrated circuit in the intermediate-frequency stages, says Ovtscharov. Color TV is still years away for Bulgaria, which has only a single black-and-white network. But Resprom plans next year to begin pilot production of color sets for the Secam standard used in France and Eastern Europe.

Except for some table models that have tubes in their final-output stages, all radios are transistorized. Some models, in fact, have IC's—monolithics imported from the USSR and Czechoslovakia, or home-made hybrids. There's a general shift from germanium transistors to more sophisticated silicon transistors, now that Bulgaria has started producing its own.

Ovtscharov says that nearly 70% of the components that Resprom uses are Bulgarian. It's a mistake, though, to think that all its electronics foreign trade is inbound just because Bulgaria imports a substantial amount of the components it needs. A good 40% of the products that come off Resprom's production lines are exported—mainly to Comecon countries and developing countries in Africa and the Near East. For Western producers, then, what little market there is in Bulgaria will be devoted mainly to cooperative deals where there's an inflow of technology. □

Hungary

Computers are needed to control automation and huge expansion of nation's entire industrial base

Any list of Hungarian specialties should have telecommunications equipment and electroacoustics well near the top. And if the Hungarians do what they've set out to do in data processing, minicomputers will turn up on the list before the current five-year plan for the country's economic development is over.

The fourth Hungarian plan, which runs through 1975, plots an annual growth of some 6% for national income. To make that goal, industrial production in the state-controlled economy must increase one-third during the five years. It can't be done simply by channeling more workers to the production lines: there's no surplus labor. What's more, the work week for factory hands is slated to shorten during the plan. That means growth is keyed to higher productivity—automated plants—and, in the words of the plan, "a considerable employment of data-processing."

Considerable, too, is the spending in sight for computers and allied equipment. There's no figure for computer investments in the plan itself, but it's reasonably sure that at least 10 billion forints ($360 million at the official rate of 28 forints per dollar) has been earmarked for computers. That compares to a total of 196 to 197 billion forints ($7.15 billion) destined for improvements in the industrial base, some of which obviously will go for automation equipment. There's good news, too, for telecommunications equipment makers in the plan. Seven billion forints (some $250 million) are tagged for improvements in Hungary's communications network. The big money is ticketed for the telephone network, but there's enough to start a color TV network.

Although the amount set aside to improve telecommunications during the 1971-1975 plan is nothing to sniff at, the domestic market is not where the country's five major producers of telecommunications hardware expect to do their main business. With the aid of an organization called Budavox Telecommunication Foreign Trading Co. Ltd., the Hungarians export some 75% of their output. Gyorgy Kolozs, director general of Budavox, says this boosts Hungary to the top among

Comecon countries if they're ranked according to the ratio of exports to telecommunications production. Kolozs won't reveal Budavox's latest annual sales figures. They're at least $60 million, though, judging from the company's promotion brochures and Kolozs' claim of 8% to 10% in annual sales growth in recent years. The Soviet Union, naturally, provides the biggest market, and most of Hungary's customers are in the seven-nation Comecon bloc. "Some 10% of our sales are outside the socialist countries," says Kolozs.

Hungarian electronics manufacturers have a long national tradition in telecommunications going for them. "The idea of a telephone exchange was first proposed by a Hungarian engineer in 1893, only five years after Bell invented the telephone," points out Laslzo Horvath, a member of Budavox' executive team. By 1924, he adds, the Beloiannisz Telecommunications Works (BHG) was building automatic exchanges under a license from the Bell Telephone Manufacturing Co. in Antwerp, a subsidiary of ITT.

The Hungarians have since severed their ties with ITT and work mainly with L M Ericsson, the Swedish telecommunications giant. It's wrong, though, to surmise that BHG does nothing but produce other people's designs. The company's private switchboard (PABX equipment is of domestic design and so is its quasi-electronic crossbar exchange equipment. Then, too, a line of rural exchanges was developed jointly by the Research Institute for Telecommunication (TKI) in Budapest and a counterpart Russian institute.

Telephone switching equipment, then, is important in Hungary. Exchange hardware, in fact, accounts for 35% of its export sales. Telephone carrier equipment checks in at 20%, and so does narrow-band uhf microwave gear. Broadband microwave adds another 15%, and the final 10% comes from vhf radio-telephone hardware. The Hungarians have worked their way in microwave up to 8 gigahertz in equipment using tubes. They began this year to produce all-solid-state microwave-link hardware for operation at 4 GHz and 6 GHz. Finommechanikai Vallalat and the Orion Radio and Television Works produce the microwave hardware.

For all their success in exports of telecommunications equipment, the Hungarians figure to change their product mix during the current five-year plan. "We're going to concentrate in the area where telecommunications, computers, automation, and miscellaneous equipment overlap," says Norbert Szolgay, drawing a four-circle figure to illustrate his point.

Szolgay is vice-chairman of the Magyar Hiradástechnikai Egyesülés (MHE), an association that guides telecommunications and professional electronics enterprises, including the five that Budavox represents for exports. MHE also has the telecommunications research facility TKI and a research institute for electronics components and instruments under its wing. One of the MHE companies, Remix Manufacturing Co., produces passive components and hybrid microcircuits. Hungary's semiconductor producer, though, is not a member of MHE. The association groups 40,000 peopie.

Exporter. Hungary intends to retain its lead in telecommunications exports, contends Gyorgy Kolozs, head of Budavox.

The shift in the telecommunications group's product mix has been ordained because MHE is once again committed to doubling its output during the five-year plan. The group's combined output now is about $100 million annually, and at that level, logging a 100% increase will be much tougher than it was during previous plans. To pull it off again, Szolgay is sure, MHE must get into fast-growth fields like data-transmission equipment and computer peripherals (computers themselves are out because their production is assigned to others). It's obvious that MHE's own research and development people can't come up with a whole range of original peripherals in time to enable the group to meet its goals. So the association has taken a license from Ericsson for data-transmission hardware. MHE also has licenses for items of communications hardware from France's Thomson-CSF and Italy's Telettra SpA. "We're looking for wider contacts with Western companies," says Szolgay.

As it shifts into fields with fast potential growth, MHE obviously isn't going to give short shrift to its traditional bread-and-butter lines. One that's doing especially well is electroacoustics—particularly high-quality public address systems and audio broadcast-studio equipment. "We're perhaps bigger producers of electroacoustics than Telefunken, Philips, or Siemens," affirms Dénes Huszty, who heads up the 350-man research department at Budapesti Elektroakusztikai Gyar. BEAG is the MHE factory for studio equipment, public address systems, and teaching equipment.

Like the telecommunications producers, BEAG lives

off exports. About 65% of its output goes abroad. The Soviet Union is the ranking customer, but BEAG has sold monitoring loudspeakers—they're ticketed at about $1,000 each—in the U.S. and Canada. In addition to some 2,000 monitoring loudspeakers, BEAG counts on selling around 250 studio consoles, worth anywhere from $5,000 to $15,000 a year.

As a small country not particularly blessed with raw materials, Hungary depends in large measure—roughly 40%—on foreign trade to keep her economy growing. And the government has decided to specialize in lines of products that can be exported and to import what can't be produced economically in the country. This strategy applies especially to data-processing. To achieve the "considerable employ" called for in the five-year plan, Hungary will need many medium-size computers. They'll all come from outside, and until 1975, largely from the West. Meanwhile, the Hungarians expect to become a major supplier of minicomputers for the Comecon countries.

The linchpin enterprise in the minicomputer effort is Videoton, also the largest consumer-electronics producer in the country. Videoton last year geared itself up to start producing a minicomputer designated the 10010, buying the knowhow from the French "Plan-Calcul" firm Compagnie Internationale pour l'Informatique (CII). The 10010, the first French-designed computer produced by CII, has been on the market since 1967. It is an obsolescent machine and not the sort of hardware to build a computer capability around through the mid-1970s. Videoton's mainstay will be the so-called 10010B, a minicomputer developed by CII in France and known there as the Mitra 15.

The first 10010Bs will be built this year, and large-scale production will be achieved in 1973, reports Alexander Lederer, the managing director of Videoton Industrial Foreign Trading Corp. (The trading company is a joint venture of Videoton and the telecommunications enterprise BHG). If the demand is great enough, Videoton may also produce the TPA-1 Hungarian-designed mini, which resembles the PDP machines produced in the U.S. by Digital Equipment Corp.

High-technology components, such as integrated circuits, will be mainly imported. The country's sole semiconductor producer, the United Incandescent Lamp and Electric Co. (better known by its trademark Tungsram), is just now getting into pilot production of ICs.

Most of the Videoton 10010B minis will go to the Soviet Union. They meet the requirements spelled out for minis designated R-10 (or 2010) in the RJAD series of computers that the Soviets and their satellites plan to standardize. In return, the Hungarians will get first medium and then large machines from its RJAD partners. "After 1975," Lederer says, "we expect to be working to a large extent with RJAD machines."

Meanwhile, Hungary will continue to add to its diverse collection of Western computers. At the end of 1970, according to official statistics, there were 120 computers in use in the country. Among them were IBM's 360/40, Honeywell's 2200, International Computers Ltd.'s System 4, Univac's 9500, and Siemens' 4004/35.

The government's long-range plans for data processing don't call for an integrated nationwide network of computers—the ultimate goal in neighboring Rumania and Bulgaria. But the National Technical Development Council, the agency that coordinates the computer efforts among the various ministries, has made a first move toward a more homogeneous computer park.

Overlap. Hungary's MHE is aiming at production that overlaps telecommunications, computers, and automation, says Norbert Szolgay.

Strategy. Alexander Lederer, head of Hungary's foreign trading company, plans sales program for new minicomputer.

"The first question asked is whether new machines we want are compatible with the upcoming RJAD series," points out Jon Szidarovszky, a top computer expert at the Ministry of Transport and Communications.

Szidarovszky already is thinking about the 1980s. "We are looking into training, mathematical models, and the kind of machines that will be needed for the 1981-1985 period," he explains. One aim is a comprehensive information system for shipping by rail, road, and waterway. The national railways and the road-transport monopoly Volán Tröszt already have major computer centers.

The road-transport group, in fact, set up a special enterprise, Volán Elektronika, to run its center. Volán has a fleet of 15,000 trucks plying the country and their operation is 90% "automated" according to vice general manager Jozsef Galántai. The center keeps three Univac computers running 24 hours a day, seven days a week. Galántai estimates it would take 2,000 clerks to do the job done by the computers and the 300 people at the center. Volán Elektronika's engineers and technicians service the Univacs themselves, as well as the 250 Swedish-made Addo off-line terminals that the trust's offices throughout Hungary use to prepare perforated tapes for processing at the Budapest center. The center also produces as a sideline a few two-way radios for the trust's taxi fleet.

The over-all five-year plan makes considerable ado about improving the standard of living: consumption of consumer goods is slated to rise by about 30%. By East European standards, Hungary is already well-off in consumer electronics. There are now some two million TV sets in operation for a population of 10.4 million. That makes Hungary number two, after Czechoslovakia, in TV sets per head.

One obvious reason is that Budapest is so big—nearly 2 million people—that there's an unusually high proportion of urbanites in Hungary. And perhaps competition has something to do with it; both Videoton and Orion compete in the home market. Together, they produce some 400,000 sets, mostly hybrids and nearly all black-and-white.

Around 30% of these sets are earmarked for export. As usual, the big customers are East European countries, but Videoton does well in Scandinavia (about 10,000 sets with pushbutton electronic tuning and a sleek Scandinavian design). As for radios, the country covers about half its needs with its output of table radios; the portables come mainly from Russia. □

Rumania

U.S. may grant "most-favored" trade status as country expands its own electronics industries

□ In many ways, Rumania rates as the maverick among the East European countries. Although Nicolae Ceausescu's government signed a friendship pact with the Soviet Union some two years ago, the Rumanians still strike an independent stance in their relations with Western countries.

Early this year, Ceausescu put out feelers aimed at eventual trade ties with the European Economic Community, the West European trade bloc that for years has been disdained by the Kremlin. And the improved relations with the U.S. that began with President Nixon's visit to Rumania nearly three years ago have reached such a state of commercial chumminess that Rumania seems destined to wind up on the list of countries that get "most-favored nation" treatment from U.S. customs when it comes to levying duties on imports. And Rumania is the only East European country where computer officials tend to change the subject when queried about their country's part in the Comecon program to develop the RJAD unified series of third-generation computers. Rumania didn't join the program.

But like its Comecon partners, Rumania has ambitious plans for the growth of its electronics industries. The government's plan for economic growth calls for a rise of 13.2% a year in gross national product during the 1971-1972 period. Output of electronics and telecommunications hardware is pegged to more than double during the five years—from 4.16 billion lei ($695 million at the official rate of 6 lei per dollar) last year to between 9.5 and 11.1 billion lei ($1.57 and $1.83 billion) in 1975. Even sharper is the ascent in store for automation equipment and data processing. This sector is scheduled to rise from 1971's 1.46 billion lei ($245 million) to somewhere between 4.4 and 4.8 billion lei ($735 and $800 million) in 1975.

Some sectors of electronics, in fact, are slated to spurt 25% each year. And the people charged with turning the plan's projections into hardware are confident they can turn the trick. "We met our goals for 1971 and we had excellent results during the first two months of 1972," said Virgil Lefter when interviewed in March. Lefter is technical director of CIA (acronym for the Rumanian phrase that means "Industrial Group for Automation)—one of two electronics conglomerates formed last year to strengthen the structure of the sector. The other is CIETV (for "Industrial Group for Electronics and Vacuum Techniques"). The two employ more than 40,000 workers in a score of factories, most of them around Bucharest.

Neither CIA nor CIETV expects to go it alone technologically to stay on target. Three of CIA's main fields are telephone equipment, automation equipment, and medical electronics. Its telephone-equipment enterprise Electromagnetica turns out crossbar exchanges in a

modern factory built under a $10-million-plus deal for a license and knowhow with Bell Telephone Manufacturing Co., an ITT subsidiary headquartered in Belgium.

The automation-hardware factory of CIA, picked up its technology from Japan's Hokushin Electric Corp. CIA's partner in medical electronics is the Compagnie Générale de Radiologie, an affiliate of France's Thomson-CSF. Although they've needed to lean heavily on outside technology so far, Rumanian hardware makers have begun to develop their own techniques, particularly for automation equipment, Lefter insists. "We're building static motor controls with Rumanian silicon transistors," Lefter says.

For computers, too, the plans are ambitious, and the technology needed to implement them is imported. The long-range goal is a nationwide system for economic planning, says Vladimir Ticovschi of the Central Institute for Automated Management Methods. This institute and the National Council for Science and Technology are the prime movers behind Rumanian data-processing plans. The Institute does the planning and the training; the Council allocates the means to get the job done. Already the Institute has eight regional data-processing centers in operation. It's gearing up to train "tens of thousands" of computer personnel—from punchkey operators to systems analysts—by 1975.

The machine that Rumanian computer officials expect will be their workhorse by the mid-1970's is the Felix 256. It's none other than the IRIS 50, the first machine developed in the "Plan Calcul" scheme by France's Compagnie Internationale pour l'Informatique (CII). The Rumanians will produce the Felix 256 under a license knowhow deal with the French. The computer rates as "medium." Its central processing unit handles 102 instructions with an average speed of 6.6 microseconds; the basic memory unit has a maximum capacity of 256,000 octets (eight-bit groups) and a cycle time of 950 nanoseconds.

Electronum, the state company for foreign trade in electronics equipment, already has a brochure out on the Felix 256. But it will be well toward the end of the year before production starts at CIETV's computer factory Fabria Calculatori Electronice (FCE), says Boldur Barbat, who's in charge of "exterior relations" for the conglomerate.

Barbat says the number of Felix 256s that FCE makes will depend on many variables, among them the ratio of domestic and imported components. The higher the domestic content, of course, the more machines will be produced. The National Council for Science and Technology doesn't spell out its plans to outsiders, but one of its officials says the capacity for Felix 256 production is 50 machines a year. FCE will make only the central processor and the disk memory units; the bulk of the peripherals will be imported.

When Felix 256 production starts to build up next year, it seems inevitable that the market available to Western companies—CII excepted—will start to dwindle, despite the upward bound in the Rumanian computer population. That market falls somewhere between $20 million and $40 million, estimates a U.S. official who has ferreted out what information is available. (Business facts and figures considered routine in Western countries are sometimes classed as state secrets in Rumania. A recent Trade Secrets Act makes it an offense to disclose business information without authority.) A further closing of the computer market will come if the Rumanians succeed, as they plan, to get a domestically developed minicomputer into production by 1974.

There's little doubt that the integrated circuits for FCE's Felix 256 will have to come from outside at first. For nearly a decade Rumania has had a semiconductor plant at Baneasa on the outskirts of Bucharest, a plant built with the aid of a technology buy from CSF before it was merged with Thomson-Houston. But not until last year did the Baneasa plant begin the step-up from germanium to silicon transistors, and the switch is still under way. There's a second semiconductor plant down on the worklist for the current plan; presumably it will turn

About Poland

Poland is conspicuously absent from this report only because Polish officials, like most of their counterparts in other East European countries, move in their own mysterious ways. *Electronics'* correspondents based in Paris and Frankfurt started arranging visits in the East European countries back in January, but officials at the chamber of commerce in Warsaw, which handles all arrangements for outside journalists to do stories on Polish industry, have adamantly refused to set up any interviews before June. Their explanation: An official round of visits to Polish electronics enterprises has been scheduled then for a small group of foreign business journalists; therefore, nothing doing beforehand. An *Electronics* staffer will probably make the tour and file a report for publication this summer.

Data flow. Ion Uidila, communications director, says that Rumania's telephone network can handle 2,400-baud transmissions.

out the ICs for Rumanian-built computers.

Look for linear ICs made in Rumania after the digital situation is in hand—perhaps in 1974. That's the year when plans call for the first linears to turn up in Rumanian radios and TV sets. Here's how the schedule looks: This year the changeover from germanium to silicon transistors will start for radio sets. The last table model with tubes in the output stages will be phased out of production during 1973. During this time, more and more TV sets will become hybrids, and by 1973, an all-solid-state miniature black-and-white receiver could be in production. The prototype will be ready by the end of 1972, but production won't start until Electronum finds customers in export markets.

All this upgrading in consumer-electronics technology will be coupled with strong gains in output by the consumer-electronics enterprise Electronica, another CIETV subsidiary. Radio sets are pegged to rise from 480,000 units last year to between 660,000 and 700,000 in 1975.

For video receivers, the figures are 305,000 units for 1971 and 500,000 to 550,000 for the last year of the plan. That's more than enough to cover the country's needs; there are no appreciable imports.

Getting programs out to the roughly 1.7 videoviewers is no problem. A full 90% of Rumania's 20.5 million inhabitants are within range of the transmitters of the first network, which broadcasts 70 hours weekly. The second network, which is on the air 30 hours weekly, now covers only 13% of the population, however. At the moment, there are no plans for color TV. Among other things, a color set would represent something like nine months' pay for an unskilled worker.

But the "owner" of the Rumanian airwaves, the Ministry of Transports and Telecommunications, does have ambitious plans for its communications network. The telephone network is in good shape; calls between the 20 main cities can be dialled automatically. The quality of the telephone network is high enough for 2,400-baud data transmission without special precautions, affirms Ion Uidila, the ministry's director for telecommunications. The ministry's own research institute has developed the modems needed to superimpose modest data-transmission facilities onto the telephone network. Uidila says that there'll be enough to handle the expected traffic through 1975 at least. All the same, the ministry has started to plan a 12-channel network that seems sure to become necessary eventually.

Modems are not the only hardware with which the ministry gets directly involved. It has under its wing an outfit known a Icret (Enterprise for Construction and Repair of Telecommunications Equipment). Icret produces fm transmitters and TV translators; the ministry also hopes to get production of microwave relay equipment started before the year is out.

The microwave net is so extensive that "by 1975, we'll have to start using 9-gigahertz equipment," explains L. Constantinescu, the ministry's technical director. The 4-GHz band is full; the 6-GHz and 7-GHz bands are almost full, and the 8-GHz band is filling up fast. □

Rumanian automators. Virgil Letter (above) is technical director for automation, and Vladimir Ticovschi specializes in management.

Money matters

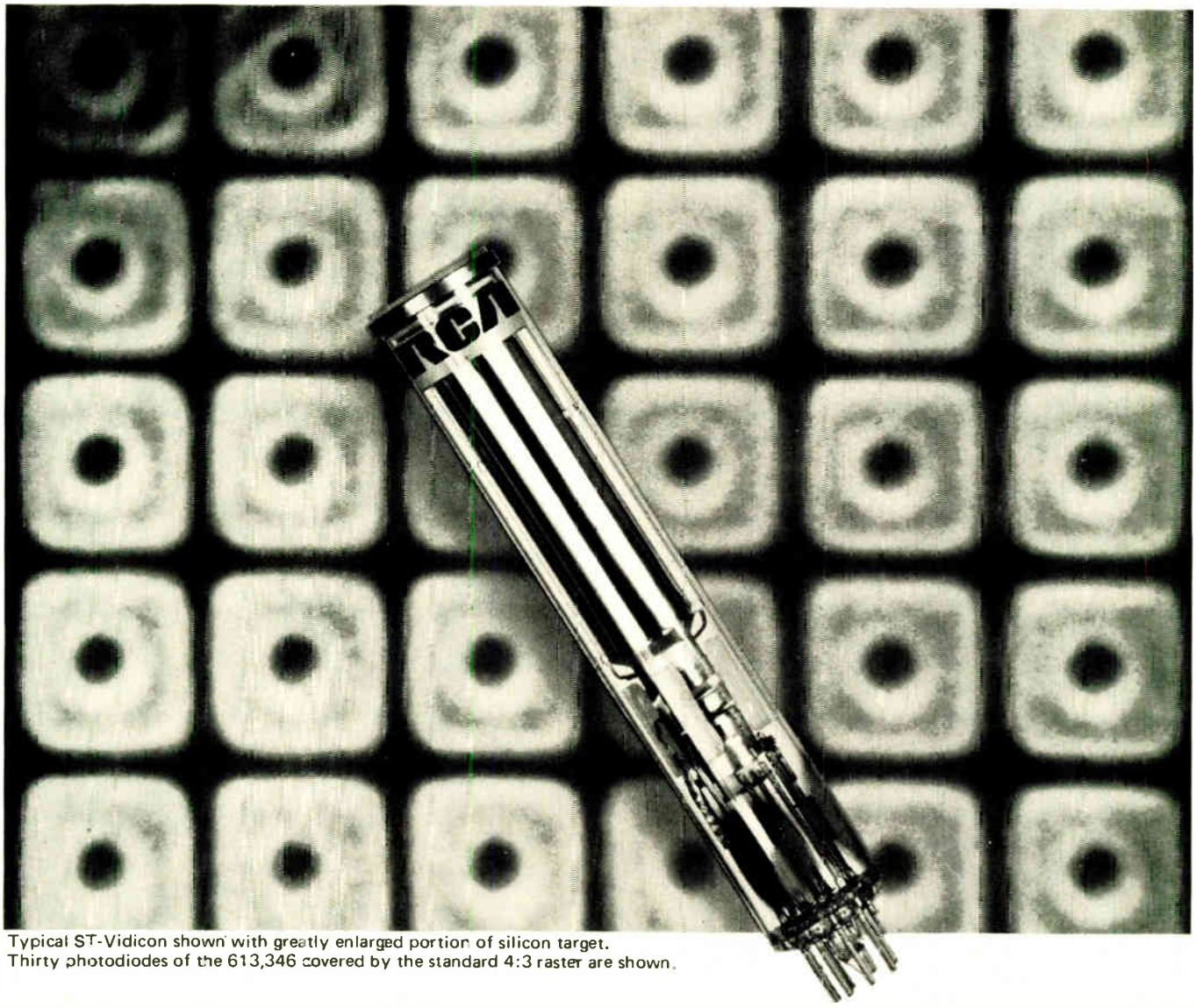
The numbers game becomes bewildering when it's played with Comecon currencies. They're not convertible, as are the currencies of the industrialized countries of the Western World. So there's no market effect to peg them against other currencies. A Russian ruble, an East German mark, a Czech crown, a Bulgarian lev, a Hungarian forint, or a Rumanian leu is "worth" what the government that mints it says it's worth.

Usually, countries hold their money in too high an esteem. The official rates for East bloc currencies overvalue them. Some countries own up to this— indirectly—by paralleling the official rate with a "tourist" rate that gives visitors from outside the bloc more local currency for their dollars, francs, Deutsche marks, or pounds sterling. The official rate in Rumania, for example, is six lei per dollar; tourists get 16. The disparity dwindles in other countries.

Throughout this report, figures that came from East bloc sources are given in the national currency, with the dollar equivalent at the official rate in parentheses. A dollar figure alone means that the information originated outside the bloc.

This special report was coordinated by Arthur Erikson, Managing Editor, International, with contributions from staffers John Gosch, Michael Payne, and Charles Cohen and World News correspondents Axel Krause, Moscow, and David Left, Prague

1,577,703 Photodiodes



Typical ST-Vidicon shown with greatly enlarged portion of silicon target.
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RCA Electro Optics

Output comparator enhances versatility of one-shot

by Harvey J. Scherr*
Westinghouse Corp., Systems Development Div., Baltimore, Md.

If an operational amplifier is used as an output comparator, a monostable multivibrator can provide wide and accurate output pulses over a broad temperature range. The one-shot is also retriggerable—that is, its output pulse duration can be extended by reapplying the input pulse. In addition, this multivibrator can be reset to accept a new trigger input within its timing period.

Each time an input pulse occurs, timing capacitor C_t is discharged by field-effect transistor Q_1, and comparator A_1 switches off. In the absence of a trigger input, C_t accepts charge from Q_1, and the comparator is turned on. Switching takes place when A_1's input voltages, e_1 and e_2, are equal. Because the comparator is off during the timing interval, there are no output errors introduced by op-amp input offset current.

Output pulse width, T, is determined by the supply voltage, V_{DD}, reference voltage, V_R, and the timing components, R_t and C_t. At the comparator's input:

$$e_1 = e_2 = V_{DD}\exp(-t/R_tC_t)$$

which can be rewritten as:

$$\exp(-t/R_tC_t) = V_{DD}/e_1 = V_{DD}/[V_RR_2/(R_1+R_2)]$$

Output pulse width becomes:

$$T = R_tC_t[\ln(V_{DD}) - \ln(V_RR_2/(R_1+R_2))]$$

If $V_{DD} = V_R$ and $R_1 = R_2$, this equation reduces to:

$$T = R_tC_t\ln(2) = 0.694R_tC_t$$

The timing equations illustrate that output pulse width is completely independent of any transistor junction voltage and therefore is independent of junction temperature dependence. Op-amp offset voltage drift principally determines the one-shot's temperature performance. And since offset drift is typically as low as 10 microvolts/°C, total variation in the multivibrator's timing interval is only about 0.002%/°C.

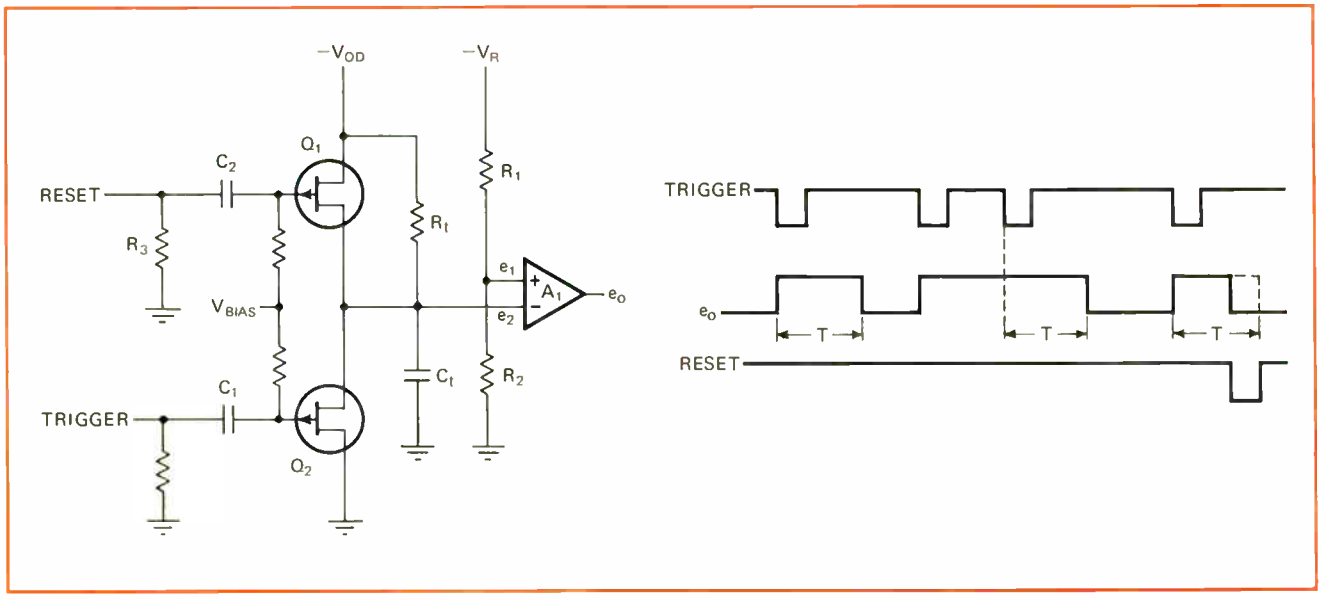
Unusually large time constants can be achieved because the primary restriction on the value of timing resistor R_t is op-amp bias current. R_t must be small enough to allow the voltage developed at A_1's inverting input to turn the comparator on. Since op-amp bias current generally ranges between 0.25 and 0.5 microamperes, resistor R_t can be as large as 10 megohms (when V_{DD} = 10 volts and e_1 = –5 V).

As illustrated in the timing diagram, the multivibrator can be re-initiated during its timing interval to stretch output pulse width. This is possible because transistor Q_1 discharges capacitor C_t every time an input pulse occurs. By adding transistor Q_2, capacitor C_1, and resistor R_3, the circuit can be reset by restoring it to its stable state. A fixed-width reset pulse cancels the remaining portion of the output pulse.

Substituting a resistor for capacitor C_2 alters the multivibrator's timing—a time out then occurs with the absence of a negative voltage from the input terminal. Circuit output polarity is easily reversed by interchanging the connections to the comparator's inverting and noninverting inputs. The active devices used determine component values. □

*Now with Stereo Equipment Sales Inc., Baltimore, Md.

Retriggerable monostable. Input trigger causes Q_1 to discharge capacitor C_t, turning off comparator A_1 and producing output. Before timing period is over, new trigger can be applied to extend output duration. Reset pulse through Q_2 can terminate output during any part of timing interval. Output comparator maintains one-shot temperature stability and permits unusually large time constant to be used.



Series resistance improves potentiometer linearity

by Harry H. Schwartz
Electrodesign Ltd., Ville Lasalle, Quebec, Canada

Adding a series resistance to one end of a loaded linear potentiometer can reduce loading error by a factor of five or more. The price for this gain in linearity is a voltage loss across the pot. But losses in amplification or drive in the order of 3 to 4 decibels can usually be tolerated in view of the marked improvement in linearity.

As shown in (a), voltage E_i is applied to potentiometer R_p and series resistor R_s. The load resistor is R_m, the output voltage is E_o, and θ is the per-unit variation of the pot wiper. Letting:

$Y_\theta = E_o/E_i$, $P_m = R_m/R_p$, and $P_s = R_s/R_p$

the voltage transfer function can be expressed as:

$$Y_\theta = \theta P_m/(P_m P_s + P_m + \theta P_s + \theta - \theta^2)$$

If $Y_0 = Y_\theta$ when $\theta = 0$ and $Y_1 = Y_\theta$ when $\theta = 1$, then output impedance ratio Z_o is:

$$Z_o = Y_\theta/Y_1 = \theta/[1 - (1 - \theta)(P_s - \theta)/(P_m + P_s + P_m P_s)]$$

For three points of this equation, the values of Z_o and θ are the same; or, since there is no linearity error, then $Z_o = \theta$. These points occur at $\theta = 0$, $\theta = 1$, and $\theta = P_s$.

The well-known curve (b) for a loaded potentiometer can be written in terms of θ and P_m:

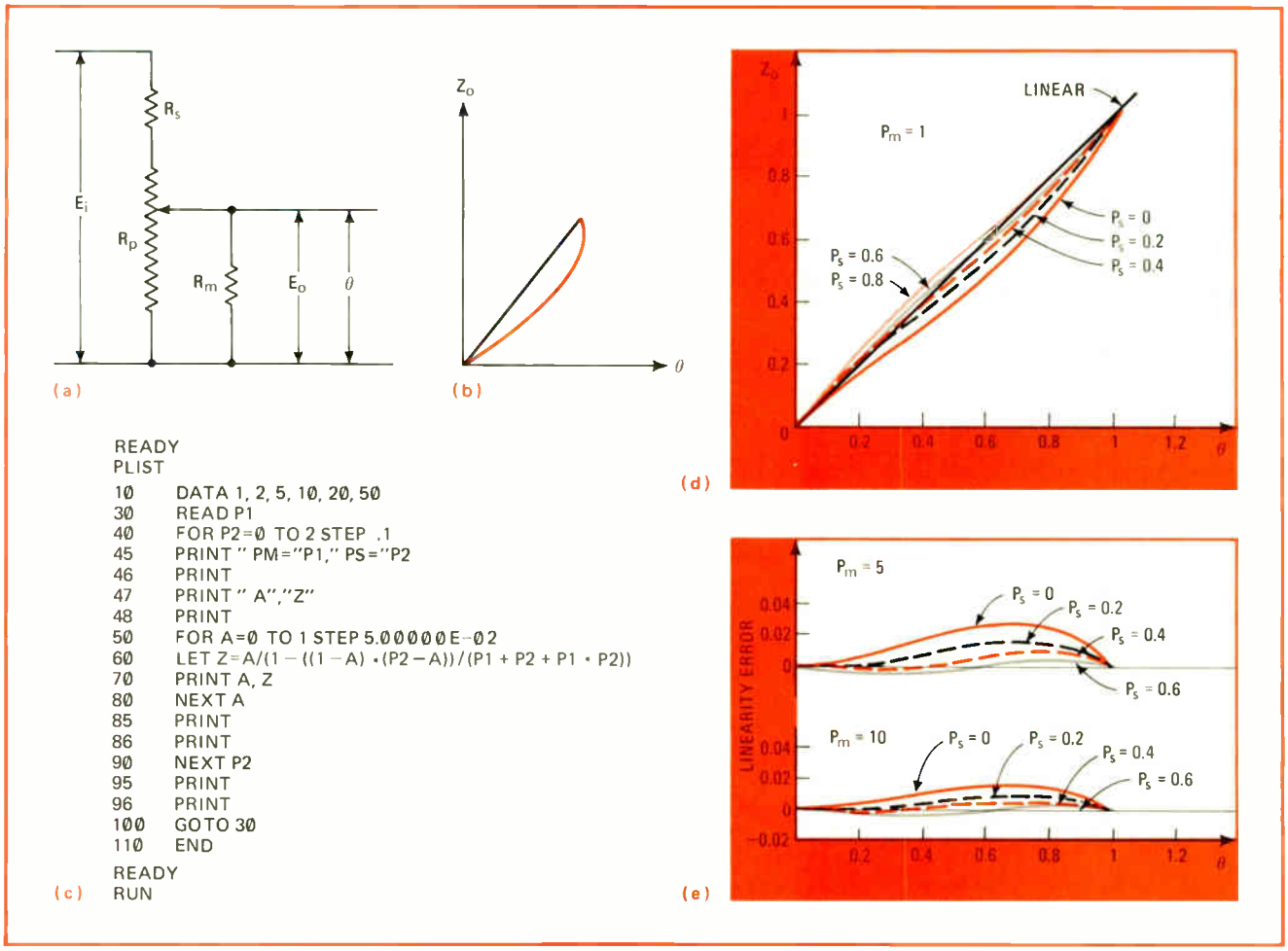
$$Z_o = \theta/[1 + \theta(1 - \theta)/P_m]$$

When the load resistance is very high, P_m approaches infinity, and the pot output is the straight black line. For finite values of P_m, the nonlinear colored curve is obtained. As P_m becomes smaller, linearity error grows.

A short computer program (c) that solves the general equation for impedance ratio Z_o can be used to determine the effect of series resistance ratio P_s for various values of load resistance ratio P_m. Generally, the larger the magnitude of P_s, the greater is the error reduction. The program varies P_s from 0 to 2 in steps of 0.1 and θ from 0 to 1 in steps of 0.05 for P_m values of 1, 2, 5, 10, 20, and 50.

The plot of (d) shows that output linearity for $P_m = 1$ is improved by a factor of five when P_s is increased from 0 to 0.6. In (e), linearity error is plotted against θ for $P_m = 5$ and $P_m = 10$ for P_s values between 0 and 0.6. Again, linearity is greatly improved. Values of P_s should be held to 0.5 or less so that the series voltage loss is tolerable. □

Reducing loading effects. Output of loaded potentiometer (a) becomes nonlinear, as shown by graph (b), with smaller load resistance ratio ($P_m = R_m/R_p$). Increasing series resistance ratio ($P_s = R_s/R_p$) decreases loading error and improves linearity. Computer program (c) finds output impedance ratio Z_o for several values of P_m, P_s, and wiper position θ. Graphs (d) and (e) show effect of P_s on Z_o and linearity error.



Circumventing BCD addition in digital phase-locked loops

by Larry Martin
Hewlett-Packard Co., Palo Alto, Calif.

Many of the applications for a digital divide-by-N phase-locked loop require the locked oscillator to be offset by a fixed frequency. Usually, the first stage of the programable binary-coded-decimal divider circuit adds the input frequency to the desired offset frequency. This BCD addition, however, can be eliminated by detecting the proper number at the output of the counter divider chain.

If a receiver is tuned to 118.15 megahertz, and its intermediate-frequency stage is at 10.7 MHz, the local oscillator must then operate at 128.85 MHz. A standard divide-by-N circuit (a) adds the i-f frequency to the input frequency, takes the BCD nines complement of the sum, and then loads the result into a programable counter divider chain. Detection occurs when the counter outputs are all nines. The input number is then reloaded on the next clock pulse and the process repeats.

Let N be the input number; in this case, N = 11815 and the desired offset is 1070. The number at the outputs of the BCD adders is N + 1070, which becomes 19999 –(N + 1070) at the outputs of the complementing circuits. Therefore, the number of counts that occurs before the divider resets is the divider state that is sensed. Or, the input frequency is divided by:

19999 –[19999 –(N + 1070] = N + 1070

which can be rewritten as:

19999 + 1070 –(19999 – N) = N + 1070, or

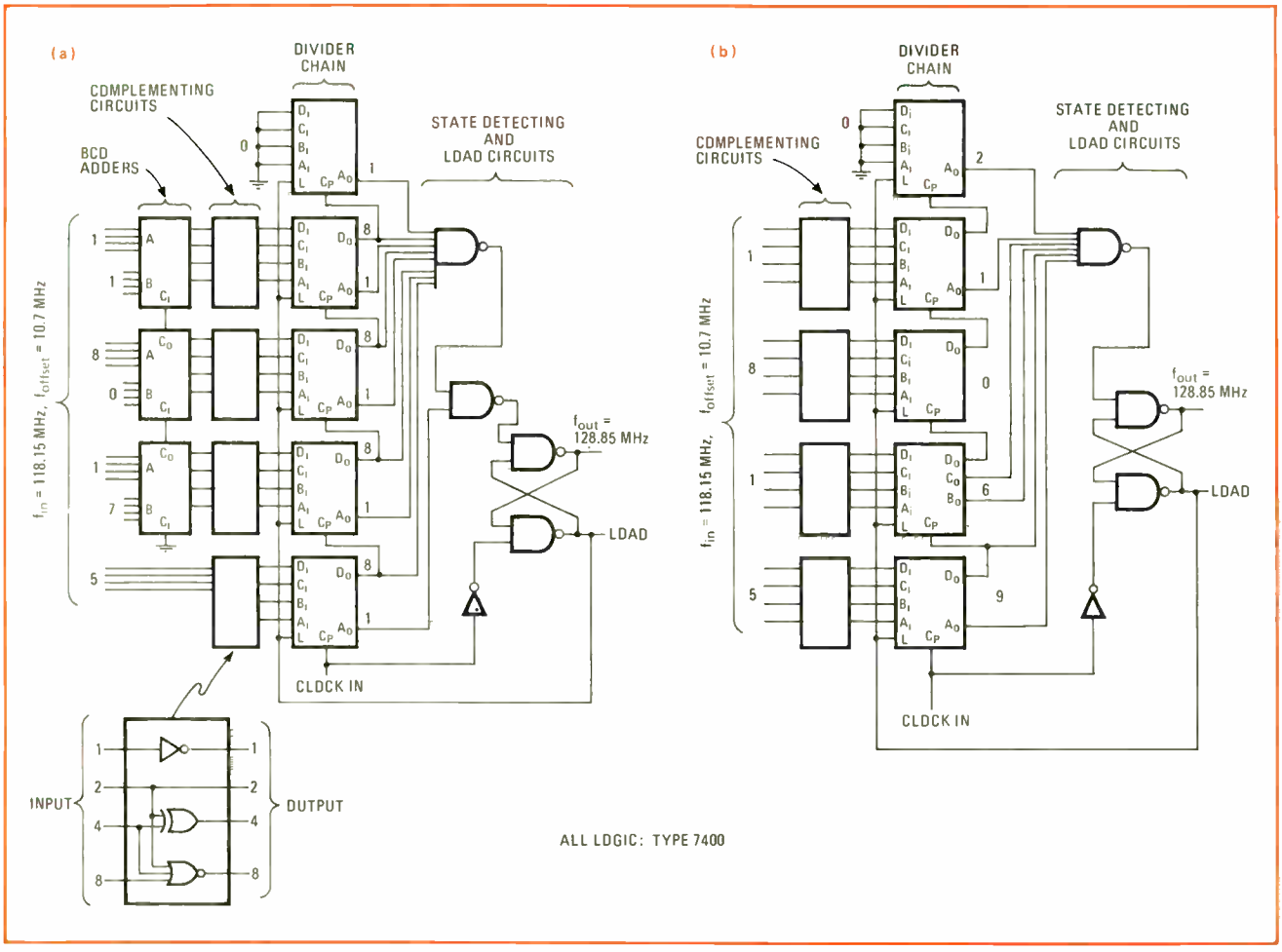
21069 –(19999 – N) = N + 1070

By counting to 21069, instead of 19999, the proper number of counts still occurs before the divider resets. The BCD adders, then, can be removed simply by detecting a different output state of the counter, as shown in (b).

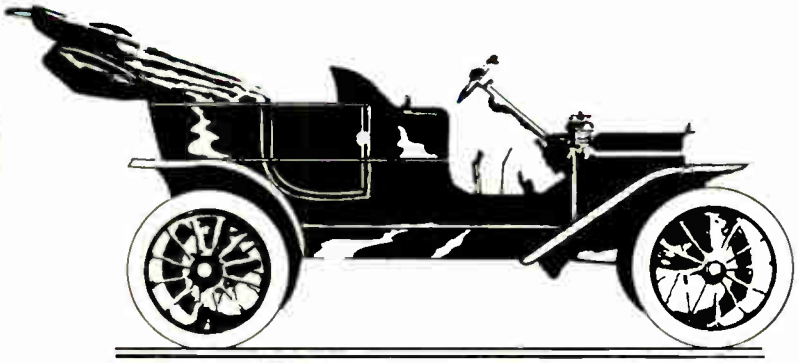
Since the divider is an up-counter, detection of the desired output state should be done when the proper outputs are ones. Because there are only six ones in 21069, as opposed to nine in 19999, one fewer output gate is needed. □

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.

Frequency offsetting. Standard divide-by-N circuit (a) sums input frequency (118.15 MHz) with offset frequency (10.7 MHz), takes nines complement of sum, and then detects signal when counter outputs are all nines. BCD adders and one output gate can be omitted, as in (b), by detecting sum of nines complement and offset frequency (19999 + 1070 = 21069). Correct count is still reached before divider resets



It came in one color only



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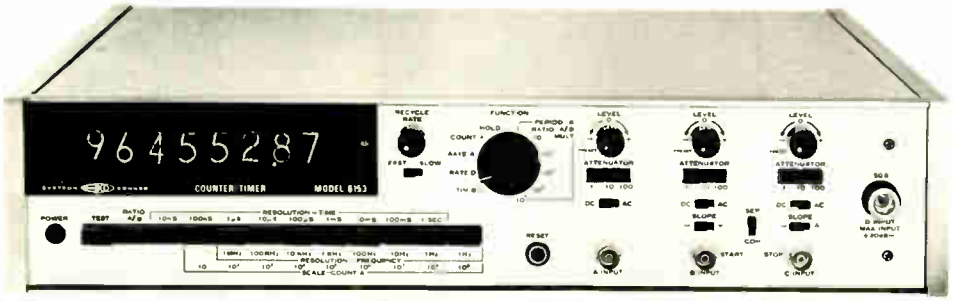

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SPECIAL REPORT

Plastic cavity packages for MOS LSI fill a very present need—but for how long?

Pre-molded cavity packages are now being made by several manufacturers; but their ultimate staying power in the business is threatened by the specters of low-cost ceramics and fully molded plastics

by Stephen E. Scrupski, *Packaging & Production Editor*

☐ The pressure to produce low-cost MOS circuits for commercial and consumer equipment—the $99 calculator, for example—is steadily increasing the pressure to reduce chip packaging costs. And because traditional ceramic packages are not getting significantly cheaper, many MOS makers are turning to plastic.

Some large MOS houses are achieving the lowest possible costs by molding their own plastic packages, but other companies, both large and small, haven't yet made the investment in equipment and engineering time that the process needs. Instead, they are turning to pre-molded plastic cavity packages, which they either make to their own design or buy from outside suppliers.

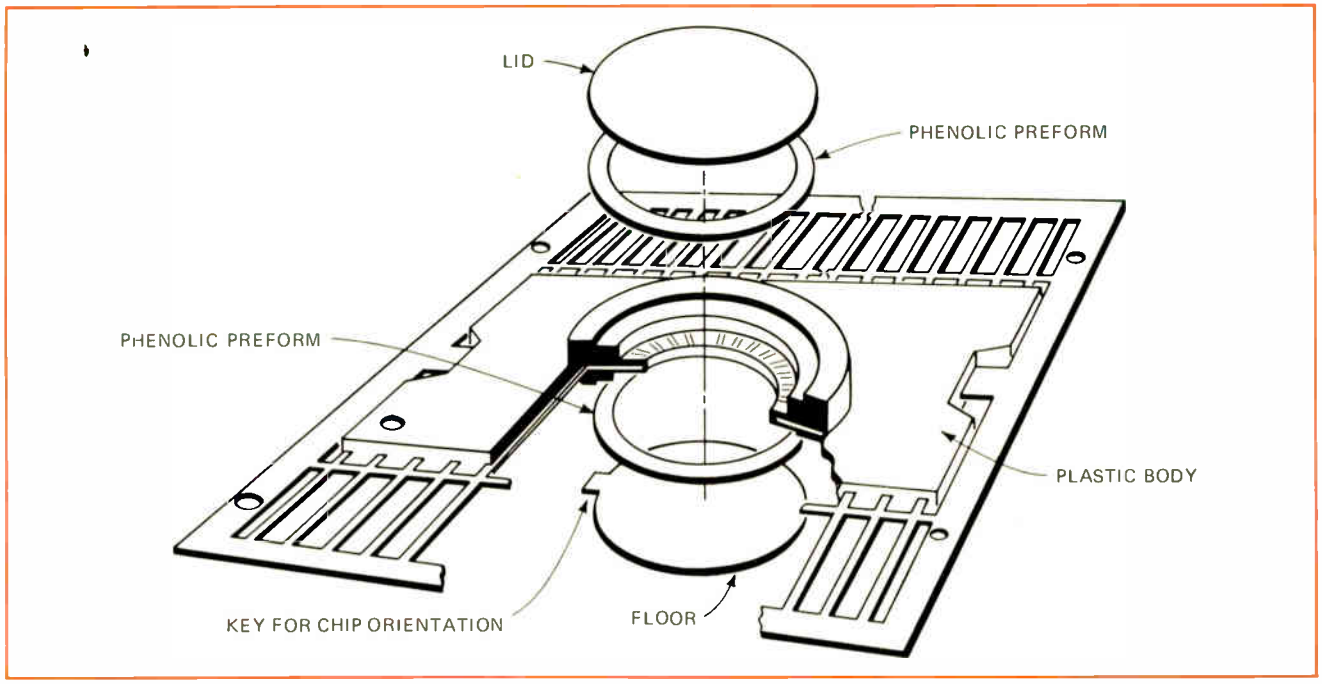
Many users of the plastic cavity package have appeared during the past year, and every producer of it is making bullish comments on the potential market. The big lure is the low-cost calculator market. According to one semiconductor maker, the commercial-equipment market is more than ready for the low-cost packages. "They're trying to sell calculators for less than a hundred bucks," he says, "and if they can get a lower price on the devices because of lower-cost packages, that's fine and dandy."

But the jury is still out on the cavity package. Before it can play an important part in packaging MOS LSI devices, it could get caught in a squeeze between a wider production of completely molded packages by the semiconductor makers themselves and new low-cost ceramic packages.

The twin pressures

On the one hand, as the chips themselves become more resistant to contamination, more people will consider completely molded plastic packages. Molding still introduces the possibility of wire-bond failures—though at least one in-house molder (National Semiconductor) claims that such failures are significantly decreased with the use of the new so-called epoxy B (actually an epoxy called Polyset supplied by Morton Chemical Co. of Woodstock, Ill.).

1. It all fits. North American Rockwell Microelectronic Co.'s plastic cavity package, being made primarily with 42 leads on 50-mil centers, allows die to be attached outside package. Die is bonded to bottom disk, which has key to assure proper die alignment in package.



As for low-cost ceramic packages, on the other hand, there is the leadless, side-metalized ceramic package for use in a receptacle [*Electronics,* March 27, p.119] that was initially developed by Kyocera International for Fairchild Semiconductor. Another is the thick-film lead-frame-last concept being promoted by du Pont [*Electronics,* April 12, 1971, p.75]. And semiconductor companies themselves are working to design a low-cost ceramic package. American Microsystems Inc., Santa Clara, Calif., for example, is just about ready to announce a package at half the price of previous ceramic packages, says its packaging manager James Barnett.

That is certainly about the price cut that would be needed to make ceramics cost-competitive with plastics, for at present plastics cost in the 25 to 40 cents range, ceramics around 95 cents to $1.00. That simple comparison does not tell the entire story, either. The difference is more like 80 cents versus $2.00, because the semiconductor manufacturer tests only packaged devices, and if the yield at that point is only 50%—a not uncommon figure—then he must buy twice as many packages as he actually ships out the door.

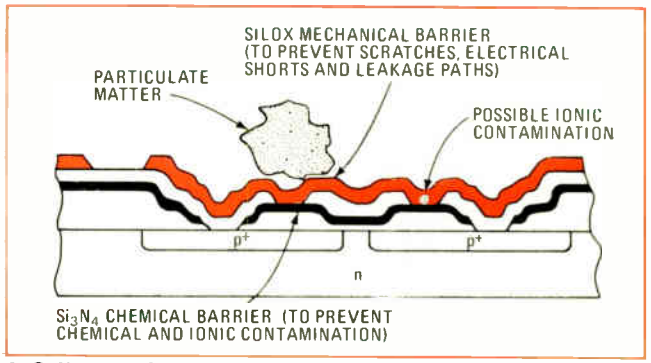
Summing up the situation is Glen Madland, president of Integrated Circuits Engineering, Phoenix, Ariz., a long-time consultant and custom producer of integrated circuits. He says: "The swing-over to cavity plastic remains very much undecided, although there is some use of the cavity package already, and it appears that it's going to find some sort of position." In saying that the idea is basically sound and eliminates many of the failure modes inherent in molded plastic, Madland echoes much of the industry's thought. But he still sees its ultimate usage hinging on the price-volume descending staircase.

Who makes what

Besides National Semiconductor, the semiconductor companies molding their own packages include General Instrument, Signetics, and Texas Instruments. Of the five companies presently producing pre-molded cavity packages, two—North American Rockwell Microelectronics Co., Anaheim, Calif., and MOS Technology, Fort Washington, Pa.—are making them for their own use, while commercial packages are available from U.S. Electronics Services Corp. (USES) of Clifton Heights, Pa., Wells Plastics of California Inc., (formerly Interbond Systems) of Sunnyvale, Calif., and Semiconductor Components Substrates Corp. (SCS) of Garland, Texas.

As for their customers, USES says it now has three high-volume users and three more who will swing over in the next two months. Wells says it has two big users for its package. NRMEC's package is in use at Monroe Calculator, Victor Comptometer, and presumably at other high-volume customers. MOS Technology's package is beginning to be used, and SCS's package is just now being introduced, with volume production slated for the third quarter.

Recently USES licensed E.I. du Pont de Nemours Electronic Products department, Wilmington, Del., which expects to be producing the USES package by the end of the year. But one other company that announced a plastic cavity package last year—Centralab division of Globe Union Inc., Milwaukee, Wis.—aborted its program shortly after the announcement, on the grounds that the responses from the marketplace didn't justify continuing the project.



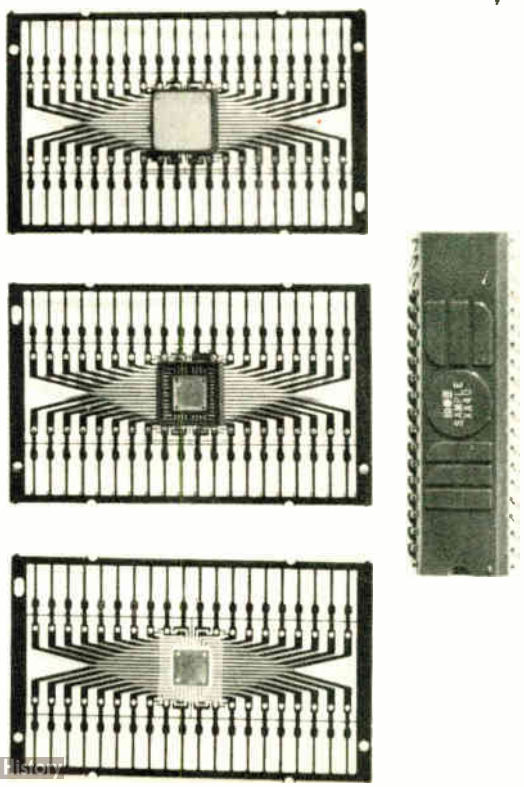
2. Self-protection. Key to NRMEC package is two layers of protection—silox for mechanical and silicon nitride for chemical—applied to chip. NRMEC says package gives gross mechanical protection.

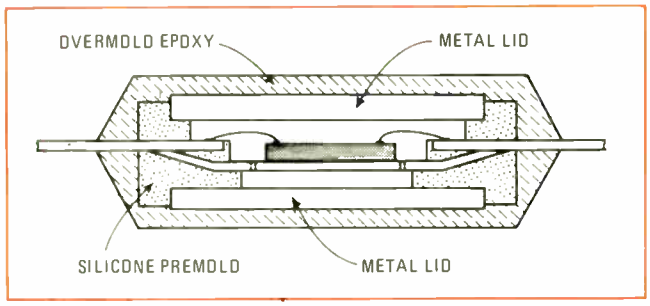
The USES unit

The USES package, the only one to carry claims of hermeticity, is designed around the company's ability to deposit metal on plastic. A standard lead frame is prepared by bending up the tips of the leads so that, when the plastic substrate is molded over them, they will emerge more or less flush with the plastic surface. This substrate is then metalized with conductor patterns that contact the lead frame tips, an interface that provides a seal against moisture. Next, another layer of plastic, with a square hole in its center for the chip, is laminated over the first, and selective plating is applied to the die-attach pad and to the exposed ends of the conductor paths in the cavity. The package is then ready for wire-bonding.

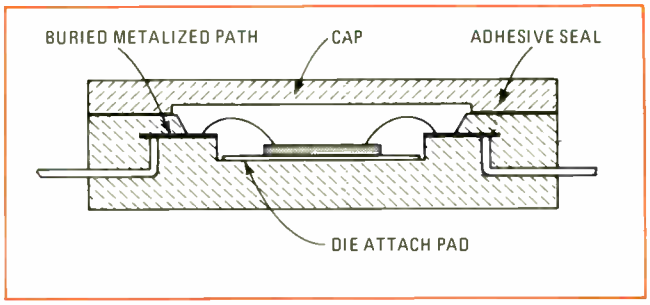
According to USES, hermeticity results from the seal

3. Double mold. In MOS Technology package, lead frame is selectively plated (bottom), silicone is molded around cavity (middle), which is sealed with lid and floor (top) and overmolded with epoxy.

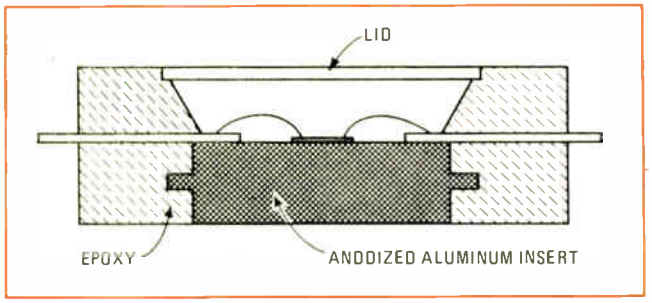




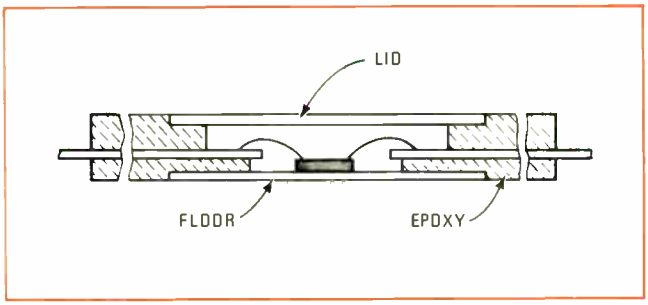
4. Well covered. MOS Technology package uses silicone for moisture protection and epoxy overmold for good seal to lead frame. With lid and floor in place, only possible thoroughfare for moisture penetrating plastic is narrow sidewalls of silicone.



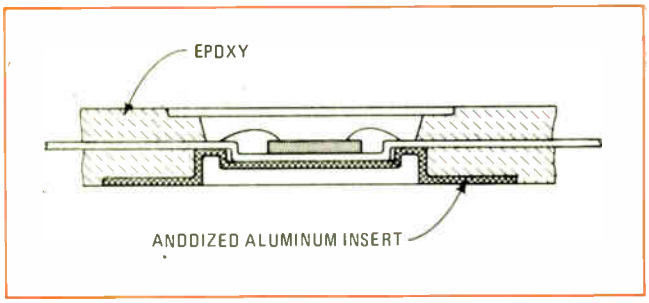
7. Metalized plastic. USES package is made by bending up tips of lead frame and molding plastic body so that tips just emerge from top surface. Metalization connects lead frame to central cavity area. Another plastic piece is cemented over metalization to form cavity.



5. Strong support. In Wells Plastic package, semiconductor die is ultrasonically bonded to anodized aluminum disk, which provides mechanical support. Die-attach pad is bent down to allow uphill bonding. Cavity lid is sealed with cement.



8. Around floor. NRMEC package is molded around lead frame, and die is attached separately to bottom metal disk with phenolic preform. Chip is wire-bonded with up-hill bonding, and lid is attached. Leads are protected in cavity by compliant coating.



6. Molding job. SCS Corp. package uses anodized aluminum insert to hold chip. Insert is molded into package during molding operation. Anodization provides insulation between insert and die-attach pad and lead frame, which are in mechanical contact.

of the metalization over the tips of the lead frame. Because the lead frame does not itself penetrate all the way into the cavity, it leaves no through path for moisture, as dye tests show, says Ray Martino, USES vice president. He explains that in packages where the lead frame does extend into the cavity, an acceptable seal is difficult to attain because the plastic must carry mold-release agents which prevent its adherence to the mold walls— and which may also have the same effect on the lead frame seal.

This explanation is questioned, however, by those building packages that way and also by a manufacturer of epoxy used for molding. The important points, they say, are to shrink the epoxy into a tight seal around the lead frame, and to apply a mold-release agent to the mold walls only, rather than mixing it with the potting compound.

One drawback of the USES package, which the company says it has now solved, was that it previously could only be used with ultrasonic bonding, and not with thermocompression ball bonding, which requires temperatures too high for plastic. However, a new epoxy and thicker plating results in a package that costs 10% more but is suitable for thermocompression wire bonding, says USES technical service manager, Michael D. Jenner. And to meet the added emphasis on more complex circuits that generate more heat, the company says it is now able to supply metal heat sinks molded directly into the package.

USES says it is confident of the package's hermeticity and will soon be trying for military approval. "Five guys put it through Mil Standard 883 tests," says Martino, "so we know we can pass the military tests."

DuPont's position

The big shot in the arm for USES, however, came earlier this year, when du Pont signed the agreement to become a second source for the package. This action of du Pont's—which, as Martino says, is "not a rinky-dink second source"—will certainly have a strong effect on whatever doubters remain in the industry.

Nonetheless, the large company also has a strong effort underway in ceramics packages, and with the USES agreement may just be hedging its bets. John J. Cox, du Pont division packaging manager, acknowledges that there still is a wide preference in the industry for ceramics, as well as much pressure to go to in-house molded plastics. In du Pont's estimation, the USES package gives a low-cost option to the smaller semiconductor companies who might not have the technical ability to develop their own molded packages.

The du Pont plastics facility will be in "modest production" by the end of the year, Cox adds. USES also will be increasing production—it will duplicate the production facilities at its present home, an old mill-type building in Clifton Heights, with new facilities at a new building in Lawrence Park, Pa.

Wells Plastics is a subsidiary of Wells Electronics, Inc., South Bend, Ind., whose president Ray Larson says there are two large-volume customers for the package—one in the commercial equipment field and the other in low-cost appliances and automotive equipment. Second-sourcing of the package will be handled in South Bend, he adds.

Wells' package

The Wells package is still basically the same as the Interbond package of a year ago. The lead frame, with the die-attach pad fixed to it, is molded into a plastic body along with an aluminum insert that serves as a rigid support for the chip during ultrasonic bonding of the lead wires. The insert is anodized to provide electrical insulation between itself and the lead frame and die-attached pad, with which it is in mechanical contact. The cavity lid is sealed with epoxy.

The package from SCS Corp. is similar in construction to the Wells package. It was developed for the company by Paul Fletcher, now director of SCS's plastics program, but formerly the vice president and a founder of Interbond Systems.

SCS specifications

According to SCS marketing manager Don Fleming, the package will not be marketed as a replacement for ceramic packages, and will not be military qualified. "We're not going to pretend that a plastic package could be," says Fleming. The package will carry leak rate specifications of 10^{-5} cubic centimeter per minute of helium, although Fleming adds that tests have shown a capability up to levels of 10^{-7} to 10^{-8} cc/min of helium. Such performance however, will not be guaranteed as part of the specification.

Like du Pont, SCS has both the ceramic and plastic areas covered. But Fleming maintains his two packages serve different markets: "Some people are trying to take ceramic technology, which is basically a high-performance technology, and force-fit it into a low-cost situation. But plastic will offer acceptable performance at considerable savings." The package will be priced at about "half the price of ceramic," he says, adding that prices could drop below a penny a pin—below 40 cents, say, for a 40-lead package—as soon as volume grows.

Will ceramic package prices come down to this level? Fleming denies it: "The ceramic package, as we know it now and as we envision changes, will still not achieve the cost-effectiveness that our customers are demanding. A plastic package is the way to go for low costs. Obviously, we have ideas on how to make the ceramic package more attractive, but such ideas will not cut the price in half."

On the bonding capability of his company's plastic package, Fleming cites a recent experience, where he took the packages into a prospective user's plant, put it on an ultrasonic bonder that was set up for ceramic, and without even adjusting the machine, bonded successfully. "They were not the best bonds in the world, because the machine was not finely tuned," he acknowledges, but the demonstration showed the customer that he didn't have to develop a new bonding technology to accommodate plastic.

NRMEC's design

The key to the NRMEC package, the company says, is the protection given to the chip before it is inserted in the package. The package itself is a simple affair, a 42-lead unit similar to earlier ceramic packages used at NRMEC. A lead frame is molded into an epoxy plastic substrate, which has a hole in the middle to serve as the chip cavity. A chip is attached to a separate gold-plated Kovar disk, which is then cemented to the lower side of the cavity, becoming its floor. The chip is then wire-bonded, and a similar gold-plated Kovar disk is cemented in place as the lid. Phenolic preforms are used as the cement.

The chip itself is given two protective coatings in the final stages of its processing. The first is a silicon nitride chemical barrier, to prevent chemical and ionic contamination, and the second is a silox mechanical barrier, to prevent scratches, electrical shorts, and leakage paths. A compliant coating is applied after wire bonding to prevent corrosion of the bonds. The cavity package was preferred to chip encapsulation for fear that thermal expansion could cause wire-bond failures, the company says. Since the chip is eutectically bonded to the bottom disk, problems of die-attach pad warpage found in ceramic packages are avoided.

The MOS Technology model

MOS Technology, an affiliate of Allen Bradley Co., has developed a plastic cavity package that actually lies somewhere between commercial cavity packages and in-house molded packages—it has no visible sealed lid once it's finished, but is completely overmolded with epoxy—Morton Chemical Co.'s Polyset.

Two molding operations are performed. First, the lead frame, with die-attach pad, is molded into silicone, the central area being left free to form a cavity around the pad. Second, after the chip has been bonded to the pad, the wire-bonds made, and two gold-plated Kovar disks placed on each side of the cavity, the assembly is completely overmolded with Polyset.

According to Alan McDulin, MOS Technology's manufacturing engineering manager, who formerly worked on the molded LSI packages at Texas Instruments, the silicone-epoxy combination reduces occurrence of the moisture penetration that corrodes aluminum. Silicone, the first encasing medium is more resistant to moisture than epoxy. However, epoxy provides a better seal to the lead frame than silicone and better resistance to salt-spray corrosion, as well as better flexural strength.

Having a cavity around the chip rather than encapsulation McDulin adds, eliminates the problems of surface effects on the MOS chip and intermittent connections of the bond wires. The cost of labor in assembly of the package is about equal to that of a ceramic package, but the plastic package yields are higher.

The two basic problems in completely molding LSI

packages lie in handling the flimsy lead frame and in preserving the wire bonds (80 bonds for a 40-lead device) under the high pressures of the molding press.

Those who mold

Of the semiconductor companies molding their own LSI packages, Texas Instruments has been at it the longest—more than a year. "As far as we are concerned, molded plastic is the way to go," says Daniel Baudouin, MOS standard products program manager. Well over half of TI's production now is molded, says Baudouin—an estimate that includes the 40-lead LSI package. One advantage of such a package, says Baudouin, is that it can easily handle large chips—230-mil square chips are an everyday job.

National Semiconductor says that it now is shipping 40-lead molded packages. One of the keys to it, according to Gene Hnatek, National's military products manager, is the so-called glassivation layer applied to the chip before encapsulation. "We use glassivation on everything except the high-speed line because it slows it down," he says.

Silicone is more expensive than the epoxy that National has now started using for all its molded devices, but that's not the only reason for National's switch. Also important are the material's own properties. The new epoxy, according to National, is "phenolic-cured" which leaves it ion-free, while its high shrinkage rate in the mold causes the epoxy to keep the chip, lead wires, wire bonds, and lead frame under compression, thus eliminating wire fatigue and eventual failure under temperature cycling. Moreover, the epoxy's glass transition temperature (the temperature at which a plastic's coefficient of expansion suddenly increases) is higher than 150°C, the worst-case operating temperature. Conventional epoxies have transition temperatures in the 110°C to 120°C range, and put extra thermal stresses on the wire bonds when packages made of them are heated beyond this range.

Signetics, though now delivering only 24-lead molded packages, is tooling up for a 40-lead version. In Signetics' case, the silicon-gate structure of its chip is cited as extra protection for the chip along with glassivation.

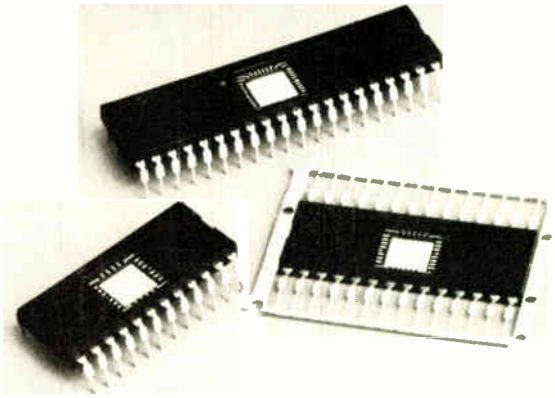
General Instruments also says it is molding up to 40 leads in prototype form, but the maximum it now has in production is 36 leads for a special customer.

AMI is a third company developing a 40-lead molding capacity. According to James Barnett, AMI packaging manager, his company opted for silicone as the encapsulant rather than the new epoxies, because though "some may claim quality, it's the lower cost that's forcing the decision to go to epoxies."

Barnett also predicts that the ceramic package now going into production for AMI will compete directly with plastics—"some day, after many millions of packages it will go out the door, fully yielded, at 35 cents." This estimate of his includes the cost increases due to poor yields on bad devices.

Users' views on the variety

One user of both types of plastic-packaged MOS LSI is Monroe Calculator, Orange, N.J. The manufacturing manager there, Dino Sirakides, says that for about four



9. Ready to go. SCS Corp will soon be ready to supply a variety of plastic cavity packages made with aluminum insert to provide support for ultrasonic bonding. Die-attach pad is part of lead frame and is bent down before molding.

to five months now he's been using cavity-type packages from NRMEC and molded packages from TI, and "we are very happy with them so far." He points out that the packages are pin-to-pin compatible with ceramic counterparts, so that the changeover meant no changes in manufacturing procedures.

Another plastics user is Victor Comptometer, Chicago, Ill. Director of components research J. Earl Thomas, says, "we have no prejudice against them." He says Victor has seen no fault with the cavity types from NRMEC it has been using, pointing out that NRMEC designed protective layers onto the chip itself so that moisture has no effect on it. When NRMEC proposed the changeover, he says, he evaluated the new packages and was able to find no defects that could be traced to package failures.

The 18-lead USES package is being bought by General Electric's Integrated Circuits Center in Syracuse, N.Y. Fran Erwin, process specialist in charge of IC assembly and packaging there, says that the commercial equipment that his company has slated to use these devices is unlikely to encounter severe environments, and in order to capture the contract for it he looked for a way to provide fast turnaround with a low-cost commercial package.

An initial problem, says Erwin, was the ultrasonic bonding of the lead wires. The plastic tended to absorb the ultrasonic energy, and the bond to the metalized conductor finger in the cavity was sometimes questionable. He found the solution by specifying 100 microinches of gold for the conductor plus a harder plastic for the body, and by setting the ultrasonic energy at a little higher level than is normally used with ceramic packages. The 100-microinches of gold is an expensive cure, but on balance it is one that is acceptable for now.

One cost advantage of the plastic package, he points out, is that its price includes the lid and epoxy preform. On ceramic packages, he says, most quoted prices do not include these two parts, which could easily cost an extra 10 cents per package. Further, he notes, the preforms for ceramic packages are an item of high slippage—"you're always losing the things, as girls flip them around," and this factor increases package costs. □

OPINION

Getting jobless EEs back to work

It is imperative to reorganize the Government's machinery to maintain an inventory of the jobs available and the skills of the men to fill them; completely new training and placement programs are also needed

by William F. Hafstrom,* *Skills Conversion Project, Cocoa Beach, Fla.*

☐ In an engineer's career, there's probably nothing as traumatic as being laid off and discovering that his next job is going to be difficult to find. It's one thing to recognize that economic downturns create unemployment—that's something that happens to the other guy—but it's quite another to be the one caught in the cutback.

For the engineer dropped from a technology-intensive industry such as aerospace, in a declining market with little or no outside help available, the problems of relocation seem insurmountable. As anyone who has worked with unemployed engineers and scientists may observe, adjustment to these hard realities is painful.

However, there's not much point in dwelling on how the economy got that way, nor in what befell many of the unemployed. Instead, a closer look at the tools available to put these engineers back to work may be more valuable. One brutal fact is that a good many long-unemployed engineers will have left engineering entirely before any organized assistance can be of help. Many others will have to move into engineering jobs outside their main interests.

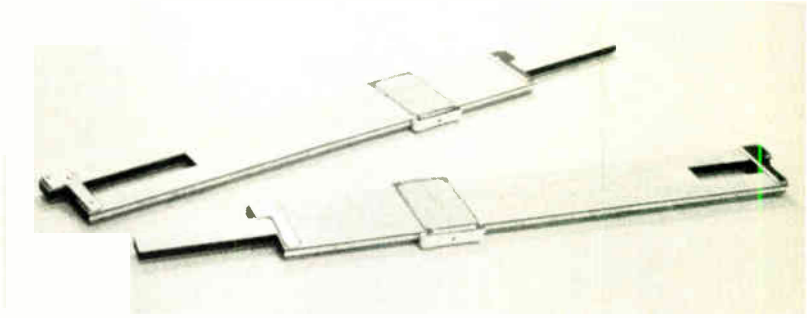
The first problem in dealing with unemployed professionals is the lack of solid figures on how many are out of work or underemployed. Consequently, it is difficult to get a picture of the specific skills represented by the unemployed pool, the age group, location, or current source of income, if any. Various registries for resumés can provide clues, but these are not definitive.

Professionals tagged

The result is that both Government and industry have been working with generalizations that lump the unemployed under the label, "ex-aerospace engineers." Attitudes about what an ex-aerospace engineer is vary, but quite often these professionals are branded as "gold-platers" and "financially irresponsible."

Another factor muddying the unemployment situation is that of perspective. Estimates of how many engineers are on the beach have ranged from 65,000 to 150,000. Based on a conservative estimate of the ratio of engineering salaries to sales dollars, it would require an increase of $30 to $75 billion in the industrial sector to absorb the jobless. This expectation is unreasonable.

It is also unreasonable to expect that increased spending by the Federal Government, if it should materialize, would alleviate the plight of the engineers walking the streets today. There's no clear indication that the specific skills required for new Federal projects such as transportation and the ecology can be satisfied from the unemployed pool, particularly since many job-seekers appear to be from middle management and above.



In short, there is no panacea for reemploying the engineers left high and dry by the ebbing economy. Time and energy may be used more productively in trying to improve the machinery of job development and placement, as this activity has been neglected during the plush days of high employment among engineers.

State employment services, funded primarily by the Department of Labor, have always had the responsibility for placing unemployed professionals in jobs, but through the years of engineering shortages, there has been little need to develop a separate capability to implement this service. Because agencies tend to concentrate on immediate problems, most state services are oriented toward placement of unskilled workers, and their activities are primarily localized.

Professional job placement consultants, commonly called head-hunters, have neglected the unemployed professional as well. These agencies have always concentrated on recruiting engineers who have jobs. Even now, a consultant—fearing resistance to paying a fee—would hesitate to suggest an unemployed engineer to a client. So from a purely practical standpoint, they make little effort to consider unemployed engineers.

In some cases, part of the value of the job candidate may be that he has been attracted away from a competitor. Yet, in some respects, these consultants have failed to sell clients on their most important service—helping employers define job needs and then matching the candidates, no matter what their employment status, to those jobs.

*Now with the Denver High-Impact Anticrime Program, Denver, Col.

Looking for jobs

Unemployed engineers have available two computerized registries operating nationwide to locate jobs. Both will accept resumés at no cost to the applicant.

The National Registry for Engineers, 800 Capitol Mall, Sacramento, Calif., is operated by the California Department of Human Resources Development in cooperation with the National Society for Professional Engineers. The program, set up by the Manpower Administration of the Labor Department, uses the 2,000 local offices of the state employment services.

Engineers can get standard registry forms from any of these offices or directly from the Registry office. Prospective employers can also get job order forms from these offices and receive without charge computer printouts of "referral profiles." While the Registry uses a computer to match resumés with job orders and sends the profiles to prospective employers, it leaves follow-up and job negotiations strictly to the two parties.

Another registry, called GRAD, for Graduate Resumé Accumulation and Distribution, is operated by the College Placement Council Inc., P.O. Box 2211, Bethlehem, Pa. Endorsed by the Engineers Joint Council, GRAD is more employer-oriented than the Registry, but it charges the employer for the service, based on need.

Job candidates stay in the GRAD computer file for six months or until placed. An employer can get information from this file by telephone, mail, or directly online by teletypewriter if necessary. Thanks to the computer memory, an employer continues to receive resumés of new candidates with specified qualifications as they enter the system. Employers order the number of resumés they want, rather than take potluck.

According to the EJC, the cost to most employers is about $300 per person hired. Job applicants can get forms for this service from the Engineers Joint Council, 345 E. 47th St., New York.

In the past year, the Technology Mobilization and Reemployment Program (TMRP) and the Volunteer Engineers, Scientists, and Technicians (VEST) program in the 14 areas of most severe technical unemployment have augmented state placement activities. However, these projects are still primarily oriented to local areas.

The Registry reviewed

The National Registry (see "Looking for jobs", p. 108) is also a recent service provided by the Department of Labor on a voluntary basis. It has not been as effective as expected because many engineers have apparently decided that the Registry is a waste of effort. On the other hand, many small companies that might ordinarily use this source of manpower information do not know that it exists.

In addition, state employment services have usually worked with the personnel departments of industries in the areas they serve. But, as any experienced engineering professional who has ever looked for a job knows, the personnel department is not the place to go because the real hiring is done by the engineering manager or his equivalent.

Companies that have used the Registry have been discouraged by the results. Partly because they did not adequately describe the positions available or because the Registry desires to expose as many unemployed engineers as possible to each opening, large numbers of resumés have flooded inquirers, who are then unable to evaluate them all. Had the results been foreseen, the desired number of resumés could have been specified.

The VEST program, patterned after the "40 Plus" middle-aged mutual benefit group programs, is organized and managed by the Aerospace Industry Association of America, representing the Joint Societies Employment Advisory Committee on a Labor Department contract.

Although the placement record from this program has been good, the percentage of unemployed engineers and scientists actually participating has been small. Moreover, since the volunteers are all ex-aerospace people, there is little first-hand knowledge within the project about other industries.

The Skills Conversion Project is another program conducted by the Joint Societies Employment Advisory Committee under a Labor Department contract. Fourteen teams across the country are investigating job development potential in non-defense, non-technology-intensive industries. This project uncovered some immediate openings for engineers and turned these leads over to the VEST program and state employment services for implementation. The project also unearthed some potential jobs that will require additional training or orientation for engineers.

Retreading tried

The National League of Cities/Conference of Mayors has pursued yet another plan in which 388 engineers and scientists received intensive courses in urban affairs in the hope of preparing them for positions in city, county, and state governments. The joint sponsors, the departments of Labor and of Housing and Urban Development, intended these engineers to fill middle-management slots. Although nearly 300 of them have been reemployed, less than 200 landed government jobs.

Common to all the programs based on the transfer of skills from one field to another are the fears of failure by both engineer and employer, accompanied by a lack of mutual understanding. There is evidence that some companies have attempted to take advantage of the retread programs by underemploying experienced engineers. In general, it's clear that the supply of technical manpower still exceeds the demand; therefore, there is little incentive for hiring the retread from an unrelated field unless it is evident that the engineer can make a definite contribution. The result has been time-consuming retraining of engineers with no guarantee that there will be jobs waiting.

As discouraging as the results of these projects have been, they have provided insights into what might be done next to change the unemployment picture. It's clear now that an engineer has to make a complete commitment to skill conversion because the problems of breaking into a new environment quickly break down the resolve of a lukewarm convert.

Yet, altering the perspective of the unemployed won't do much good without also providing effective tools for

getting new jobs. The present program for job placement assistance, including the projects discussed here, are far from adequate to cover the scope of the problem. The state agencies are swamped, and the new programs, VEST and TMRP, have not attracted enough support from either the unemployed or employers.

The first priority, therefore, is to provide the jobless with a new professional placement bureau. As a starter, this move should include elevating within the Labor Department the level of responsibility for engineering placement and authority. Only a few administrators are participating from the department's Manpower Administration. Their clout is a $42 million appropriation for the TMRP. The department's ponderous organization, divided into many autonomous groups, inhibits their activities. As a result, the $42 million has become an embarrassment almost impossible to apply directly to the placement of engineers.

Placement bureau needed

Although this suggestion may be criticized as forming yet another bureaucratic empire, a special group at a significant level within the Labor Department ought to have the responsibility for developing and administering placement programs for engineers and scientists. This staff must have the responsibility for all the resources required to accomplish the job—a data bank, placement consultants, and training funds.

Using the successful techniques developed by private head-hunters as a model, the job placement system in the Labor Department should be re-oriented. Instead of concentrating on the unemployed, it should focus on the employer.

The employment consultant understands that the best way to fill a job is to start with an adequate definition. He exerts great effort to define his starting point, rather than sending the employer on a wild goose chase. This capability does not exist in the public sector. Instead, the public system supplies as many resumés and candidates as possible, a procedure that helps few.

Therefore, a part of the new professionals' service should be a personal, employer-oriented counseling/placement function geared to defining needs and screening potential candidates. This plan could be handled on a regional basis.

Attempts to place professionals have usually started with the assumption that large groups of engineers could go through a crash educational program and quickly fill large technical voids in other sectors of the economy. In practice, these voids have not been found, but this fact does not obviate the necessity of rethinking the problem and reversing the procedure by finding the job opportunities before conversion.

Along this line, effort should be made to merchandise the employment services available to prospective employers, especially among small and medium-size firms. This information should go directly to managers and engineering department heads, rather than personnel directors, since these are the ones who actually hire engineers. Another positive step is to provide greater cross-fertilization of career opportunities and background to all engineers. Engineers experienced in the aerospace environment have little understanding of how their counterparts perform in other industries.

This may be closing the barn door after the horses have gone; however, dissemination of job opportunities in various industries by the Labor Department and professional societies could help head off a future unemployment crunch.

Quicker benefits sought

A near-term step should be to expand the National Registry. While a complete file of all the unemployed engineers is a valuable immediate goal, a more practical ultimate objective would be a registry of all professional manpower—employed as well as jobless—that could provide a basis for identifying an unemployment problem early and help to begin shifting to openings elsewhere. As it is presently run, the Registry only goes half-way, which raises expectations hard to satisfy.

Private management consultants can also contribute to revamping the professional placement system. These organizations have the expertise, but have generally avoided the unemployed as unsalable. A commitment on their part to include unemployed candidates in filling jobs could change this negative attitude and put the contribution of the consultant into proper perspective.

Meanwhile, the Federal Government, through funding, will have encouraged state, county, and city governments to employ more engineers. Certainly the necessity to work out solutions to such technical problems as law-enforcement techniques, wired cities' cable television services, mass transit, and the like is clear and present. Tying professional employment to aid programs could pry open the doors to local governments.

At the heart of these recommendations is formation of a national plan for technical manpower, an idea which probably would have seemed absurd in the past. Yet by adding projections of manpower requirements, the output of universities, and the attrition rate to the basic registry, this country could be in a better position to forecast its needs for engineers and respond before another unemployment crisis once again squanders highly trained men. □

Grass-roots reaction

William Hafstrom knows what he's talking about when it comes to employment programs for engineers. As head of one of the regional Skills Conversion Program teams, he discovered at first hand the problems and frustrations of finding jobs for out-of-work professionals. He also found out what the other programs were doing and had an inside look at the Department of Labor.

It is from these grass-roots observations that he prepared this article calling for changes in the way engineers and scientists receive employment assistance.

Hafstrom is also a personal example of converting aerospace knowhow to other jobs. A veteran of aerospace firms on both coasts, he is now working for the Denver, Colo. anti-crime program. This project, supported in part by the Law Enforcement Assistance Administration, is aimed at developing data systems and computer-assisted control programs for police work in major cities.

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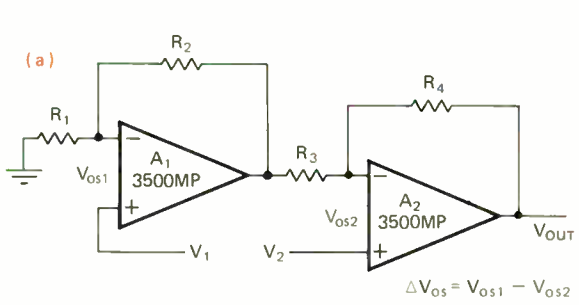
Drift-matched IC op amps can save money

by Larry Choice,
Burr-Brown Research Corp., Tucson, Ariz.

Using the right drift-matched IC operational amplifiers can drastically cut the cost of any multiple op amp circuit that requires low-offset voltage drift. Several individual low-drift IC op amps are presently available with guaranteed nulled-offset drifts as low as 0.6 microvolt per degree centigrade over varying temperature ranges. They cost $16.30 to $50.75 in quantities of 100. Also available are drift-matched IC op amp pairs which can provide performance equal to two unmatched units each with a drift of ±0.5 μV/°C, yet are about half the cost of two of the least expensive unmatched low-drift units. Moreover, they need no external offset nulling to achieve low drift.

Just as transistors can be drift-matched, amplifiers can be matched for minimum "differential" (between two devices) offset voltage (ΔV_{os}) and minimum "differential" drift. Unfortunately, today's dual IC op amps, unlike dual transistors, do not in general have good matching for offset voltage and drift; the best match is



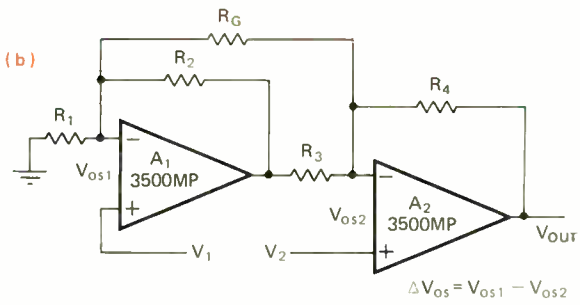
$\Delta V_{os} = V_{os1} - V_{os2}$

FOR $R_4/R_3 = R_1/R_2$

$V_{OUT} = [1 + (R_4/R_3)][(V_2 - V_1) - \Delta V_{os}]$

ADVANTAGES
- HIGH INPUT IMPEDANCE
- SIMPLEST CIRCUIT

DISADVANTAGES
- MINIMUM GAIN ≅ 10 (TO PREVENT A_1 FROM SATURATING WITH LARGE COMMON-MODE VOLTAGES)
- DIFFICULT TO VARY GAIN: $A = 1 + (R_4/R_3)$



$\Delta V_{os} = V_{os1} - V_{os2}$

FOR $R_4 = R_1$ AND $R_3 = R_2$

$V_{OUT} = [(V_2 - V_1) - \Delta V_{os}][1 + (R_4/R_3) + 2R_4/R_G)]$

ADVANTAGES
- HIGH INPUT IMPEDANCE
- GAIN VARIABLE WITH SINGLE RESISTOR (R_G)

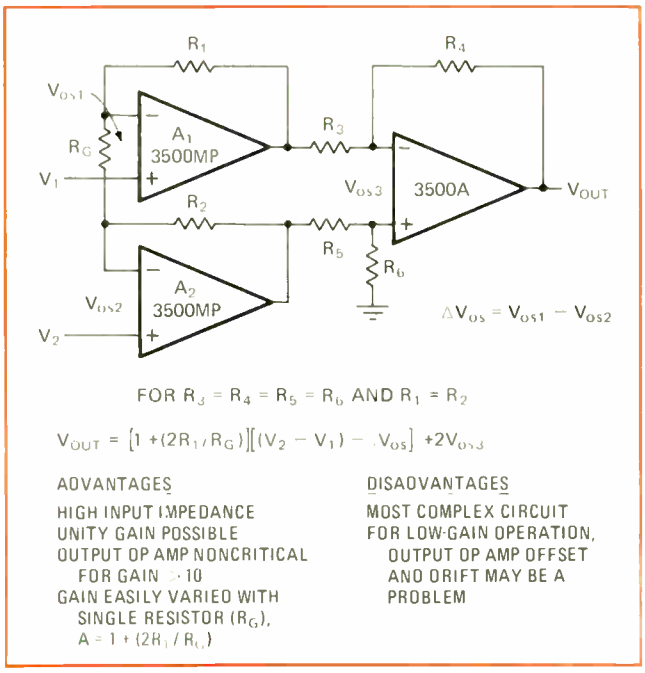
DISADVANTAGES
- MINIMUM GAIN ≅ 10 (TO PREVENT A_1 FROM SATURATING WITH LARGE COMMON-MODE VOLTAGES)
- RELATIVELY COMPLEX GAIN EQUATION: $A = 1 + (R_4/R_3) + 2R_4/R_G$

1. Improved two-amplifier differential circuit needs only one resistor, R_G, to vary gain, but resistor values must be matched.

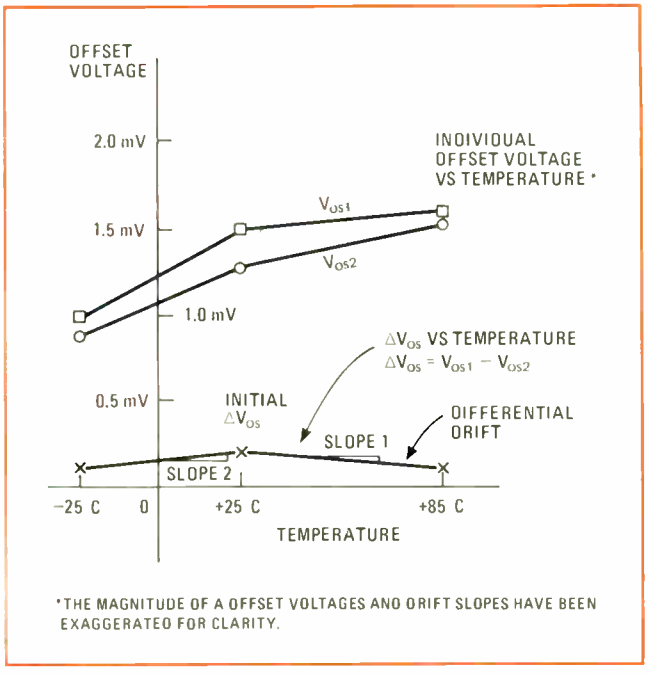
COMPARING LOW DRIFT IC OP AMPS

Unit	Unit price 100 –249	Max. initial offset voltage in μV @ 25°C	Max. average drift μV/°C: No trim	Max. average drift μV/°C: Offset nulled	Min. slew rate with unity gain compensation V/μsec	Temp. range	No. of external components for unity gain compensation	Max. input bias current nA @ 25°C
Burr-Brown								
3500E	$20	500	1.0		1.0	–25°C to +85°C	0	±50
3500MP	$16.70 per pair	200*	1.0*		1.0	–25°C to +85°C	0	±50
Precision Monolithics, Inc.								
SSS725AJ	$50.75	100	0.8	0.6	0.008 typ	–55°C to +125°C	4	70
SSS725EJ	$16.30	500	2.0 typ	0.6	0.008 typ	0°C to +70°C	4	80
Analog Devices								
504L	$20.40	500		1.0	0.12 typ	0°C to +70°C	1	±80
508L	$30.00	500		1.0	0.12 typ	0°C to +70°C	1	±20

* Maximum differential between the two units in the pair.



2. Three-amplifier circuit improves common-mode rejection.



3. Offset drift matching of the 3500MP reduces differential drift.

achieved through drift testing combined with computer selection of pairs. Although the Burr-Brown 3500MP is the only one presently matched for drift as low as 1 μV/°C, certainly any type of op amp is amenable to matching. However, for good linearity of the matched drift, the drift of each unit should be no more than 5 μV/°C. Of course, low input bias currents, internal unity gain frequency compensation, and output short-circuit protection are additional performance criteria which also may be important in matched applications.

The most common use of op amp pairs is in differential input (instrumentation) amplifiers, which often require extremely high input impedance and in which the effects of offset voltage drift may be reduced by matching. Other applications needing drift-matched ICs include multiple-pole active filters, dual-reference voltage sources, voltage-to-current amplifiers, and matched dual-channel amplifiers or filters.

To assure optimum drift performance, certain precautions are necessary: because two separate matched op amps are used, the 3500MP is furnished with a metal heat sink to assure that both chips are at the same temperature. In addition to use of a heat sink, the power dissipation of both op amps should be kept approximately the same. For example, just a few degrees internal temperature differential between chip and the IC case would add typically 10 μV to ΔV_{os}.

Input bias currents are always a matter of concern in any low-drift bipolar op amps. These currents, which flow through an equivalent input source resistance, generate additional offset voltage and drift, and this limits the maximum input impedance that can be used. The low input bias currents of the 3500MP allow equivalent source resistance of up to 10 kilohms before drift and offset are significantly affected.

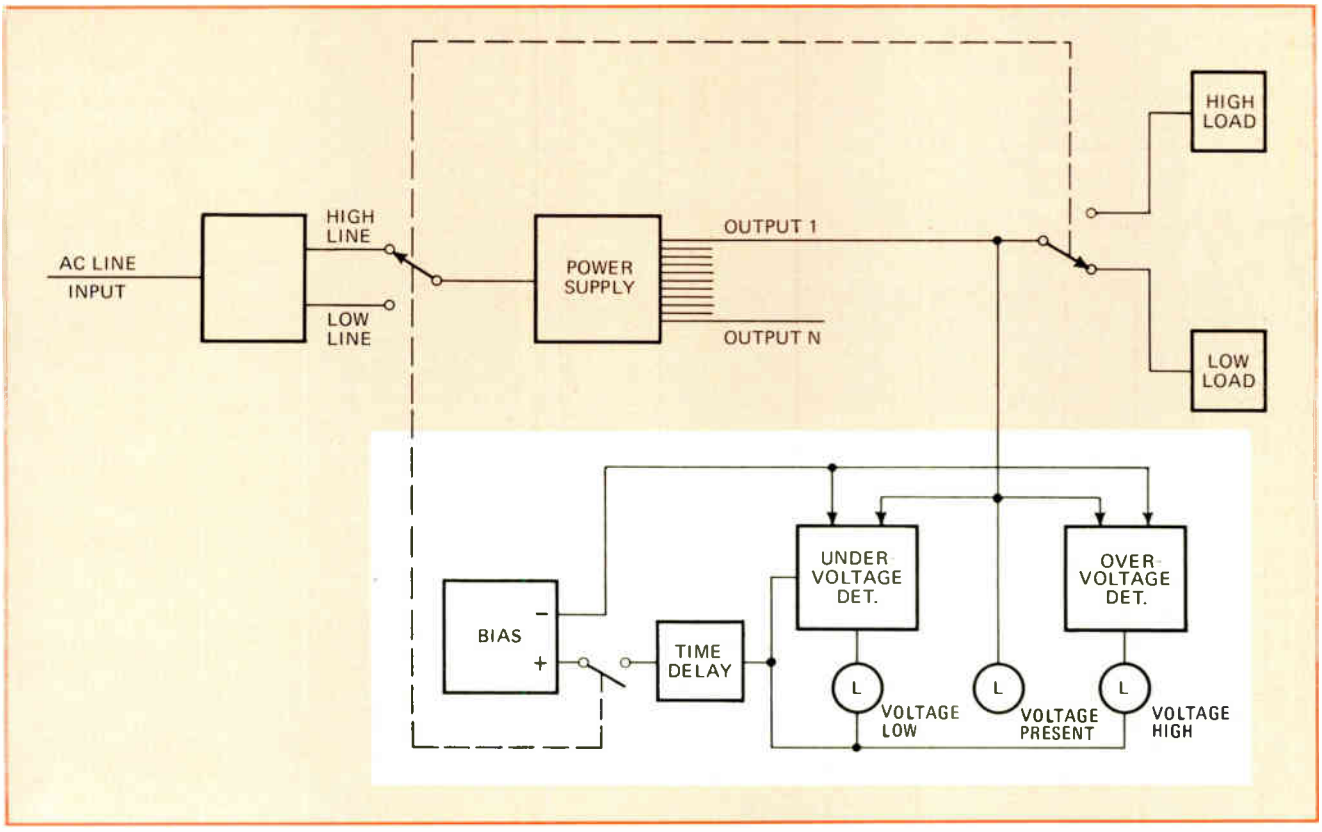
Using an external potentiometer to null initial offset voltage can add offset voltage drift. When a matched pair of op amps is employed, it is advisable to adjust $\Delta V_{os} = 0$ to minimize offset adjustment effects on drift, and not $V_{os1} = 0 = V_{os2}$. □

Simple production testing of multioutput dc power supplies

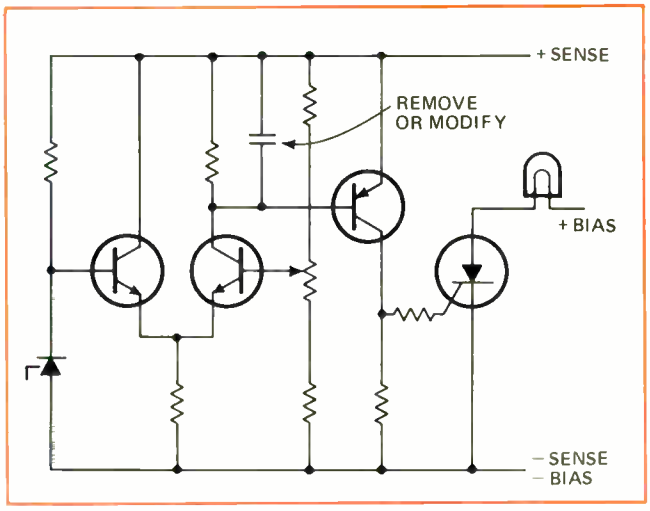
by John Lawrence
IBM Corp., Kingston, N.Y.

Production testing of multioutput dc power supplies can be a time-consuming task. Typically, each output is tested separately, a digital voltmeter being used to monitor the voltage under various line and load conditions. There are usually only two operating conditions under which the output voltage must be measured to ensure that the power supply is operating properly—high line voltage with low load current and low line voltage with high load current—making it possible to design a simple inexpensive tester that requires a minimum of operator skill, and provides fast testing.

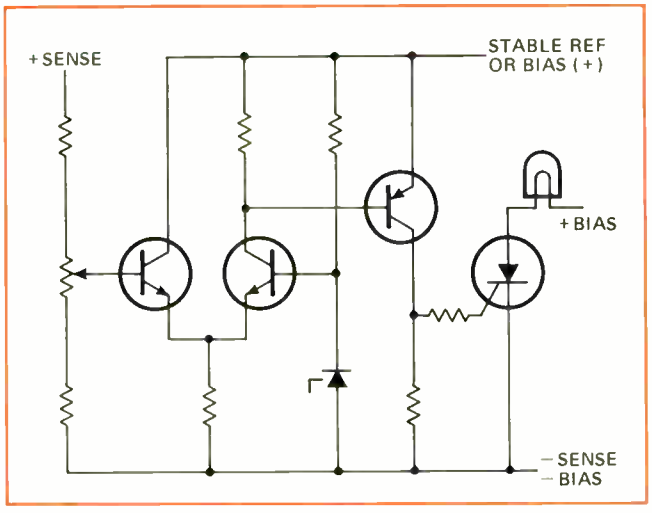
Basically, the tester consists of a pair of crowbar circuits and a pair of loads for each power-supply output (Fig. 1). Actually, one of the crowbar circuits is used in its standard configuration as an over-voltage detector (Fig. 2), while the other is modified for use as an under-voltage detector (Fig. 3). Each detector's output is fed to a panel indicator which provides an unambiguous "go" or "no-go" reading.



1. **False indications** are eliminated by reliable test setup that delays application of bias voltage until switching transients have settled.



2. **Over-voltage detector** fires a lamp when sense input is too high.



3. **Under-voltage detector** uses a modified over-voltage detector.

Depending upon whether the crowbar is to respond to the average dc level of the power supply under test or to the minimum peaks of the output voltage, the RC circuitry may have to be modified (Fig. 2). To control the trip-point sensitivity, a variable resistor forms part of a voltage-divider circuit. It should be a potentiometer with a high turns-to-resistance-change ratio.

To prevent false indications from line and load-switching transients, it is necessary to delay applying bias voltage to the monitoring circuits. The switching should be designed so that the bias is removed and reapplied each time the line and load are switched. This not only allows the monitoring circuits to ignore initial switching transients, but also turns off any SCRs that have been previously fired.

If peak-to-peak ripple must also be monitored, a good approach is first to rectify the alternating current. The dc level is then amplified and fed to a level-detector which drives an appropriate indicator when the ripple exceeds some preselected value.

In addition to the fault indicators mentioned thus far, it is wise to include a voltage-present indicator as well. This will assure the operator that the equipment is in full working order. It is also a good idea to install test jacks so that the monitoring circuitry can be calibrated from time to time. □

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Engineer's newsletter

IC chip acts as breadboard and custom circuit

There's a revival of the custom IC design-kit idea coming. Exar Integrated Systems Inc., Sunnyvale, Calif, has a kit, the XR-C100, that's based on one standard chip with 200 components. The chip is the **basis for obtaining 22 different building blocks and also serves as the final circuit.** The modules differ only in the way the metalization pattern is applied to the basic chip—one chip has five npn transistors connected to the leads; another has four pnp and npn transistors, and still another has the chip's resistor array connected. You externally interconnect the building blocks until satisfied with the circuit, and then tell Exar how you connected them. The **company then applies a similar metalization pattern to the basic chip to duplicate your circuit.**

One squeeze makes 50 connections

Changing a 50-contact connector by removing and replacing each wire requires plenty of patience. But now Amp Inc., Harrisburg, Pa., is ready to offer **a tool that makes all 50 connections at once, on a new Amp connector that mates with telephone-type connectors.** You simply fan in the wires, watching color codes, and then apply the tool. Squeezing the two "butterfly" halves of the tool pushes each wire into a slot on the back side of the connector that cuts through the insulation and makes contact. A companion slot grips the insulation for strain relief.

DAC competition heating up

If you're using 8-, 10- or 12-bit digital-to-analog converters, you'll probably soon find yourself in a buyer's market. **Within a year, there may be half-dozen monolithic 10-bit DAC's on the market.** One was announced recently by Precision Monolithics, Santa Clara, Calif., and the major IC houses are expected to follow. This may pressure the companies that have been building hybrid DACs to reduce prices.

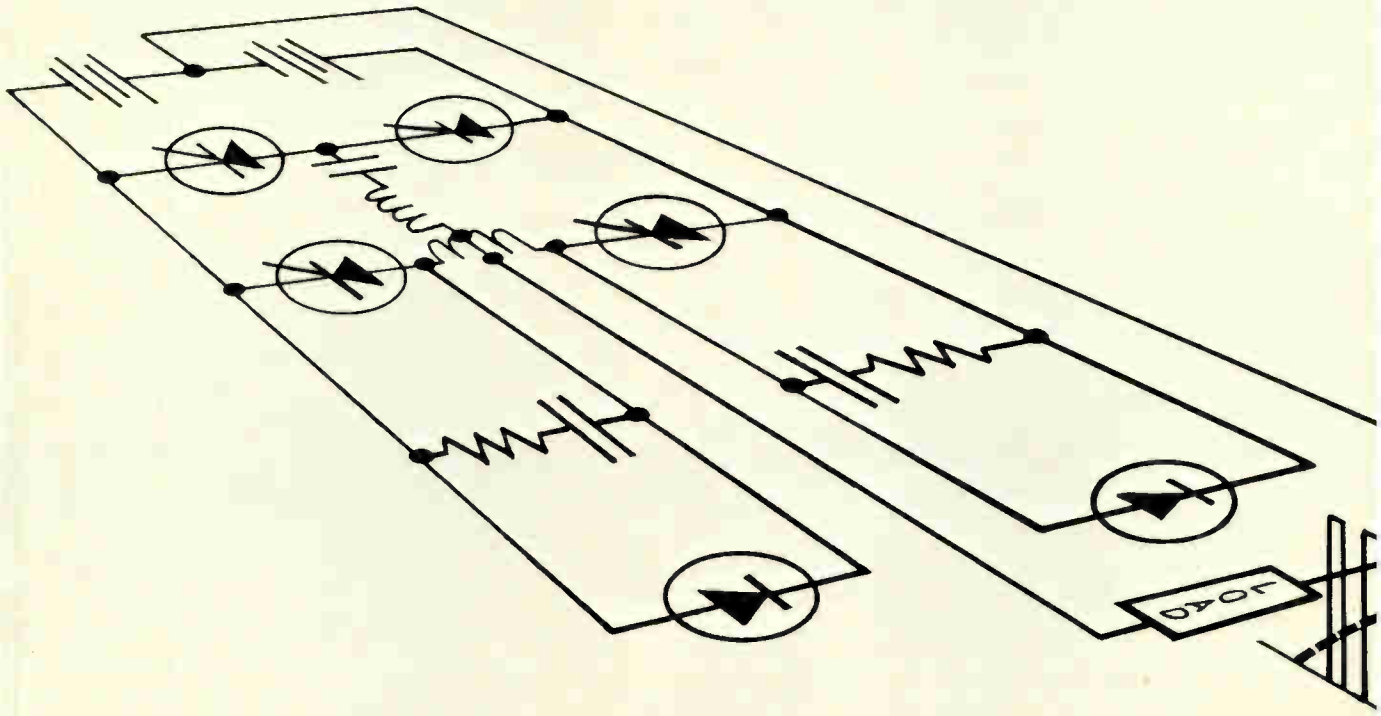
DIP supplies dc to op amps on digital boards

Quick, now, how many type components are normally available in dual-in-line packages? Well, apart from ICs, there are relays, resistor networks, multiple switches, trimmer pots, and dc-dc inverters. That last one is new to the DIP family. Its maker, Reliability Inc., Houston, Texas, says it **supplies positive and negative voltages for, say, an op amp when it's placed on a board with mostly digital circuits that use only 5 volts.** The inverter—a $25, 24-lead DIP,—will supply ±12 or ±15 V, or +12 and -6 V, and will deliver 1 watt—enough to handle 25 op amps.

Addenda

The National Security Industrial Association, 15th & H Sts., N.W., Washington, D.C. 20005, will send you a copy of a **report on the lessons learned by member companies that have tried to switch to the civil sector.** "Special Survey of industry experience in the application of advance technology to civil sector needs" will cost you $2 if you're an NSIA member, $3.50 if you're not. . . . If you're getting that high-and-dry feeling because you've heard that IBM's leaving the reed-switch business, help is on the way. Within three weeks of IBM's announcement, Gordos Corp., Bloomfield, N.J. says **it is ready to supply duplicates for two IBM reed switch types: 765972 and 765830.** Other suppliers will probably follow.

INVERTERS



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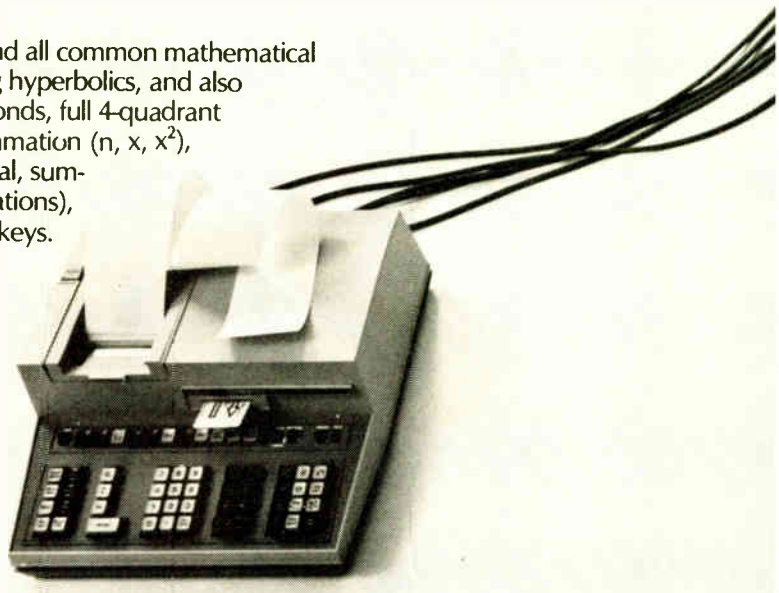

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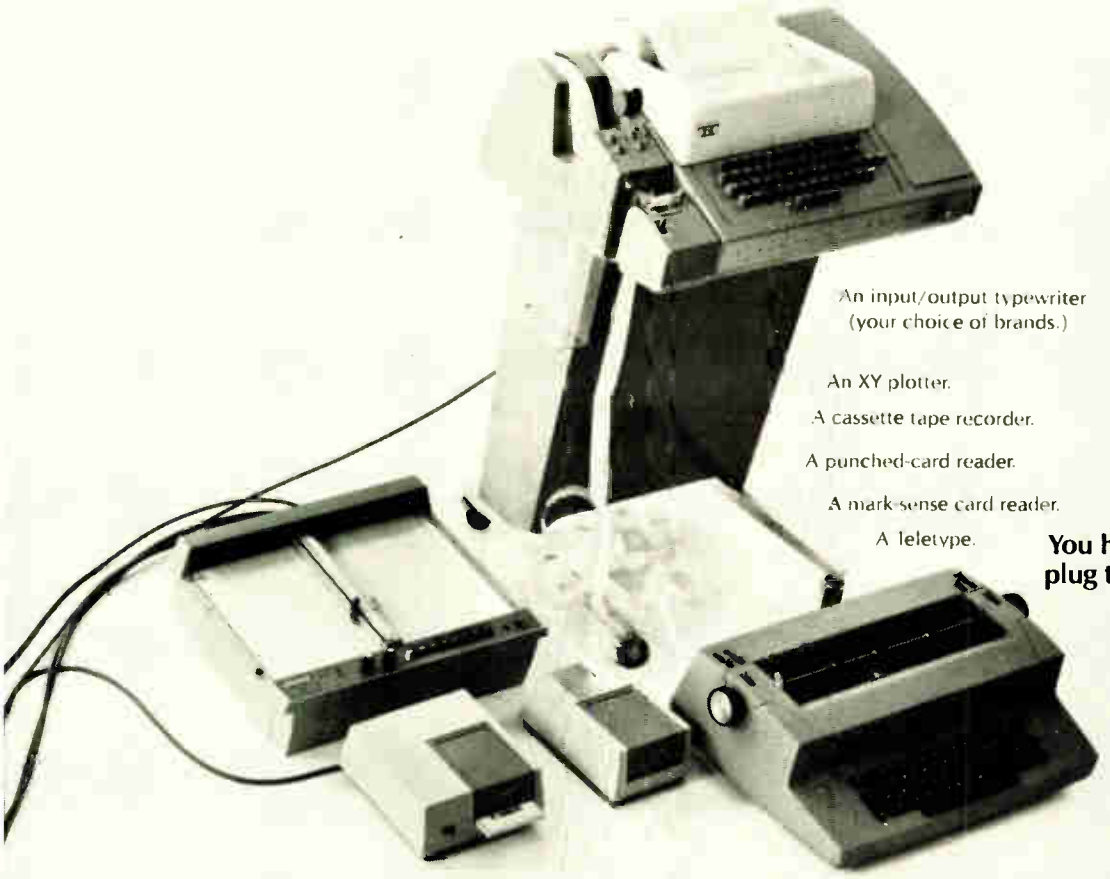

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Circle 119 on reader service card

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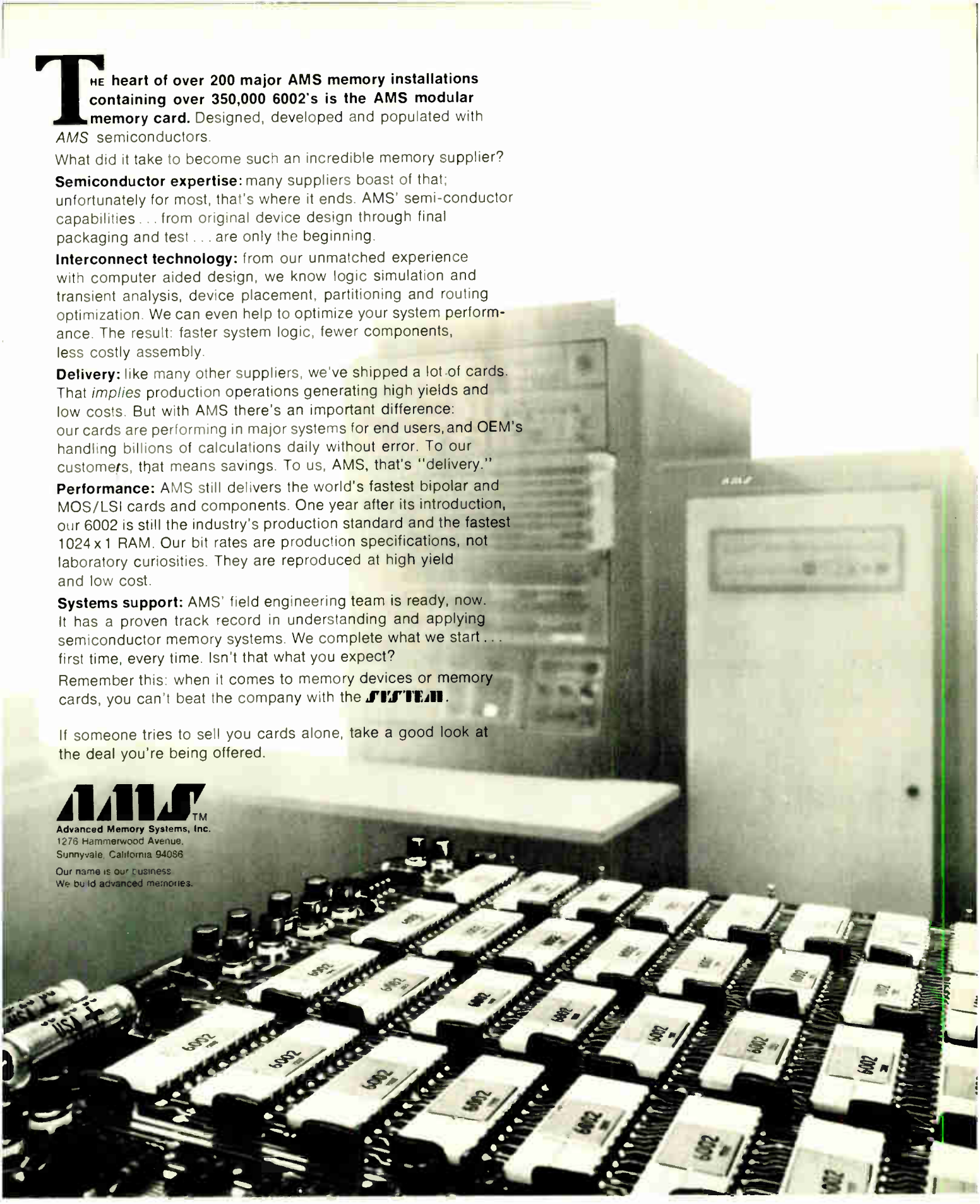

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Disk geared to fast minicomputers

Memory for 16-bit processors uses flying head-per-track technique, offers data transfer rate of 7.5 megabits per second, 10-ms access

by Stephen Wm. Fields, San Francisco bureau manager

Ever since the new generation of fast MSI/LSI minicomputers has been available, peripheral equipment makers have been playing a game of catch-up. Some disk files, to take just one example, have not been able to keep up with the data rate demands and the fast data access requirements of the latest 16-bit-word central processing units.

By employing a new twist on an old idea, Omron Systems Inc., Mountain View, Calif., has developed a disk file system that offers extremely high speed: data transfer rates on the Omron 6000 disk system go up to 7.5 megabits per second, and worst-case data access time is 10 milliseconds. Average point-to-point access time is only 5 milliseconds.

The old idea is head-per-track, and the new twist is a high-performance, low-cost flying head assembly. Bernard Jacobs, Omron's president, says, "The first disk systems years ago were head-per-track, but then IBM came out with the single-head voice-coil concept, which cut down on head costs and reduced head crashes." He points out that one problem with the old head-per-track system was that complex mechanical assemblies were employed to retrack the heads when the disk started and stopped. If these failed or jammed, the heads would crash into the disk, destroying it.

But, says Jacobs, "both head and disk technologies have moved forward since then, and we thought that they could yield a better price/performance ratio." To eliminate the head crashing problem, Omron designed a new head cluster assembly that flies a low 20–25 microinches above the disk surface. In the Omron 6000, a 6-inch-diameter disk is used with 10 head assemblies. Each head assembly has 11 tracks, one of which is a spare, making 100 tracks with 10 spares. The spare tracks are either hardware- or software-addressable. When the disk is off, the ceramic/ferrite heads are resting on the nickel/cobalt disk surface. Then, as the disk builds up to its 6,000-revolutions-per-minute final speed, there's an airfoil effect: the heads take off and fly. Since the disk and the head material are equally hard, there is no scouring. When the disk shuts off, the heads land. "In tests," says Jacobs, "we've experienced no degradation in either the disk or the heads after 8,000 start/stop operations."

Part of the reason for the need of the super-fast disk is the changing role of the minicomputer. "People now realize that they cannot afford time-sharing systems," says Jacobs. "The trend is toward smaller systems employing fast minicomputers. And they need large, fast, peripheral mass-memory systems."

To minimize routine maintenance time, the 6000 employs a positive air filtration system that continuously purifies the disk's environment and virtually eliminates disk damage due to dust.

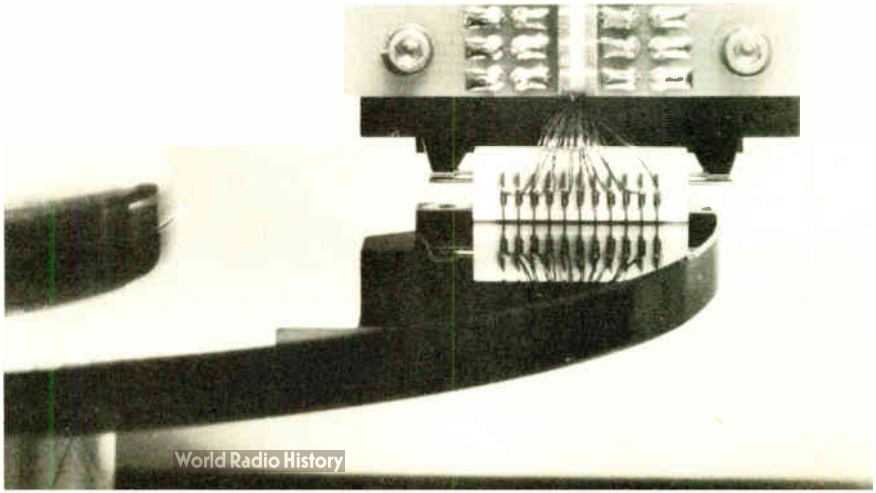
For users who need more than the 7.5-megabit storage capacity of the 6000, Omron has developed the model 3000 system, which employs a 12-inch-diameter disk rotating at 3000 rpm. Sixteen head assemblies are used to provide 160 data tracks with 16 spares. Data transfer rate is the same as that for the 6000 system,—up to 7.5 megabits per second—but storage capacity is increased to 24 megabits, and average access time is 10 milliseconds. Worst-case access time is 20 ms.

Both systems come complete with all read/write and interface electronics, power supply, and cabinet. Controllers for almost any minicomputer can be supplied by Omron.

The system may be ordered with up to 10 head assemblies for the model 6000 and 16 for the model 3000. Price of the 6000 system is 0.05 cent per bit in OEM quantities, and for the 3000, 0.025 cent per bit. A fully loaded 6000 sells for $3,500 and the 3000 for $5,000 in OEM quantities.

Omron Systems Inc., 440 East Middlefield Road, Mountain View, Calif. 94040 [338]

Low-flying. Photo shows one of 10 head assemblies that fly 20–25 microinches above Omron 6000 disk. Part of circuit card containing read-write electronics is visible at top.



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Contains all the digital circuitry necessary to build an 8-bit successive approximation A/D converter.

HI-0180
This new device replaces three conventional TTL MSI packages, resulting in significant space and cost savings.

Features:
Both serial and parallel output data compatible with DTL/TTL.

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Applications:
The HI-0180 can be used with the HI-1080, 8-bit D/A converter, the HA-2111 comparator, and a reference voltage source to implement a complete 8-bit A/D system capable of converting unipolar or bipolar signals with 1/2 L.S.B. accuracy at up to 40,000 conversions per second.

Other applications include:
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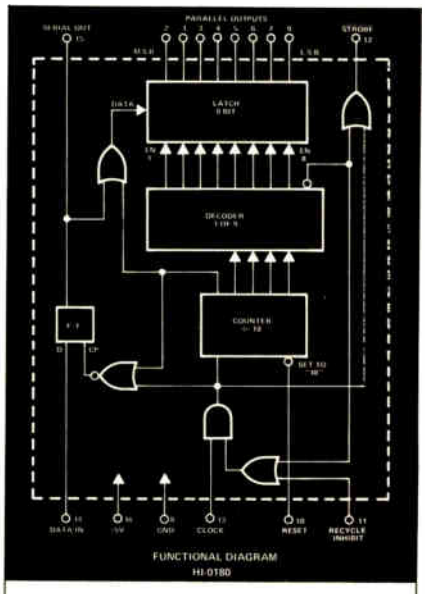
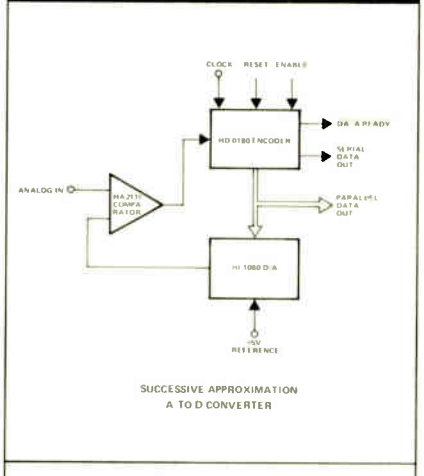
For details see your Harris distributor, representative or write direct.





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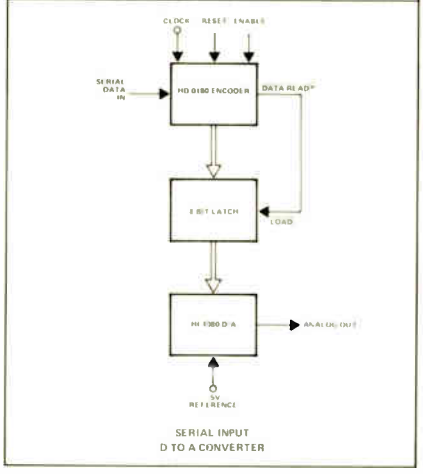

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The military version consists of our new HI-0180 encoder, the HI-1080 D/A converter, the HA-2111 voltage comparator. **$65.00** in 1-99 quantities.

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Components

Module is multifunctional

Unit multiplies, divides; with op amp, it computes vectors and rms values

Equipment designers are promised space-saving and cost-saving with a multifunction module that Analog Devices says is the first of its kind. By means of two programing resistors, the model 433J can do multiplication, division, squares, square roots, reciprocals, powers, and pressure-volume/temperature computations. With an inexpensive external operational amplifier, the module can compute vectors and rms values to dc. As a result, it can replace several dedicated modules in OEM designs. Priced at $75 in quantities of 1 to 9, the 433J measures 1.5 by 1.5 by 0.62 inches.

Fred Pouliot, marketing specialist at Analog Devices, says that advanced techniques in log circuits were what enabled the company to put so many functions into such a small module. The unit handles two input signals as logarithms, with a log ratio circuit at the input and an antilog circuit at the output. The two programing resistors establish signal exponent values, which can range from 0.2 to 5. Because of its logarithmic design, the unit's operation is limited to one quadrant, but Pouliot feels this will not substantially limit its usefulness.

The module is accurate to within 0.5% for all functions. Multiplier performance for outputs from 10 millivolts to 10 v provides a total error drift coefficient of 0.01%/°C. Worst-case output noise ranges from 100 microvolts at 10 v to 300 μv at 0.1 v in a 10-hertz-to-1-kilohertz bandwidth, which Analog says is three times better than most transconductance-type multipliers or dividers.

But the most significant improvement in performance, the company says, is in the divider function. The 433J's error is only 30 mv at 100 mv input. This results from an open-loop design, which makes accuracy of the module independent of denominator amplitude, drift, linearity, and noise.

Besides a ±15-v supply, the user of the 433J supplies either a potentiometer to give variable exponents or two fixed resistors to give a constant exponent. Placing the resistors and op amps is up to the designer of the system.

Since functions are determined by pin connections, the 433J can be designed into an instrument where a switch changes functions. Major applications for the module are seen in medical, industrial, and process control equipment.

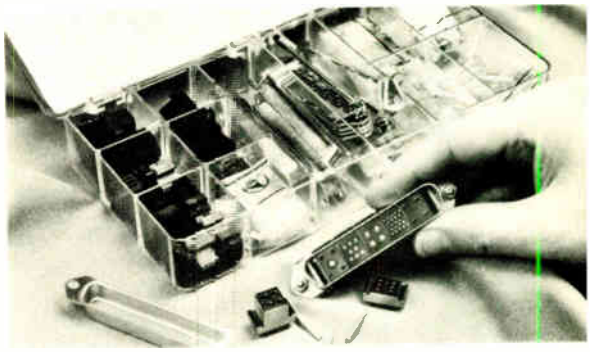
Analog Devices Inc., Rte. 1, Industrial Park, P.O. Box 280, Norwood, Mass. 02062 [341]

Kit permits user to design his own miniature connectors

The modular connector—a concept that has been around for a long time—has been applied to miniature types by Amphenol, which estimates that, besides reducing costs, it will save the user as much as eight weeks of development time.

The company's custom connector kit, priced at $25, enables the user to assemble his own rack and panel connectors. It's called the 137 series MIC-KIT (modular integral connector kit), and contains five types of contact modules along with enough hardware to make three pairs of connectors. Intended for breadboarding, prototyping, or short production runs, it also eases the conversion to large production runs, since Amphenol need only tool up for a one-piece insulator to take the place of the modular insulators.

The series 57 shell size (Amphenol's Blue Ribbon connector size) holds five contact modules. There are also five varieties of modules: a blank that's used as a spacer when four or fewer contact modules are used; a module that takes either a coax contact or one No. 12 power contact; one that takes up to four



No. 16 contacts; one that takes up to eight No. 20 contacts; and one that takes up to 21 No. 24 contacts. The insulation is Amphenol's standard glass-filled Nylon Zytel 101, which has a rated operating temperature range of -55° to 125°C.

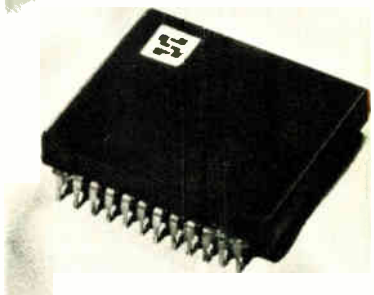
The kit obviates not only the long delivery time, but also the preliminary back-and-forth negotiations as the connector design is developing. Another advantage, says Amphenol, is that designers can reduce the number of connectors in a system, since one shell will hold a variety of contacts. Thus, there will be no need to use individual connectors with only a few contacts. Coax contacts, too, can be merged into the single connector.

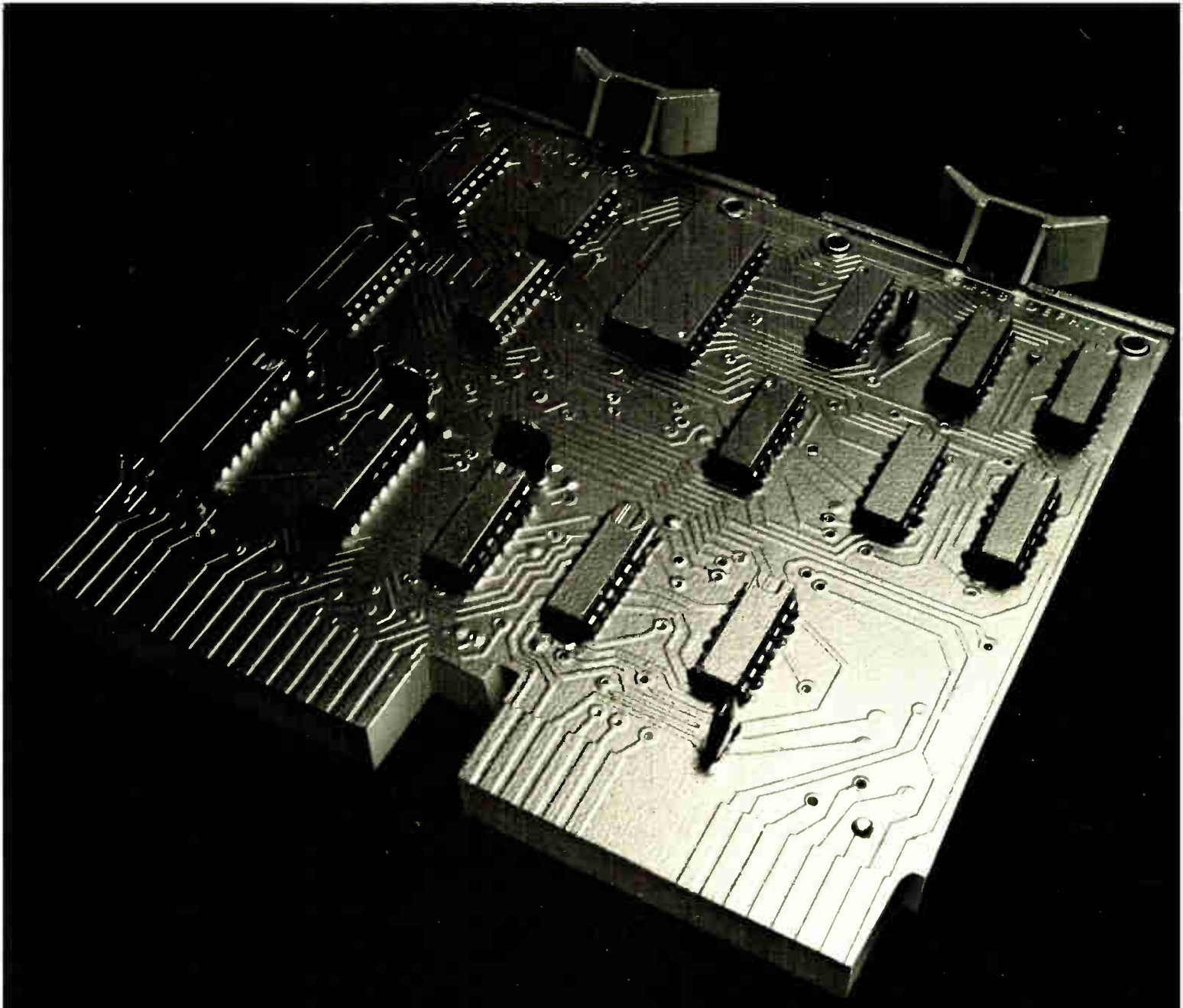
The kit will be available from distributors, as will all parts of the kit so that users can buy only those parts they need.

Amphenol Industrial Div., Bunker Ramo Corp., 1830 South 54th Ave., Chicago, Ill. 60650 [342]

Thermal switches provide isolated tone signaling

A thermal switching device called the TC-8 uses polyconductor technology. The unit enables data transmission equipment and automatic





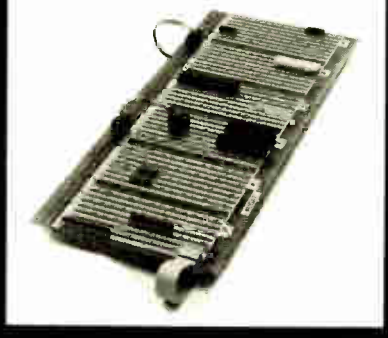
Augat says: Take a hard look at circuits cast in iron.

Think about it. In the electronics industry—which thrives on change—something as difficult to change as the PC board is practically taken for granted.

Ironic. Especially since there's an alternative that gives you all the flexibility that PC boards lack. With Augat's dual-in-line plug-in panels you can make component and wiring changes in minutes. In breadboarding, prototyping, production.

Augat saves you time and money. There's no waiting for artwork and fabrication, as with PC boards. No need for inventories of logic cards. What's more, the Augat panel gives you up to three times the packaging density of planar printed circuit boards, with greater reliability.

All of which means that your product gains an important competitive edge simply by switching to Augat panels.



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Circle 126 on reader service card

callers to operate directly with touch-tone telephone sets, or other tone generators, without using an isolation transformer. Each unit includes eight small thermal switches that change resistance from 300 kilohms to 50 ohms at a critical point of about 65°C. Internal heaters in the switches are turned on and off by signals from the data set, thus controlling frequency selection. Price is under $2.

Multi-State Devices, Superior Electronics Industries Ltd., 1330 Trans-Canada Highway, Montreal 740, Canada [343]

Trimming pot handles 2.5 watts at 85°C

A trimming potentiometer called Tex Trim is wirewound, and has a temperature coefficient as low as five parts per million per °C and a power rating of 2.5 watts at 85°C. Ninety-eight percent of the resistance element is embedded in an alkyd molding compound, and the molded element can produce any configuration required with a change of cases. Price is from $1.70.

TexOhm, Trimmer Div., Rte. 4, Box 595, Waco, Texas 76705 [347]

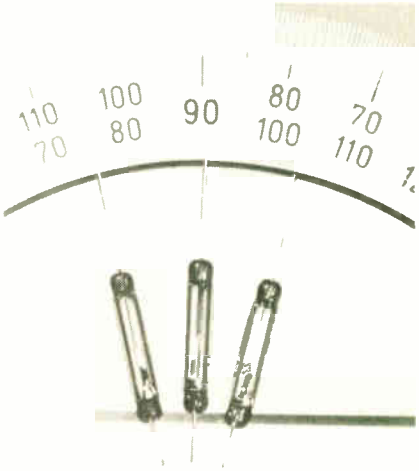
Transducer simulator checks system performance

A bridge transducer simulator, the model 40, substitutes for a transducer in verifying system performance, or in amplifier drift calibration tests. Features include seven shunt calibration steps from 0.5 volt to 50 millivolts at 10 volts excitation, and an internal reference that supplies 0±1 millivolt to determine system excitation voltage. Bridge resistance is 300 ohms. Price is $99.50.

Fogg System Co. Inc., Box 22226, Denver, Colo. 80222 [346]

Mercury reed switch offers dry reed speeds

A mercury-wetted reed switch designated the MRHG-2 offers an actuating time of one millisecond. This operating speed, usually associated with dry reed types, is largely the result of the location of the gap in the center of the form A switch. The single-pole single-throw unit can be mounted to within ±15° of a vertical position. Physical dimensions are: glass diameter, 0.130 in.; glass length, 0.800 in.; over-all length, 1.765 in.; and minimum trim length, 0.925 in. Price is $2 in 1,000 lots.



Hamlin Inc., Lake Mills, Wis. [345]

Pc board trimmers feature low price

Three models of a printed-circuit board trimmer are available in the following price ranges for quantities of 1,000 to 1,999: the model 3359 is 50 cents, the model 3353 is 20 cents, and the model 3351 is 15 cents. The unit offers less than a 1% resistance change after normal circuit-board cleaning processes, and is rated at

New products

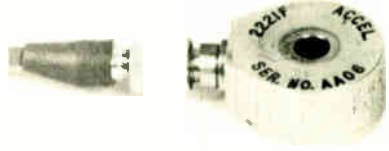
either ½ watt at 70°C or ⅓ watt at 60°C. Three operating temperatures are available and range from −65 to

+125°C, 0 to +100°C and 0 to +70°C.

Bourns Inc., 1200 Columbia Ave., Riverside Calif. 92507 [344]

Accelerometer designed for shock, vibration tests

A hermetically sealed piezoelectric accelerometer is capable of operating at temperatures up to 500°F. The model 2221F is designed for low-level shock measurements of up to 2,500 g and for airborne vibration measurements. It is also suitable for a broad range of testing applications



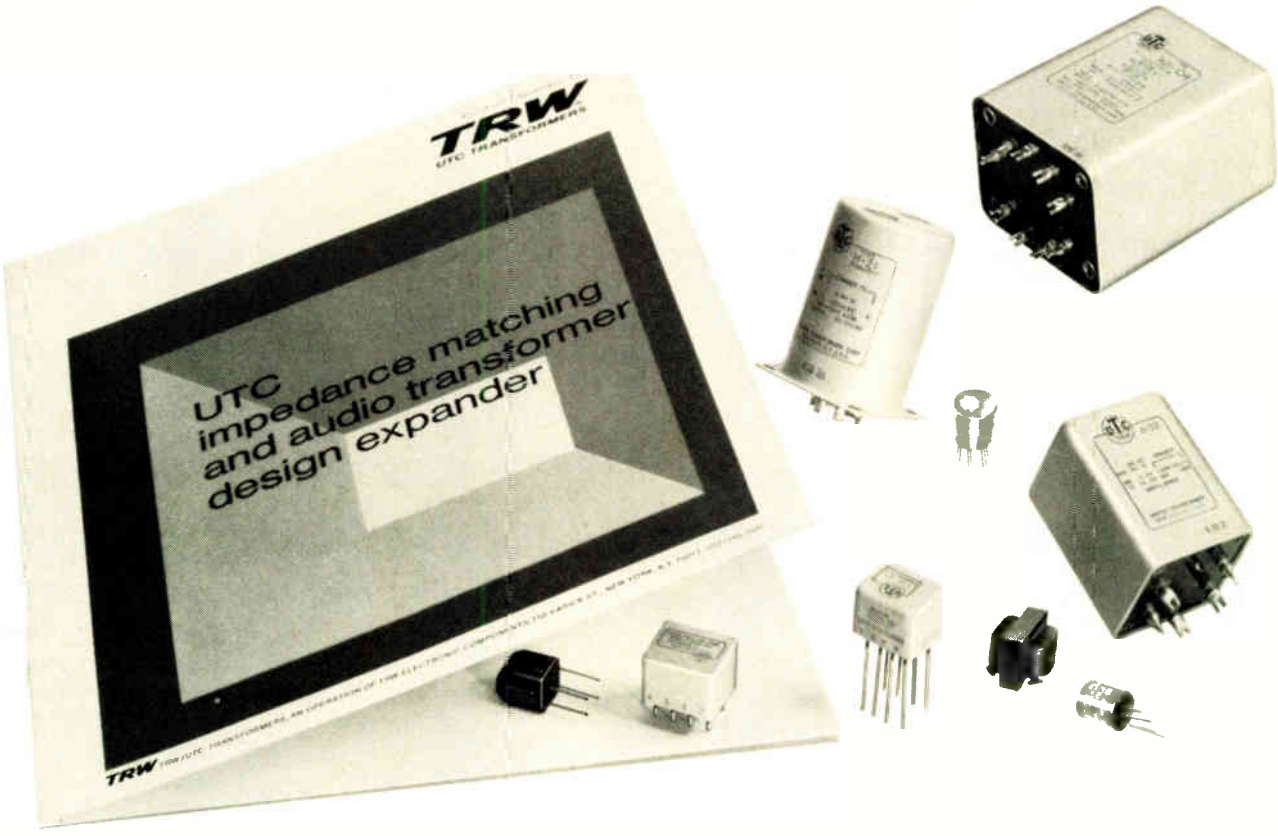
utilizing a resonant frequency of 42 kilohertz. Charge sensitivity is 10 picocoulomb/g, and voltage sensitivity is 9 millivolts per g. Frequency response is from 2 hertz to 8,000 Hz. The unit will withstand shocks to 5,000 g without damage.

Endevco Dynamic Instrument Div., 801 S. Arroyo Parkway, Pasadena, Calif. 91109 [349]

Shaft position encoder measures 1 by 1 inch

A subminiature shaft position encoder measures 1 inch in length by 1 in. in diameter. It is encased in a size 11 servo housing, and is designated the series 820. The photo-

TRW transformers: designer's choice, distributor service



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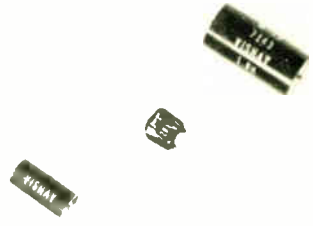
electric device is applicable to almost any high-density packaging uses. Light-emitting diodes are used as illuminating sources, and pulse rate can be specified up to 500 pulses per revolution. Operating speed is 50 kilohertz maximum. Price is $125 to $150 in single quantities.

Disc Instruments Inc., 2701 S. Halladay St., Santa Ana, Calif. 92705 [348]

Resistors are direct replacements for wirewounds

A line of radial and axial lead resistors designated the M series is intended as direct replacements for wirewounds. Fabricated from bulk metal film on ceramic, the resistor



chip is calibrated and then coated with silicon rubber. Temperature coefficient is ±10 parts per million per degree Centigrade maximum for all values. Stability is 30 ppm/year, and tracking for all values is 4 ppm/°C.

Vishay Resistor Products, Div. of Vishay Intertechnology Inc., 63 Lincoln Highway, Malvern, Pa. 19355 [350]

Take stock in yourself.

In addition to the benefit it provides for the country as a whole, the U.S. Savings Bond Program provides an easy and safe way to set aside funds for future needs.


Robert W. Sarnoff

This year, Robert W. Sarnoff, RCA Chairman of the Board and Chief Executive Officer, has agreed to head the U.S. Savings Bond Program in the electronics industry.

RCA has been an enthusiastic supporter of the U.S. Savings Bond Program since it began. Last year, 87.2 percent of RCA employees participated in this systematic method of saving.

A lot of people in the electronics industry are finding that the best way to help themselves is to help their country.

Take stock in America.

Buy U.S. Savings Bonds.

Semiconductors

Quad op amp uses one supply

Motorola and National aim low-priced chip at auto, industrial control markets

The principal thrust in development of operational amplifiers has been toward all-purpose, high-performance devices. But semiconductor makers are now shifting emphasis to the promising markets for low-priced, special-purpose monolithic units, particularly those that incorporate several devices on a chip. First Motorola, and now National Semiconductor, have announced a quad op amp—four amplfiers on a chip.

The devices can operate either from a single +5-volt supply or from the two supply voltages usually required for conventional op amps. These are the first units with the 5-v single-supply feature, making the quad op amp ideal for many industrial control applications, in design of active filters, and for other applications where only the single 5-v supply is available.

Semiconductor makers are also confident that the 5-v capability, plus low prices, will make the devices attractive to designers of automotive electronics for fuel injection, electronic ignition, safety device control, and other systems.

National's entry, the LM3900, is priced at 75 cents each in quantities of 100. It can operate from 4 to 30 volts dc and has an open-loop gain of 70 decibels that is available from dc to 2.5 megahertz. In addition, the output of the unit is short-circuit-protected.

The Motorola device, designated the MC3401, comes in a single plastic package, and sells at $1.75 each in quantities of 100. It operates from supply voltages of 5 to 18 Vdc, without the common-mode input voltage problems usually encountered by conventional op amps operated from a single supply.

Both the Motorola and National op amps, which are internally compensated, use "current-mirror" circuits to obtain noninverting inputs, rather than the differential amplifiers normally associated with op amps. This allows a user to employ a conventional common-emitter input stage, which can be biased more easily from a single power supply.

Input bias current of the Motorola MC3401 is only about 50 nanoamperes, while unity-gain bandwidth is 5 MHz, adequate for many gain-block purposes.

Motorola Inc., Semiconductor Products Div., P.O. Box 20924, Phoenix, Arizona 85036 [411]

National Semiconductor Inc., 2900 Semiconductor Dr., Santa Clara, Calif. 95051 [371]

12-digit calculator chip has memory register, too

Designers of calculators are promised added versatility and flexibility with the introduction of the CT5005 FlexiChip by Cal-Tex Corp. of Santa Clara, Calif. The chip offers not only the standard four functions (add, subtract, multiply, and divide), but it also has a separately addressable memory register—all on a single chip.

Designed for a 12-digit display calculator, the CT5005 is a p-channel MOS circuit that includes two operator registers as well as the memory. The memory allows incorporation of a four-function-constant operation as contrasted with the two-function constant usually found in calculator chips. In a machine using the CT5005, the K key would be replaced by two keys: RM, to display the contents of the memory; and CM, to clear the memory register.

Decimal point placement from one to five places is easily accomplished by touching the decimal and number keys simultaneously.

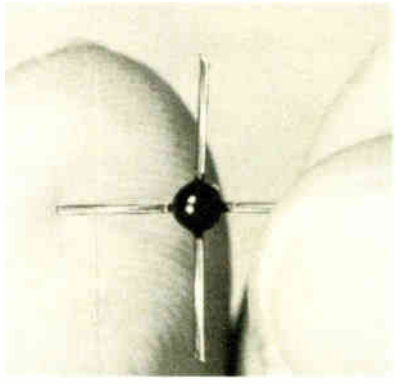
Other significant features of the FlexiChip are two-phase clock operation, automatic keyboard debounce, leading-zero suppression, and automatic lockout of unsure repeat operations.

Prices range from $15 to $23, depending on quantity.

Cal-Tex Semiconductor Inc., 3090 Alfred St., Santa Clara, Calif. 95050 [412]

Epoxy transistor cuts cost of thick-film hybrid circuits

A subminiature epoxy transistor that measures 0.09 inch in diameter by 0.06 in. in thickness is designed to cut the cost of thick-film hybrid circuits. Designated the MET series, the devices offer handling ease, protection against moisture, humidity, mechanical damage during shipment and assembly, and minimum loss on thick-film circuits during assembly. This avoids manufacturing problems encountered with wire-bonded chip resistors.



Sprague Electric Co., 35 Marshall St., North Adams, Mass. 01247 [413]

Buffer converters are for high-current sinking

Buffer converters designated the CM4009A/CM4010A are used for high-current sinking capability. The complementary metal-oxide-semiconductor hexadecimal devices can handle a minimum of 8 milliamperes and are available in inverting and non-inverting types. Applications include use as a C/MOS hex inverter, C/MOS-to-DTL/TTL hex converter, C/MOS current sink or source driver, and C/MOS logic level

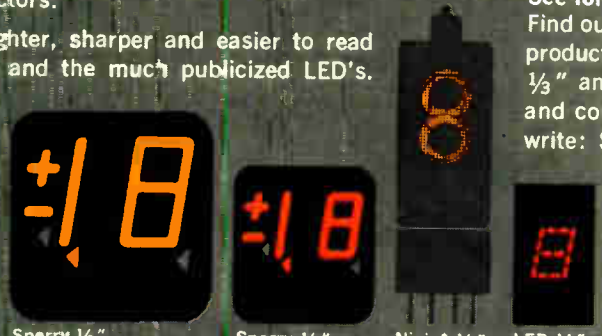
Sperry displays have more eye appeal!

Panel meters, DVM's, instruments, calculators, computers, business machines and other equipment have more "buy appeal" with advanced Sperry displays† because they have more eye appeal where it really counts — right on the face of your product. These are the unique displays which produce continuous characters, with no irritating gaps or breaks between segments. Sperry displays are also better looking because character shape was determined by human factors engineering — with full consideration given to aspect ratio and form factors.

Sperry displays are brighter, sharper and easier to read than tube-type displays and the much publicized LED's. They have no screens, filaments or "off" numbers to impair readability. In fact, they're so much better looking that it is impossible to show the difference on the printed page. You have to see the actual display to fully appreciate their excellent appearance. Compare them side-by-side with any other display. You'll find Sperry beats them all.

Sperry displays also come in colors — attractive easy to read orange or red. Not always true of other types. And Sperry beauty is also more than skin deep. There's the wider viewing angle, low power consumption and proven reliability, not to overlook the cost — $1.00** per digit in large OEM quantities for either the ½" or ⅓" display.

See for yourself.
Find out how great Sperry displays can look on your product. Check the reader service card for sample ⅓" and ½" self adhesive, printed display strips and complete technical information, or phone or write: Sperry Information Displays Division, Post Office 3579, Scottsdale, Arizona 85257. Telephone (602) 947-8371.



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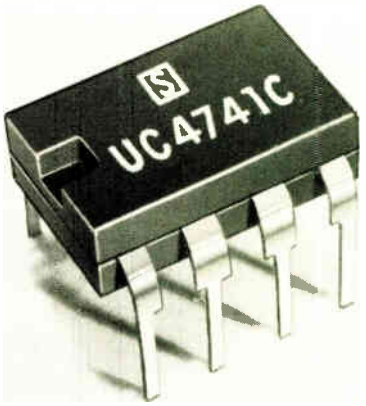
†Patent Pending
*NIXIE is the registered trademark of the Burroughs Corporation.
**Price is $2.30 in 5,000 digit quantity.

New products



converter. Conversion ranges from C/MOS logic operating at +3 volts to +15 v, to DTL or TTL operating at +3 to +6 v.

Solitron Devices Inc., P.O. Box 23157, 8808 Balboa Ave., San Diego, Calif. [414]

Silicon rectifier is rated at 10 to 18 kilovolts

A 10- to 18-kilovolt silicon rectifier called the E10-10 features specifications of up to 10 milliamperes and 16-kilohertz operation, with controlled avalanche. The epoxy-en-

cased unit can handle up to 125°C maximum junction temperature at low leakage current. The small size of the silicon diodes suits them to use where space is at a premium. Typical applications include power supplies, television, oscilloscopes, and electrostatic copiers.

Henley Electronics Inc., 202 E. 44th St., New York, N.Y. 10017 [417]

ROM built for high-density microprograming tasks

A 16,384-bit metal-oxide semiconductor read-only memory is designed for custom high-density microprograming. The model EA4800 is also suited for high-resolution

The Big Sweep 100 kHz-18 GHz.

It's a whole new generation of solid state sweep oscillators from Singer.

The 6600 Sweep Oscillator with its wide selection of plug-ins covers the 100 kHz to 18 GHz range. Below 1000 MHz, you have as many as three units from which to choose the one best suited to your application. One model includes a power-set meter adjustable over a 140 dB range for applications requiring sweeper *and* signal-generator-like performance. Microwave plug-ins are pin-leveled, internally or externally, all the way up to 18 GHz. And with a 20 dB power control range. But there is much more than exceptional performance to the 6600.

The uncluttered front panel with its lighted, push-button controls, makes operation self-evident and confusion-free. With four sweep modes, full band, marker, △F, and manual—each with frequency markers—the 6600 sets a new standard for ease and flexibility of operation.

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Solid State Sweep Oscillator Model 6600

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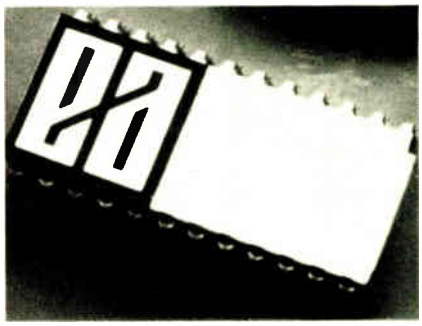
character generation and for fixed memory applications such as logic-function generation. The unit utilizes low-voltage MOS enhancement-mode p-channel technology, and operates on +5- and -12-volt power supplies. Internal resistors on each input allow direct transistor-transistor-logic compatibility. Price in 100-



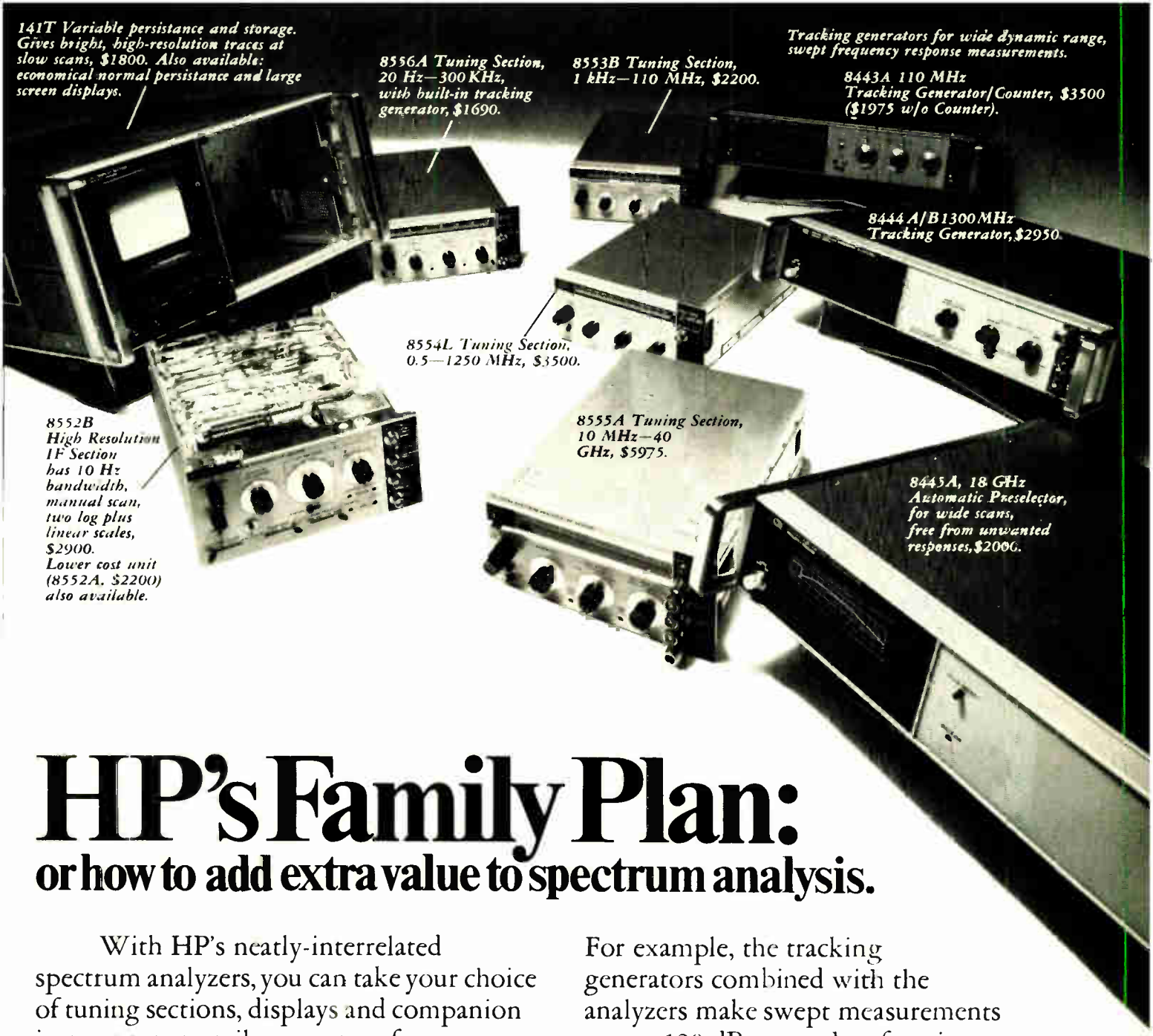
lots for a silicone-packaged device is $52.50, and for the ceramic package the price is $60.
Electronic Arrays, 501 Ellis St., Mountain View, Calif. 94040 [416]

Dynamic register provides 10-MHz shifting rate

A 1,024-bit multiplexed dynamic shift register is designed to provide a 10-megahertz shifting rate over the full temperature range of -55° to +125°C. The metal-oxide-semiconductor circuit, called the HDSR 1024 utilizes ion implantation technology to minimize gate overlap capacity. Inputs can be directly driven by transistor-transistor logic and diode-transistor logic levels, and both bipolar and MOS circuits can be driven by the output stages. The unit is also available in dual and quad structures, in addition to the basic single structure. Price in 100-lots is $20.
Hughes Microelectric Products Div., 500 Superior Ave., Newport Beach, Calif. [418]

Unijunction transistors extend programing range

Two programable unijunction transistors are designated the 2N6027 and the 2N6028, and both extend



HP's Family Plan:

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With HP's neatly-interrelated spectrum analyzers, you can take your choice of tuning sections, displays and companion instruments to tailor a system for your measurement needs — all the way from 20 Hz to 40 GHz. Then, as your requirements expand, re-configure your system simply by adding the related piece of equipment. That's the value of our family plan.

By themselves, any of the 4 spectrum analyzers give you unparalleled signal analysis capability made possible by absolute amplitude calibration, low distortion, high resolution, and wide frequency scans coupled with the ability to zoom down to a narrow scan.

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And our automatic preselector for the microwave tuning unit does away with image, multiple and spurious responses.

All in all, HP's family of spectrum analyzers gives you the greatest depth and breadth of performance and the best value in signal analysis equipment available anywhere. For more information, call your local HP field engineer or write to Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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SIGNAL ANALYZERS

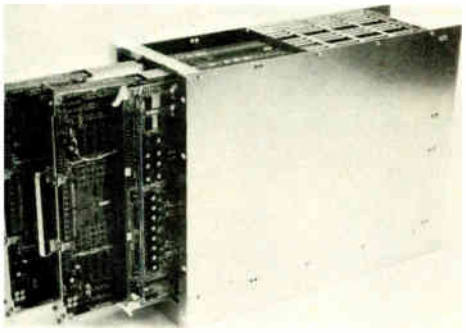
Circle 137 on reader service card

Data handling

Memory uses low-drive cores

Compact system offering 1.5-microsecond cycle time is priced under a cent a bit

Makers of core memories aren't sitting by idly in the face of increasing competition from semiconductors (see p. 64). An indication of this is a new memory system from Lockheed Electronics that features up to 524,288 words by 24 bits in a standard relay rack 17 ½ inches high. For most applications, the complete system will sell for under 1 cent per



bit, the company says.

Besides a cycle time of 1.5 microseconds, the new machine has an access time of 600 nanoseconds—a speed that Lockheed feels will be particularly suited to new memory markets that are opening up as main memories enter the 600-nanosecond cycle region. Examples are auxiliary memories, replacement mainframes in older equipment, and add-on memories. Some users have even found this type of memory ideal for replacing drums and disks in time-sharing applications due to the substantial improvement in speed and the reasonable cost.

Called the CC-150, the system uses 18-mil lithium ferrite cores that require only about 420 milliamperes nominal drive current instead of the 650 mA that is standard. This reduced current simplifies drive circuitry, permitting increased use of integrated circuits, and the 3-d, three-wire organization provides a significant reduction in stack selection diodes over memories with a 2½-d organization.

Lockheed will sell the memory in several configurations depending on user requirements. The simplest is a core plane in 65,000 words by either 18 bits or 24 bits. Next is a three-board submodule containing the stack plus drive and sense circuitry for plugging into a system. Complete modules are rack-mountable and 17 ½ inches high; they contain one to eight submodules plus timing and control boards in a chassis for the maximum memory size of 524,288 words.

Finally, for end users, a complete system with interface to a mainframe, power supply, system self-test, and power controller, is available.

The system has standard TTL-level interface, and a basic submodule requires about 110 watts worst-case.

Lockheed Electronics Co., Data Products Div., 6201 East Randolph St., Los Angeles, Calif. 90040 [361]

Low-cost filter sharpens contrast in displays

The important thing about a display—whether it's a cathode-ray tube, a gas-discharge readout, or a light-emitting diode—is readability. To enhance contrast and thus improve readability, some type of tinting is usually necessary on the faceplate, in order to match the emitted wavelength. But one of the problems has been that the faceplate, tinted or not, also produces specular reflections—even to the point, one user says, that CRT operators can use the screens as mirrors. And the usual way to correct this has been to put a coating like magnesium fluoride on the faceplate—a process which might cost as much as $50 for a large CRT.

Panelgraphic Corp., a New Jersey company specializing in display panels, has developed a coating method that it says will cut ambient and internal reflections to 1% at one-fifth the cost of magnesium-fluoride coatings.

The anti-glare filter, called Chromafilter, has a coating about 0.1-mil thick on rigid plastic substrates that can be clear, neutral gray, or tinted to match the color of the display. The coating is scratch-

resistant—it passes a scratch test of 100 grams with sharp stylus on the commonly used Princeton scratch tester. It will withstand alcohol, acetone, caustic and chlorinated solutions (also such common liquids as coffee and nail polish, which, says Panelgraphic president Edward Finney, can present problems on horizontally mounted faceplates).

The coated material is delivered either in sheet form or cut to size. The commonly used substrate for filters 0.030 to 0.060 inch thick is rigid vinyl, which can be sheared, punched, or machined. Acrylics commonly used in 0.060- to 0.125-inch thicknesses have excellent machining characteristics. The filter can also be produced in a combined filter-panel form with lighted legends used alongside the CRT or readout display in a single-piece design.

Typical prices range from 25 to 35 cents for a small filter that might be used with a calculator or digital panel meter to about $10 for one used with a large CRT.

Panelgraphic Corp., 10 Henderson Drive, West Caldwell, N.J. 07006 [362]

Paper tape system reads to 300 characters a second

A paper-tape system designed for use with the Micro 800 and Micro 1600 computers consists of a combi-

New products

nation eight-channel reader/punch, an interface controller, interconnecting cables, and mounting hardware. It reads fanfold tape at rates of up to 300 characters per second, and punches up to 75 characters per second. The interface controller contains the logic as well as the circuitry for control of the reader/punch and for transfer of data between the computer and tape unit. It is on a single printed-circuit board. Price of the unit is $3,995.

Microdata Corp., 644 E. Young St., Santa Ana, Calif. 92705 [366]

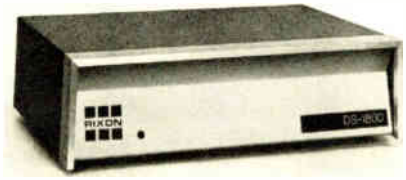
Computer is aimed at control applications

A processor called the Systems 71 is a 16-bit type computer and is an all-core memory version of the company's Systems 72 computer. The model 71 is compatible with the model 72, and applications are in real-time data acquisition and control. This includes process control, production testing, and remote batch processing. The unit can also be used as a peripheral processor when linked to the company's 32-bit computer systems.

Systems Engineering Laboratories Inc., 6901 W. Sunrise Blvd., Ft. Lauderdale, Fla. 33313 [368]

Data modem operates at up to 1,800 bits/second

A data modem designated the DS-1800C is intended specifically for multipoint polled applications over leased four-wire type 3002 voice-grade communications circuits. The unit operates at rates up to 1,800 bits per second. A carrier detector is specified at from 4 to 8 milliseconds, and is used to minimize turn-around time. Operation can be either four-wire full duplex or two-wire half duplex.



Rixon Electronics, 2120 Industrial Parkway, Silver Spring, Md. 20904 [364]

Key station includes 128-character display

A cathode ray tube key station, the CMC 103, is for use with the CMC 5 Keyprocessing System. Features of the unit include a 128-character video display: the screen shows 112 data characters plus a 16-character message indicating column number, field number, format level, and other status information. Also offered are field separator marks, cursor, and first-character indicator lights. Both the display and the cable-connected keyboard are movable. Leasing price is $70 per month.

Computer Machinery Corp., 2231 Barrington Ave., Los Angeles, Calif. 90064 [365]

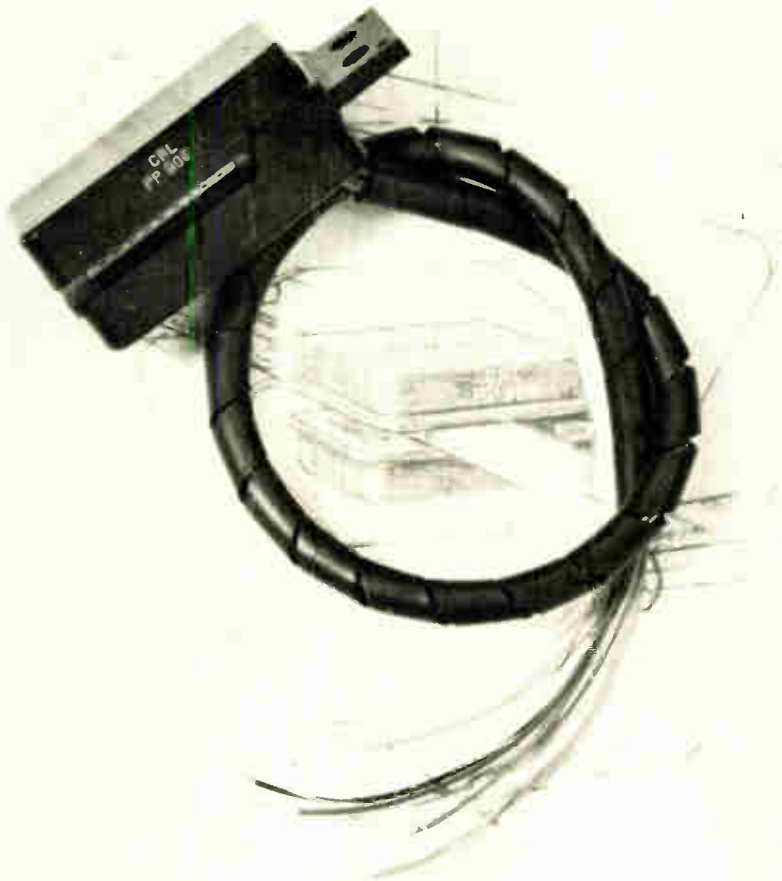
Color imaging system built for computer display

A computer-output video color-imaging system, called Spectrovision, produces full-color, gray-scale and color-coded images from common digital sources. The result is a flicker-free screen display using hue, saturation and luminescence

Solutions to light sensing problems

A Ready-To-Install LED/Sensor/Amplifier

for reading tapes and cards



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We call it the **"Perfect Pair"**, and for good reason. The **Perfect Pair** is a complete LED emitter and Opto-Hybrid® sensor/amplifier/digitizer subsystem—ready to install. That's right, one package containing perfectly matched emitters and sensors that easily mounts in your equipment—reduces production costs—makes a better product. Attach the leads and it's ready to operate at speeds in excess of 1,000 characters/second. Solid state reliability of the light emitting diodes ends tungsten filament breakage and degradation problems, eliminates heat and reduces power supply current drain. The sensing unit has all the advantages of Centralab's Opto-Hybrid® circuits.

The standard PP900 nine channel **Perfect Pair directly retrofits existing systems** and is compatible with DTL/TTL logic systems. And the "A" version is capable of reading translucent tape with transmissivity up to 50%. When desired, custom designs can be economically supplied to fit special applications.

If you make or use tape or card readers, the **Perfect Pair** will save you time, save you money—and improve your product! Contact us! Find out why we've earned the reputation as light sensing problem solvers.

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Circle 143 on reader service card

for discrimination of three-dimensional subject matter. In addition to real-time operation, the unit enables the operator to assign and reassign color values, and to correct,

compensate or rescale displayed values on all three axes. The IBM-compatible display has a keyboard for on-line control.

Aerojet General, Data Systems Div., 9200 E. Flair Dr., El Monte, Calif. 91734 [363]

Microprocessor designed for real-time systems

A microprocessor, the model 80, is a byte-oriented microprogramed unit designed primarily for OEM use in real-time dedicated applications. The architecture of the model 80 permits modules of bipolar, MOS, or core memory, and various types of read-only memory to be combined or intermixed in both data and instruction memories in 256-word modules. The microprocessor is subroutine-oriented, and employs an automatic pushdown stack for routine linkage. Up to 4,000 words of read-only memory and 4,000 words of random-access memory can be added to the basic model.

Automatic Electronic Systems Inc., 5455 Pare St., Montreal 309, Canada [369]

Core memory has cycle time of 1.2 microseconds

The Micromemory 6000 is a core memory with a cycle time of 1.2 microseconds and an access time of 550 nanoseconds. Worst-case power consumption is 0.11 milliwatt per bit in a 65-word-by-40-bit system

Was Velikovsky *Right* After All?

When Dr. Immanuel Velikovsky startled the nation in 1950 with his bestseller, Worlds in Collision, he was greeted by a storm of intemperate rhetoric from prominent scientists around the world. A Michigan professor of astronomy wrote in a letter to Velikovsky's publisher: "Can we preserve democracy when education in true scientific principles . . . can be nullified by the promulgation of such lies—yes, lies, as are contained in wholesale lots in Worlds in Collision? . . . No, I have not read the book . . . And I do not intend to waste my time reading it."

Velikovsky's crime was to have proposed that sound evidence exists for the occurrence of near collisions between Earth, Venus, and Mars in historical times—collisions which destroyed civilizations and sculpted the Earth's surface. Such events figured prominently, Velikovsky claimed, in the escape of the ancient Israelites from Egypt.

By 1962 a few scientists, willing to brave the official scorn, spoke out for Velikovsky. Astronomer Lloyd Motz of Columbia University and physicist V. Bargmann of Princeton, writing in Science (Dec. 21), cited Velikovsky's successful prediction of two astonishing discoveries—the extremely high surface temperature of Venus (hotter than molten lead) and the emission of radio signals from Jupiter. "Although we disagree with Velikovsky's theories," the two scientists wrote, "we feel impelled to make this statement to establish Velikovsky's priority of prediction of these two points and to urge, in view of these prognostications, that his other conclusions be objectively re-examined."

But it has only been the past two or three years which have seen among scientists a more widespread acknowledgement of Velikovsky's vindication and a mushrooming interest in his work. Space age discoveries forced this reevaluation. For example—

- Last December 29 Dr. S.K. Runcorn, a leading authority on magnetism, told an A.A.A.S. gathering, "When we received the Apollo landing sample, as with the other groups who had been studying the magnetic properties, we were all surprised to find remanent magnetization."
- But Velikovsky had written in the N.Y. Times on July 21, 1969 (before the lunar landings): "The moon has a very weak magnetic field; yet its rocks and lavas could conceivably be rich in remanent magnetism resulting from strong currents when in the embrace of exogenous magnetic fields." The actual discovery of this magnetism has posed a perplexing riddle for scientists that, apart from Velikovsky's explanation, remains unsolved.

Velikovsky was once derided for claiming that Venus might rotate backward, that the moon, Mars, and Venus are losing heat, that moonquakes are frequent, that the moon's surface contains radioactive "hot spots," that the Minoan linear B script was an early form of Greek, that human settlements would be discovered in the now uninhabitable Siberian wastes . . But the record now favors Velikovsky on all these points, as on many others.

An international selection committee is being set up to date Egyptian New Kingdom objects; preliminary tests have already favored Velikovsky's revised chronology. A group of physicists are undertaking a computer analysis of ancient astronomical records to determine whether the solar system's order has changed during man's history.

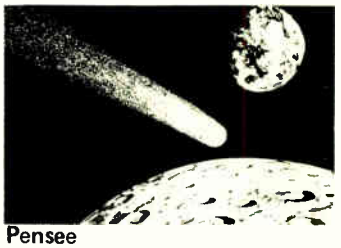
"I do not know of any specific prediction you made that has since been proven to be false."

So stated the late H.H. Hess, chairman of the Princeton University geology department, and chairman, Space Science Board, National Academy of Science. A full evaluation of Velikovsky's record is set forth in a special issue of *Pensee* magazine: IMMANUEL VELIKOVSKY RECONSIDERED. This will be the most discussed and hotly debated magazine this year. Contributors include Dr. Horace Kallen, co-founder and former dean of the graduate faculty, New School for Social Research; Dr. Lynn Trainor, professor of physics, University of Toronto; Dr. William Mullen, in the history and classics departments and the division of interdisciplinary general studies, University of California (Berkeley); as well as Velikovsky (who contributes three major articles), and numerous other scholars.

You will find the following features in IMMANUEL VELIKOVSKY RECONSIDERED:

- **a list of nearly 40 "impossible" scientific claims Velikovsky made in 1950, all of which were substantiated by later investigations.**
- **an interdisciplinary survey of the new avenues of research opened up by Velikovsky's work.**
- **a full-length analysis of Stonehenge and its meaning in the light of cosmic catastrophes during man's history.**
- **a debate: Are the moon's scars only 3,000 years old?**
- **Pharaoh Akhnaten and his revolutionary worship—Was Venus instrumental in the heresy?**

Pensee is published by the Student Academic Freedom Forum, a tax-exempt, educational foundation. Single copies cost $2,00; you may purchase 10 or more for $1.50 each.



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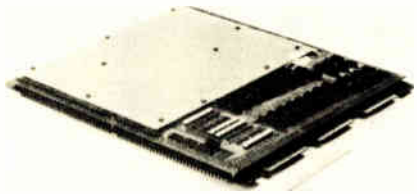
New products

configuration. The unit is available with from 16,384 to 65,356 words by 40 bits and from 32,768 to 131,072 words by 20 bits. Field expansion of the memory capacity (within the module) is possible with the addi-



tion of pluggable stacks and printed-circuit boards. The card memory system uses two printed-circuit cards in the minimum capacity configuration, five cards when fully expanded.

Electronic Memories, Div. of Electronic Memories and Magnetics Corp., 12621 Chadron Ave., Hawthorne, Calif. [367]

Rack-mounted modems built for on-line systems

The 330 series of rack-mounted modems are intended for on-line data communications applications. Each cabinet has space for up to 16 modems plus a display panel providing indication of the status of four control and two data functions. Each modem contains a separate

power supply, initiate and respond to long-space disconnect, lost carrier disconnect, 10-second fail-safe disconnect, busy-out, and loopback by local and/or remote control. Price is $465 for the cabinet with display panel, and each modem is $195. Leasing price of the complete system is $88 per month.

ComData Corp., 7544 W. Oakton St., Niles, Ill. 60648 [370]

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Instruments

Scope testing is simplified

Calibrator can display percentage error directly for time and amplitude

Doing a complete calibration of an oscilloscope will never be a fun job, but Ballantine Laboratories' latest instrument promises to make it a lot less of a chore than it used to be. Combining voltage, sweep, and rise time functions in one package, the model 6125A oscilloscope calibrator features a built-in deviation meter that displays the scope's time and amplitude errors directly.

The amplitude (voltage) section has both dc and 1-kilohertz square-wave capability. The dc output can be positive, negative, or ground, while the square wave is always positive-going. Maximum amplitude error is less than 0.25% of setting. The output voltage covers the range of 10 microvolts per division to 20 volts per division in the commonly used 1-2-5 sequence. A series of pushbutton multiplier switches allows the display to be expanded to cover CRT graticules with 3,4,5,6,8, or 10 vertical divisions.

The deviation control allows the operator to adjust the calibrator's output until the trace coincides exactly with the graticule division. The deviation meter then displays the percentage error directly on one of two ranges—either ±3% or ±10% full scale.

The crystal-controlled time mark generator covers the sweep range from 100 nanoseconds per division to 0.5 second per division. Like the voltage generator, it is calibrated in a 1-2-5 sequence, and can be used in conjunction with the deviation meter. With the deviation switch off, the time base has a maximum error of 0.01% of setting. On the 3% deviation range the maximum error increases to 0.1%, and it goes up to 0.2% on the 10% deviation range.

The rise time output is a square wave with a positive-going slope that lasts 1 nanosecond when working into 50 ohms. The square wave has an extremely flat top to permit easy testing and alignment of wide-band oscilloscopes.

The 6125A weighs 15½ pounds and costs $1,875.

Ballantine Laboratories Inc., P. O. Box 97, Boonton, N.J. 07005 [351]

Frequency divider operates from 100 Hz to 200 MHz

A programable frequency divider for signal analysis and waveform synthesis operates on any signal from 100 hertz to 200 megahertz. It can be programed by thumbwheel switches to divide an input signal by any selected integer number. Called the model I-1002, the unit can also be used for bandwidth reduction, and for signal analysis connected with processing data from instrumentation tape recorders.

Probe Systems Inc., 655 N. Pastoria Ave., Sunnyvale, Calif. 94086 [339]

Function generator provides phase-locking capabilities

A function generator called the model 748 offers broadband, a-m, fm, and phase-locking capabilities,

as well as combinations of the three. Sine, square, and triangular output can be swept, frequency-modulated, gated, or phase-locked over the directly dialable range from 1 hertz to 2 megahertz. Sine-wave output may also be amplitude controlled with signals from dc up to 2 MHz. Phase-lock capability allows the unit to function as a synchronous detector. Price of the unit is $515.

Clarke-Hess Communication Research Corp., 43 W. 16th St., New York, N.Y. 10011 [340]

Incident recorder offers four thresholds

An incident recorder called the model DA-720 handles the number of input events and their duration. Four thresholds defining five amplitude windows (two of which are open-ended) are provided to give

performance characteristics for propagation fading and incident studies. The unit is designed to deliver much of the information previously obtained manually from strip-chart recorders. The output may be printed on paper tape or Teletype.

Techal Electronic Services, 2346 Spruce St., Vancouver 9, British Columbia, Canada [353]

Bit-error test set generates a psuedo-random pattern

A bit-error test set consists of a pattern generator and independent receiver. The model 7090 is designed to measure and display bit errors that are produced by magnetic tape recorder/reproducer equipment, rf communications equipment, and pulse-code-modulation bit synchronizers. The unit generates a 2,048-bit pseudo-random pattern compat-

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ible with IRIG Document 118-71, and provides PCM codes compatible with IRIG Document 106-71. Price is less than $2,600.

Coded Communications Corp., P.O. Box 767, 533 Stevens Ave., Solana Beach, Calif. [354]

Digital timer is accurate to hundredths of a second

A new digital timer, designated Compu-Timer, is powered by six alkaline penlight cells, and incorporates an illuminated digital display, integrated circuitry, and a miniature oscillator. The oscillator splits seconds into 1.6384 million parts, and the instrument measures up to 9 minutes, 59 seconds, and 99 hundredths before recycling. It can be operated manually or by using an input plug for electronic control of

the start-stop operation. Any on-off control can be used.

Preysz Precision Instruments, P.O. Box 2508, Madison, Wis. 53701 [355]

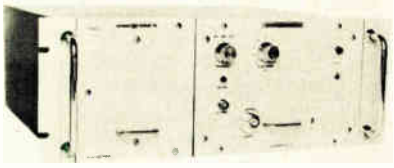
Sound-level meter is also impulse-impact analyzer

The model 1933 sound-level meter and analyzer also functions as an impulse-impact and octave-band analyzer. A-, B-, and C-weighted sound-level measurements are push-button-selectable, and output is read from a linear meter scale which displays directly in decibels over a 20-dB range. Octave-band readings require one adjustment of the two range controls, and the input signal level then automatically self-adjusts. Price of the unit is $1,350.

General Radio Co., 300 Baker Ave., Concord, Mass. 01742 [357]

Kilovolt pulse generator has 50-ohm impedance

A nanosecond kilovolt pulse generator features a characteristic impedance of 50 ohms, and has a variable output of 1 to 9 kilovolts. Rise and fall time is 1 nanosecond, and delay



is 20 ns. The unit is capable of pulse repetition rates of up to 100 hertz and can be triggered manually by pushbutton, or electrically by repetitive 3-volt pulses. Applications are in speed switching, such as the gating of image converter cameras in nanosecond photography.

EG&G Inc., Electro-Optics Div., 35 Congress St., Salem, Mass. 01970 [356]

Phase-angle voltmeter spans 30-Hz to 300-kHz range

A phase-angle voltmeter series measures over the range of from 30 hertz to 300 kilohertz. The PAV-4 series has a dynamic range of from 300 microvolts to 300 volts, harmonic filtering, and high input im-

New products

pedance with or without input isolation. Each of the three mainframes accepts a range of fixed- and variable-frequency plug-ins. The fixed-frequency plug-ins have a minimum phase accuracy to within 0.5°.

Singer Instrumentation, Los Angeles Operation, 3211 S. LaCienega Blvd., Los Angeles, Calif. 90016 [358]

Real-time analyzer traces noise, vibration sources

A real-time analyzer called the Spectrascope SD330 is an analyzer, spectrum averager, and display oscilloscope in one package. It allows the operator to trace sources of noise and vibration in a wide variety of equipment, including compressors and motors. Frequencies of up to 20 kilohertz can be processed and presented in four modes. The input signal can be derived from conditioned accelerometers, velocity pickups, microphones, or tapes.

Spectral Dynamics Corp., P.O. Box 671, San Diego, Calif. 92112 [359]

Digital panel meters include power supplies

A series of digital panel meters with LED displays are available in either 3-digit unipolar or 3½-digit bipolar configurations. Features include the suppression of insignificant leading

zeros, externally programable scaling, input filtering, and decimal location. All models have self-contained supplies and are interchangeable with other DPMs.

United Systems Corp., 918 Woodley Rd., Dayton, Ohio 45403 [360]

Some engineers are practically extinct at 35.

Birds and engineers both face occupational hazards.

The dodo, unfortunately, had tiny wings. He couldn't fly, so he perished three centuries ago.

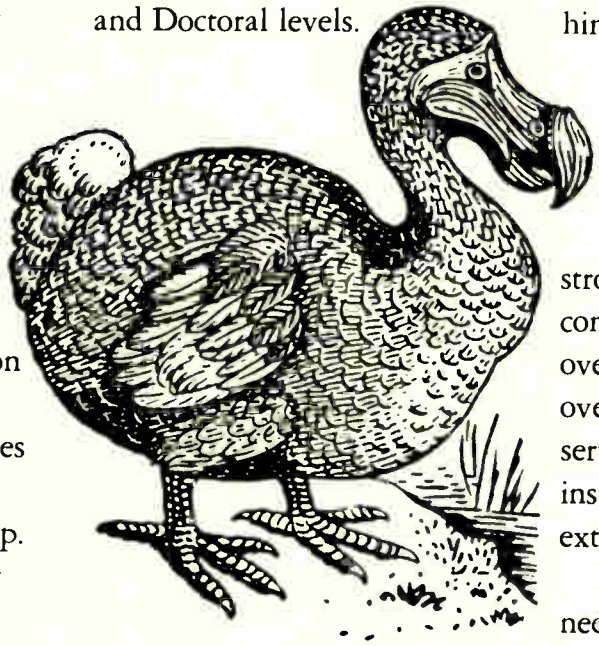
Today many engineers face a real and growing hazard: professional obsolescence in the prime of their careers.

Because the proliferation of knowledge is so swift, because technological changes are so sweeping, R. & D. engineers often can't keep up. Their competence no longer fits the need.

Extinct at 35? It happens. In Alvin Toffler's best-seller, *Future Shock*, an electronics-industry spokesman is quoted as follows: "... the so-called 'half-life' of a graduate engineer is only ten years."

A tragic waste of one of the country's priceless assets. But at Hughes we do more than deplore it. We've developed an extensive program to combat technical obsolescence.

We award fellowships yearly to selected candidates for graduate study at Masters and Doctoral levels.



We pay 75% of the cost when Hughes engineers take appropriate college courses after hours.

Our Technical Education Center develops forecasts on future technology needs, and establishes programs to meet these needs. Including courses, on-premises, by recognized specialists.

And the Engineering Rotation Program enables a new Hughes engineer to take on a series of interdisciplinary job assignments. He gains broader experience fast, determines what field interests him most.

We also keep building a stronger, more diversified company. Today Hughes is in over 80 major areas, including over 550 products and services. And that's good insurance against becoming extinct.

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New literature

YIG devices. Physical Electronics Laboratories, 1185 O'Brien Dr., Menlo Park, Calif. 94025. A nine-page bulletin lists the technical specifications of a YIG-tuned Gunn diode and a YIG-tuned transistor oscillator. Circle 421 on reader service card.

Power supplies. A four-page brochure from Acopian Corp., Easton, Pa. 18042, describes power supplies for mounting on printed-circuit boards, and for use in other limited-space applications. [422]

Trimming potentiometers. A short-form catalog, describing a line of trimming potentiometers for general-purpose and military applications, is available from Weston Components, Archbald, Pa. 18403. [423]

Multimeter. Triplett Corp., Bluffton, Ohio 45817, has published a four-page brochure featuring the model 603 field-effect-transistor volt-ohm-milliammeter. Specifications and general descriptions are offered along with illustrations. [424]

Multiplexer. Data distribution applications and user benefits of the Multitran modular time division multiplexer are detailed in a brochure from Computer Transmission Corp., 1508 Cotner Ave., Los Angeles, Calif. 90025. [425]

Multipen recorder. A four-page bulletin from Soltec Corp., 10747 Chandler Blvd., N. Hollywood, Calif. 91601, provides a general description and specifications of a multipen recorder. [426]

Contacts. A 12-page brochure from Engelhard Minerals & Chemicals Corp., 430 Mountain Ave., Murray Hill, N.J. 07974, outlines typical applications and the importance of silver-cadmium oxide contacts. [428]

Analog circuits. Analog Devices Inc., Route 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062. A product reference guide lists the company's line of products including analog circuits. [429]

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Promises to keep

**"But I have promises to keep,
And miles to go before I sleep."— Robert Frost**

In 1976, a few short years from now, America will celebrate the 200th anniversary of a unique promise. The promise, and the enduring dream, of "Life, liberty and the pursuit of happiness."

It is good to pause and look back. To reflect on and renew that historic promise.

But it is also necessary to look ahead.

Because America has new promises to keep. And a long, long way to go.

We have promised not merely to maintain, but to enhance the American way of life. To improve the standard of living *and* to improve the quality of life in tomorrow's America.

We have promised to produce the things—the goods and services—that make life possible and pleasant. And we have also promised to pay more heed to the intangibles that make life meaningful.

We have promised to conserve and protect our natural resources. To restore the vitality and preserve the beauty of our environment. To clean up our air and cleanse and refreshen our rivers, lakes and streams. To rebuild and reshape our cities, and to rationalize and reorder the chaos of a transportation system gone awry.

We have promised to care for the sick and safeguard the public health. To give new dignity and new hope to the poor, and to assist the disadvantaged. To do a better job of educating the young, and a much better job of cherishing and enriching the lives of the old.

All of these things, and more, we have promised to ourselves. And there is little argument about our promises. Most Americans agree that these are, and should be, our national goals.

But how do we deliver on our pledges? How do we match promise with per-

formance? How do we reach our goals? These are the hard, practical questions that perplex and divide us.

There are no simple answers to complex questions. But as we stand hesitant at a crossroads, debating which path to take, a few things do seem obvious. And perhaps it is time for a little plain talk.

Time to say flatly that there is no easy, primrose path that will take us where we want to go. The easy paths lead backward, or nowhere. The road that leads ahead is a hard road.

Because there is no way to produce less and have more.

No way to do less and accomplish more.

No way to give less and get more.

No way to sit on our aspirations and expect things to take care of themselves. Somebody, somehow, has got to *do* the conserving, protecting, restoring, preserving, cleaning, rebuilding, reshaping, rationalizing, reordering, caring for, safeguarding, helping, educating and cherishing.

And the only way to do a better job in all of these areas is to work at the job. Work harder or smarter, or both.

And, most importantly, work together. The job is too big for any of us working alone. And too big for all of us, working at cross purposes.

There is no easy way, and there is no one, patented, exclusive way. No Liberal way and no Conservative way. No Democrat way and no Republican way. No business way and no labor way. No strictly government or wholly private way.

There is only a productive way or a nonproductive way.

And the productive way calls for all of us to join together. Not in perfect harmony. Not in ultimate brotherhood. And not in some high-flown crusade.

But in the simple recognition that we all—business, labor, government and private citizens—have a job to do.

That we all have contributions to make.

And that each is vital, necessary, indispensable. Not to be done without.

The original promise of America was set forth in the Declaration of Independence.

The new promises of America call for a new Declaration of *Inter*dependence.

For a new awareness and acknowledgment of our mutual dependence. Each upon each. All upon all.

This awareness, this new Spirit of '76, will not spring full-blown from this, or any other, proclamation. It cannot be legislated. It cannot be imposed. It cannot be synthetically drummed up.

It will begin, if at all, when the American people begin to tire of the politics, the policy, the endless futility of "confrontation." It will begin when they look at our goals on the one hand, and our petty squabbles on the other, and conclude quite simply, "You can't hardly get there from here." And that's a fact.

There are, at this crossroads in time, many paths to take. But there is only one useful way to go. Forward. Together.

It is time to face facts.

For we have promises to keep, and miles to go before we sleep.

We at McGraw-Hill believe in the interdependence of American society. We believe that, particularly among the major groups—business, labor and government—there is too little recognition of our mutual dependence, and of our respective contributions. And we believe that it is the responsibility of the media to improve this recognition.

This is the first of a series of editorial messages on a variety of significant subjects that we hope will contribute to a broader understanding.

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John R Emery

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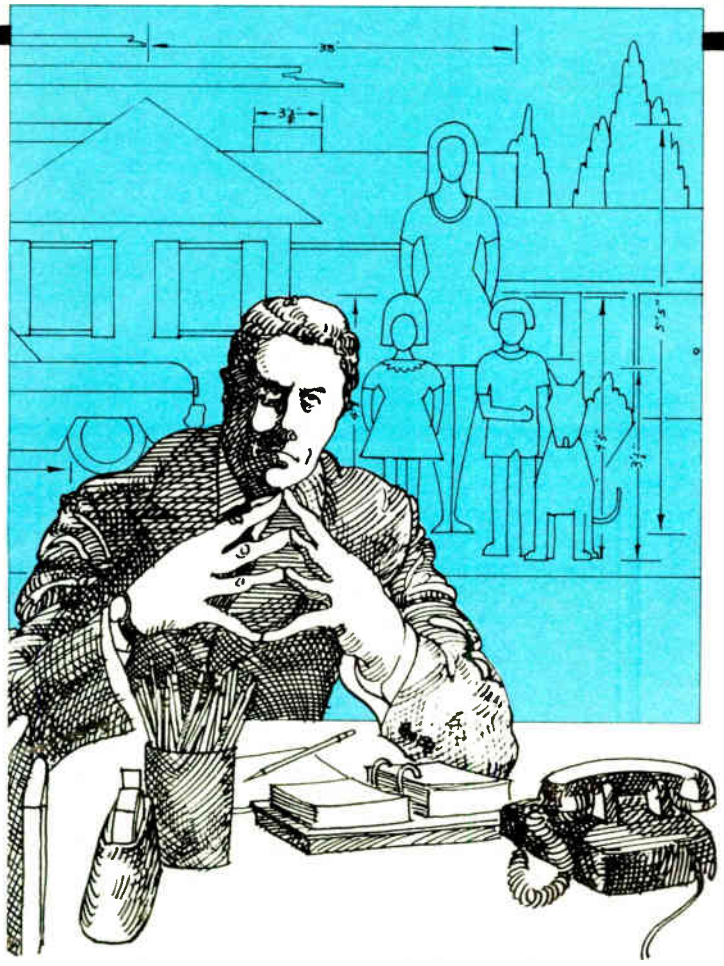

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MAY 1972

SPECIAL REPORT:
ESTATE PLANNING

The profitable and lively art of lifetime "estate planning"

Estate planning is no dreary routine that begins when a man is past his prime. It's a fast-moving, flexible technique that can translate a career of income-production into a more meaningful and satisfying adventure for a man and his family. It's something that ought to begin when he is flexing his muscles and rolling steadily toward the top in his business or profession.

This isn't suds—it's *true*. The trouble is that to many people, "estate planning" amounts to a tedious, unpleasant—and often postponec—chore that smacks of dusty wills, taxes and death. Indeed, such planning has to do with making proper arrangements for the disposition of one's property after death. But this is only part of the package. In its full sense, estate planning means working out ideas and objectives, picking options, and taking actions during one's lifetime to achieve an optimum utilization of all family assets—for *now* and for the distant future, as well.

Personal financial planning is a better label—and to this, the concept of long-range foresight and activity must be added. Although this kind of planning must take into account the impact of income, gift, and estate taxes, the idea of tax-saving should *not* be the primary objective. Too many estate plans have been distorted by the search for tax breaks that all too frequently have fallen apart on technicalities or been vastly outweighed by neglected family considerations. An estate plan must have as its first goal the meeting of the unique personal needs of the family. The emphasis falls on the word "personal."

Family needs, of course, can change dramatically in the span of a lifetime. The "needs" of a man of 30 usually revolve around paying monthly bills and acquiring life insurance to protect a young family in the event of his premature death. Buying his first life coverage is, in fact, the usual first step in estate planning taken by a young husband. At 60, he may be revamping an investment portfolio to reflect the changes that will come with retirement, and making gifts to his adult children, and possibly to charity, as well.

Ideally, estate planning should begin as soon as one begins to acquire assets. This is especially true since most of us begin acquiring both family responsibilities and assets at about the same time. Unfortunately, though, many younger men miss the point and procrastinate. They feel that they aren't rich enough—or old enough—to be concerned about death and taxes. The truth is, this attitude is a blunder. A career

man of 30 can ill afford to get into bad habits in handling his property. Often, for example, a young husband falls into the idea of owning all assets jointly with his wife. But this is a trap: As net worth increases, many valuable financial planning options can be lost, and a number of unnecessary problems—some of them serious—created.

It's also common for men in their 30's or 40's to be unaware of the many ways life insurance can be utilized in a good long-range plan, and to put off buying meaningful coverage until the premiums are too high—and the need, in a sense, too low. The protection that variable annuities can afford against inflation may not even be considered. The advantages of making life insurance death benefits—and perhaps all company retirement benefits—payable to a trust created in middle age are often overlooked entirely. Yet, a trust is one of the best ways to provide the flexible protection and discretionary management a family requires if it suddenly receives a large sum of money because of the death of the breadwinner. Insurance, in short, produces an "instant estate" that needs to be carefully and expertly planned well in advance.

Fundamental to all smart personal financial planning—that is, estate planning—is good legal advice. It takes a family lawyer to advise on how best to organize one's affairs to meet all the requirements of the law, and to prepare any legal documents, such as wills or trusts, that may be needed. The trust officer of a good local bank can, of course, explain the bank services that may be of help. Other people who may be needed are investment and tax advisors, a life insurance agent, as well as the individual at one's office who handles the retirement programs. It is the lawyer, of course, who remains as anchor man.

When a man starts to work with his lawyer and others, he should give them candid, detailed information about himself, his family, and his finances. Sometimes overlooked is that an estate plan is really only as good as the information that goes into it. The progress of professionals is frequently bogged down by clients who furnish incomplete and even misleading information. The nature of all assets (real estate, securities, cash, profit-sharing entitlements, and so on), the form of ownership (sole name or joint names, for example), and current values, must be detailed. Potential future assets should not be overlooked; and naturally, liabilities must be fully revealed.

One should also be prepared to speak candidly about the family's needs. Who are the people who *must* be taken care of? How old are they? Perhaps there is a child whose career objectives involve a lengthy and expensive education, or one who, because of illness or disability, may never become self-supporting. The more fully one discloses all of these facts, the sounder will be the recommendations made. Again, an estate plan that does not fit the specific situation will be of little help—and it could be harmful.

Already mentioned is one important situation in which a trust might be one of the logical recommendations made. There are a number of others. In any case—and this is crucial in modern estate planning—the provisions of a trust, whether it is created during one's life or by will, should be drawn so that the trustee is given *broad* discretionary powers. He should be able to freely invest the trust fund, manage the family business if there is one, and make money available to the family by "invading principal" if necessary. In the absence of commanding reasons to the contrary, the trustee's discretion should not be rigidly restricted. If rigidity ties the trustee's hands so that he can't respond to changes in circumstances that inevitably occur—especially if there is an active investment portfolio—then the basics of the entire estate plan may very well be defeated.

Once a plan has been set in motion, it becomes important to keep it up to date. *Personal financial planning is not a one-shot proposition.* Periodic reviews are a must. Moreover, any major change in one's assets or personal life—an inheritance, the birth of a child, a move to another state, a divorce, or such—is also a good reason for doublechecking. The *form* of all investments should be regularly reviewed to be certain they measure up to standards set by the basic plan. It should be noted, for instance, that some attractive tax-shelter investments that have lately found their way into ambitious estate plans might one day create problems—among other things, the non-liquidity of some of these investments is often overlooked.

Such a program may sound formidable and, one might think, far too complicated. In practice, it is simple for most people—and the costs are not great.

We spend a sizable part of a lifetime in accumulating property. It is logical to spend at least a small fraction of that time making sure that what is accumulated is managed and disposed of wisely. "Estate planning" is the process by which this is done. It takes a bit of doing to *own* property successfully—just as it does to earn it in the first place.

—JAMES W. NORTH

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Teamwork is key to developing a viable plan

"Show me a will," says one veteran Wall Street bank trust officer, "and I'll tell you who the architect was. If there are too many trusts, it was a banker. If there are too many fiduciaries, it was a lawyer. If there is too much insurance, it had to be an insurance man."

The banker's summary is a candid swipe at what all too often passes for estate planning. But one point is well-taken: Properly done, the task calls for expertise in a variety of disciplines—the law, investment counseling, insurance, accounting, and, ultimately, estate management. Ideally, it would take a team of experts acting in concert. Certainly, in an age of increasingly complex tax structures and financial markets, it is not a do-it-yourself project. Seeking professional help is a must—but where to look?

It is doubtful that "estate planners" yet constitute a separate profession. More accurately, the practitioners tend to be estate specialists whose "real" professions are the law, banking or, most commonly, insurance.

With more people more sophisticated in money matters, today's CLUs (certified life underwriters) have become more broadly competent in the intricacies of estates. Some major companies devote much of their sales and research effort to this market—New England Life, Northwest Mutual, Connecticut General, Connecticut Mutual, and New York Life, among others. Not that the old-time, hard-sell policy-pusher no longer exists—he is just easier to spot.

"You don't have to be a genius," says one insurance industry spokesman, "to tell when a salesman is putting his commissions ahead of your interests. The conscientious CLU sees his role not strictly that of salesman but as a catalyst in the whole estate-planning process."

Puns about "catalytic agents" aside, a competent CLU will guide his client to the other experts and services his situation may require. One of his more helpful services may be in knowing which lawyer or law firm best suits a client.

Picking an adviser is vital to a man with estate problems. It's generally agreed that the lawyer is the kingpin of any estate-planning team. This is not only true because of the volume of routine legal work involved in any estate, but because of the close lawyer-client relationship essential to a successful estate plan. A man's lawyer, particularly in estate matters, should know and understand his family situation as well as he does his business affairs. Thus one leading Manhattan attorney sets this cardinal rule for new estate clients: "Bring your wife along. She should get to know us now, not later in a time of stress."

Legal fees in general are up, but not sky-high for estate work. There was a time when lawyers made a practice of writing wills free or at nominal charge. "We used to think of wills as a sort of loss-leader," says one. "Now, since so much of the lawyer's work can be deducted as 'tax advice', we charge anywhere from $50 up." Still, $200 is about tops for a will without serious tax, trust or other complications. Executorship and other fiduciary fees and commissions vary from state to state, but usually remain between 2% and 3% of an estate's value.

Most estate lawyers agree that a good accountant is a vital member of the team, particularly in cases where a family business is involved. "Preferably," says one attorney, "he should be the same man who has been handling the client's financial and tax work right along." Tax guidance from a CPA is also considered invaluable, although estate counselors warn against too much emphasis on tax savings in designing a will. "Tax gimmicks," says one, "may save money, but sometimes at the sacrifice of the better interests and happiness of the heirs and beneficiaries."

To an increasing extent, lawyers today are stepping away from the investment business, avoiding heavy portfolio management duties. Says the partner of a large Manhattan firm, "We encourage people to name banks as fiduciaries. For one thing, they are permanent. For another, they're likely to have more competent knowledge in investment matters at their disposal."


North


Greisman


Brosterman

The members of PB's team

In compiling this Special Report on estate planning, Personal Business relied heavily on its own team of visiting experts, three men—all lawyers by training—who have distinguished themselves in three separate areas of the field.

Robert Brosterman, attorney, author and lecturer, is considered an advisers' advisor in the estate planning business. For several years he has made a business of telling professional estate planners how to carry their message to their clients. A recognized authority on the uses of life insurance in estate planning, he has served as a consultant to some of the nation's more progressive insurance companies. He has also counseled bankers, accountants and other lawyers, as well as the countless readers of his book, *The Complete Estate Planning Guide* (McGraw-Hill, $7.95).

Bernard Greisman is without doubt the most widely-read tax writer in the country. Like Bosterman a member of the New York Bar, Greisman is the professional who writes J.K. Lasser's *Your Income Tax*, the familiar yellow paperback (Simon & Schuster) that appears in nearly every U.S. book shop and sells well over 500,000 copies a year.

James W. North is an executive vice-president of Chase Manhattan Bank, which has one of the most active, respected and progressive estate planning and trust divisions in the U.S. A Columbia Law School graduate (1950), North early put the lie to the dusty image of the banker as creakingly cautious advisor to widows and orphans. He's regarded as a leading philosopher of modern estate planning, and the originator of some of its freshest ideas.

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Writing a will and wrapping up a long-range plan

Where there's a will, there is a lawyer's fee, so the saying goes. But the benefits that flow from a wisely drawn will are great, and foolish is the man who neglects this duty.

The paramount argument in favor of having a will drawn is that with a will a man can prescribe precisely *how* he wants his property distributed—he can provide for his family *in his own way*.

Consider the sad case of Jones who died intestate, survived by his wife and five children. He had wanted his wife to have and control all of his relatively modest $100,000 estate; but because he left no will behind, she actually received only one-sixth of the estate—her share under a state law which allows a widow a share no larger than that of a surviving child. It isn't that the state's law of "descent and distribution" is unfair, but rather—like the laws of other states—it is simply non-selective.

The central goal of estate planning is to provide maximum support and security for all members of the family depending on their special needs. The will, operating within the limits of the property available, is the prime document that lets a man accomplish this. It permits him to define specifically how various family needs are to be met. For example, it enables him to give sums of money to his children, with the amounts depending on their income levels and prospects. He can do the same, of course, with personal property, be it stocks, bonds, real estate parcels, or works of art.

One of the developing new trends in estate planning is the flexible and *variable* distribution of wealth to children. The idea that a father must strain to treat all of his children alike financially is fast going by the boards.

By drawing a will wisely, a father usually can make certain that the family residence will be retained for his widow and children. He also can use the will to keep federal and state taxes to a minimum, and even manage to curb unnecessary administration expenses. The overriding point, however, is that the head of a family can *set his own rules* for the future management of his property, down to picking the men who will do the managing. In writing a will, it's possible to answer precisely the four main questions related to distribution—how much, how, when, and to whom.

How much property shall be given to each beneficiary? The family situations are myriad. For example, if one's wife is to be primary beneficiary, the chore is simple. But where, say, a disabled child is involved, a father might want to set aside a larger-than-usual share for his benefit. Note that if there are children of various ages—say 10, 15, and 20 years—a distribution of equal shares will not benefit them equally. Recognizing that during the father's lifetime, he will have paid the cost of supporting and educating the eldest, it may be inequitable that the youngest should pay for similar support and education from his inheritance, should the father die. *If* equality is the goal, it might be obtained by giving the youngest child an amount which would be required for this added support and education, and then dividing the remainder of the inheritance equally among all three children.

How will the estate be distributed? The big decision, of course, is whether the property should be willed outright, or in trust. And a prime question is how well—or poorly— one's wife handles large sums of money. Some men get twisted into knots over this, and out of sheer sentimentality refuse to recognize that a widow naive in business matters can all too easily fall prey to bad advice. Well meaning friends and relatives can "help" a widow into the poorhouse, and hucksters can quickly finish the job. Trusts, whether established by will or lifetime agreement, also can save substantial amounts of estate and income taxes.

When shall the property be delivered to the beneficiaries? Another new trend in estate planning is the delayed gift. The traditional idea that a man's property ought to go to his heirs at the time of his death is more and more being disregarded. This is especially the case when there are children. A share given outright to a child under 21 has to be administered by a court-approved guardian. This may be both unwieldy and costly. And when the child reaches 21, the property *must* be turned over to him, whether or not he is ready or able to manage it. Instead, a man's will can set up a trust covering the child's share, with the final gift date delayed until the child reaches a more mature age, say, 25 or 30, even older. A father can, of course, provide in his will that property be used for the benefit of his children during their lives, then vest in *their* children, thus conserving the estate and saving taxes.

Who shall manage the property? It is only by his will that a man can name the executor of his estate and the trustee of any trust established. A probate court usually will confirm the appointment of any executor if he is over 21, though in some states a non-resident may not be confirmed. If there are children under 21 guardians for property and person should be named.

A will for one's wife is also a vital element in a family estate plan, and ignoring this has caused many a tangle in estates— and many a tax dollar. A wife may feel that she has no real need for a will because she has virtually no property in her name. But if she outlives her husband, she may have a sizable amount of property to bequeath. Her will should be coordinated with her husband's will, and delaying this chore is one of the repeated miscues in estate planning. Even without property, it is important that a wife name a guardian for children. And it should be stressed, again, that this is reason enough to write a will.

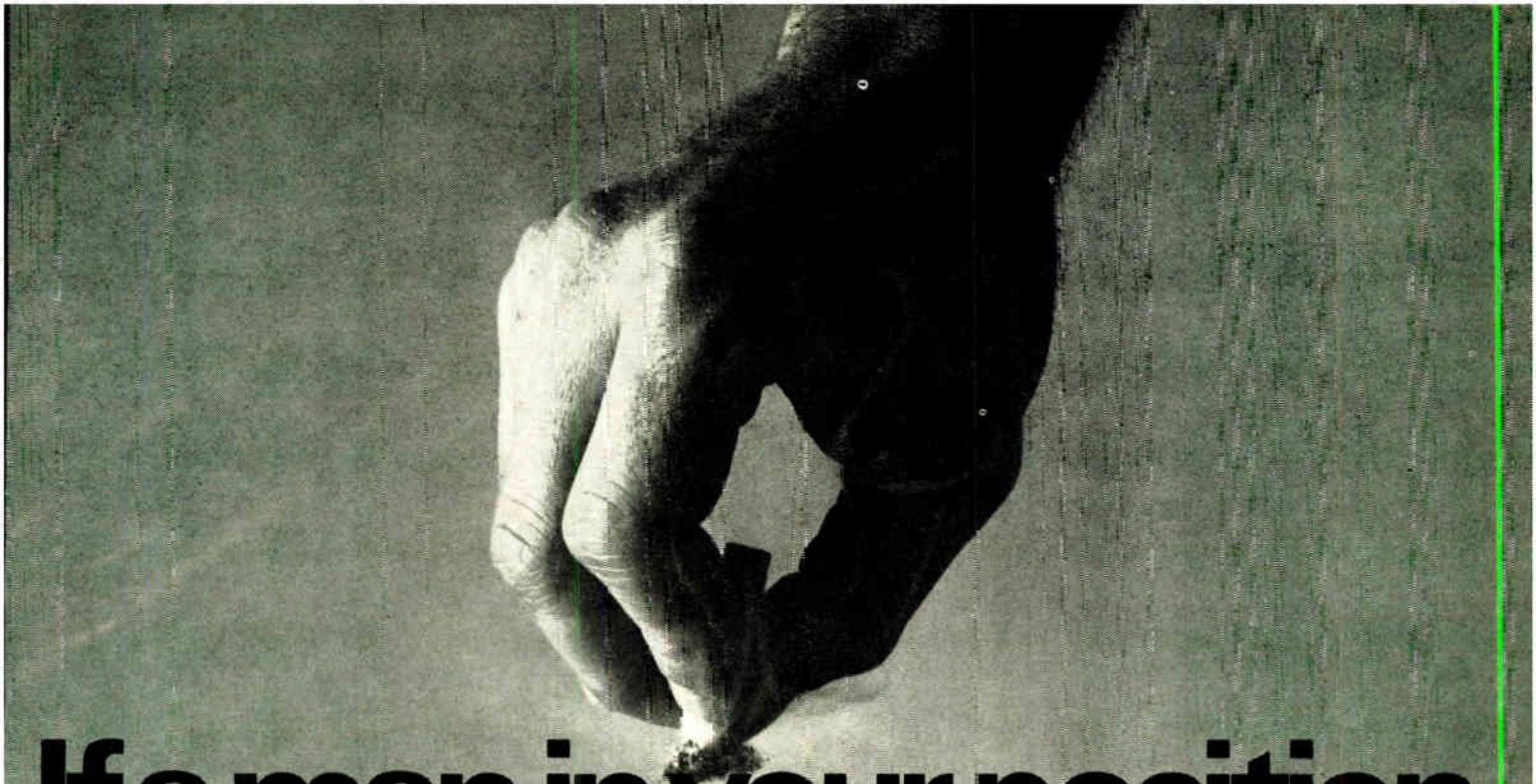
Even without children to consider, a will for one's wife can be important. The laws of many states provide that the estate of a person dying without a will must be divided between the widow or widower and the heirs-at-law of the deceased—parents, brothers, sisters, etc. Many a husband has discovered to his grief that he had to divide with his wife's relatives money that he had put into his wife's name before her death.

The so-called "simultaneous death clause" in a will can also be important for the children in a family. This applies to an accident in which both husband and wife lose their lives. In such cases, the heirs under most state laws lose the benefit of the marital deduction— which allows 50% of a man's estate to pass to his wife tax-free. There is a way to hang on to this deduction, however, even in the case of simultaneous death. The husband should make sure that his will contains a clause specifying that in a common disaster, it shall be presumed that his wife survived him.

A will should be reviewed every three or four years. Some changes calling for revision are apparent: births, deaths, marriages, new state laws. Others are easier to overlook. Suppose, for example, that one's property has increased greatly in value, and a trust is provided for wife and children. It might be wise to revise the trust to allow more freedom for using principal during the wife's lifetime. If property has sunk in value, the reverse holds.

For only a few minor changes in a will, a codicil—or modification—will do the job. But one should never attempt this by simply adding a typed paragraph. Even a small change must be executed formally.

—ROBERT BROSTERMAN



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Executorship: fraught with woes, worries—and work

NAMING AN EXECUTOR SHOULD NEVER BE A SENTIMENTAL AFFAIR

"In appointing his executor, a prudent man will exercise the utmost caution, and will *never* act out of sheer sentimentality in naming his wife, a relative, or a close friend. He should also tread with greatest caution before he himself accepts such a role as a favor to a friend or relative."

That advice is contained in the introduction to a widely-used law school casebook. A Cincinnati lawyer, as many in his profession before him, recently had occasion to read it aloud to a client, a prosperous professional man of 47 who had come to him for estate planning advice—and indicated he would like to have his brother named executor under his will.

"How in blazes he ever got the idea," the lawyer marvels, "is more than I can understand. For one thing, his brother is 10 years older than he is, and will probably go long before him. For another, he doesn't know a damned thing about investment." He adds: "Frankly, I wouldn't take the job, either. This guy is too close a friend."

Nonetheless, say the pros, people persistently name executors—and accept executorships—out of sentiment or respect. The result: hardship all around. The Cincinnatian, quite properly, finally named a local trust company.

The problem is, of course, that in making out their wills, many moneyed people tend to underestimate the job of an executor. In the first place, there is a time element that should be considered. No one should expect a short six-month or even one-year term of duty. The average estate, if at all complex, takes two years, and many take longer. More important, an executor shoulders a heavy responsibility. Not only has he a wide range of duties—including the delicate task of satisfying the decedent's family on a purely personal level—but if the administration in his hands turns sour, he may find himself digging into his own pocket, and even penalized in terms of paying special fees, fines, or extra tax charges to the government.

"Today," says the Cincinnati lawyer, "the executor's chores have been increased by a number of factors. Federal and state tax laws are more complicated. An investment portfolio is harder to handle—at least, harder than in the 1950s and 1960s."

Generally, the executor has two chief responsibilities: He must assemble and distribute the assets of the estate—and this is complicated by ownership of property over wide geographic areas in many cases. Second, he must see that all the debts of the decedent (including taxes) are paid. Along with these basic duties, an executor is faced with collecting income from various sources; selling off assets to pay, first, debts and then cash bequests, and adjusting claims of creditors against the estate. In the end, the job may even involve the operation of a family business, possibly for an extended period.

In sizable estates, the investment function of the executor usually is paramount; for example, the tedious job of selecting from the decedent's portfolio the proper assets to sell to pay taxes.

The stickler is that carelessness in any of these affairs by the executor can cost him money from his own pocket. In a recent New Jersey case, for example, the failure on the part of the executor to promptly sell off estate assets that were declining in value cost him the difference between an early and the delayed sales price. In a recent federal court case, an executor had failed to keep up on his tax figures. He had paid out regular debts of the estate, leaving tax money short to the tune of over $25,000—and he was forced personally to balance the account with Internal Revenue.

Special care should be taken before naming one's wife as executrix. True, a commission can be saved—but the move can be folly unless a man is satisifed that his wife is capable of managing property and investments. This holds true even if there is a trustee named in the will to oversee the estate for the benefit of the family. The trustee, however skilled, must wait in the wings until the estate has been settled. During the year or two (or longer) for settlement, the executor is totally in charge.

There are alternatives. A man can name his family lawyer as co-executor, along with his wife as executrix. This puts the attorney in a stronger position to protect the family's interest, with or without a trustee waiting off stage. Or, of course, a bank or trust company can be appointed to serve as executor and possibly as an eventual trustee.

A guardian, too, may need some help

It isn't always enough simply to name a guardian for your children in your will. If you'll be leaving a substantial estate, you probably ought to consider creating a trust, with a skilled trustee, to manage the property—instead of naming a guardian for this task. You still would have a personal guardian, to look after the youngsters themselves. This arrangement has at least two important advantages:

- A trustee can be given as much discretion in handling investments as you see fit. A guardian of a minor's property, by contrast, is hamstrung by state laws. Among other things, he has limited financial authority—and usually can put money only into highly conservative channels.
- A trustee can continue to manage the property for as long as you specify. But a guardian automatically loses his authority the day the child turns 21.

Of course, it's as important as ever to name a *personal* guardian. If you fail to do so, a court might have to appoint one. Don't assume that your executor will become guardian—unless you say so in your will—or that some unwritten understanding with a favorite relative will necessarily hold up. Other members of the family—or even the child himself, if he's 14 or over—might overturn the agreement.

The guardian doesn't have to be a relative, as many people suppose. He might be a trusted friend of the family. No one can challenge your choice except by upsetting your entire will—which is most unlikely. If you need to change your will to take care of a guardianship, it can be handled by a codicil. It might be wise for you and your wife to make the change in both your wills at the same time. And remember that it's wise to name an alternate guardian.

A personal guardian who has been appointed by the court has a great deal of freedom in caring for a child. When you name your own guardian, though, you can make your views clear—in your will if you wish. You can be as specific as suggesting a church, private school, or college. These directions, however, place the guardian only under a moral obligation—not a legal one. A court isn't apt to interfere with differing decisions by a guardian—except on the question of a child's religious training.

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Slickest, most flexible device for planning

Obviously the trust is a basic tool in planning. Properly employed, it can work wonders. It can save income and estate taxes, provide experienced management for family property, and even vest the income or principal in descendants who may not be born for years to come. Actually, a trust can do everything in administering property which you could do yourself and, in some respects, it can do a good deal more.

Trusts are either created by an agreement during one's lifetime (living or inter-vivos trusts) or by a will (testamentary trusts). Although a living trust is made today, it can continue after death and thereafter function in the same way that a testamentary trust does. The broader the discretion given to the trustees, of course, the more flexibly they can carry out the grantor's intended objectives.

A number of provisions are used to build flexibility:

Sprinkling provisions. These permit the trustees to pay income to selected beneficiaries to the exclusion of others. This is especially important where there are several children to be supported by a surviving wife. Instead of having all income paid to her and subjected to her higher tax bracket with the after-tax amount used for the children, larger amounts can be made available for them by having the income paid to them directly.

Discretionary provisions. These allow trustees the discretion to encroach upon principal in behalf of selected beneficiaries based on their need or level of financial experience. If a beneficiary has valid needs in excess of trust income, or shows an ability to take over the ownership, the trustees may distribute to him either a part or all of it. Contrary to the usual belief that manhood begins at 21, it's often a mistake to distribute principal to children just because they've attained that age. It is often better that they receive large lump sums at later ages, when they have developed maturity and financial experience. But note that partial distributions can be made meanwhile, so that they may develop the needed experience.

Generation-skipping provisions. These conserve property for future generations and save estate taxes. Example: Jones' will establishes a trust that is to operate during the lifetimes of his son, B, and his grandchild, C. Income is to be paid to B and C within the discretion of the trustees, and, at the death of the survivor of B and C, the principal goes to C's children. After Jones' death, no estate tax on the trust fund will be involved until the death of *C's children* when the ownership of the property in their estates will make it subject to tax. If Jones had left his estate outright to B, it would be taxed when B died and if B left it to C, it would again be taxed at C's death. Jones' trust, therefore, saves the principal from two taxable events—and maybe from taxation for up to 100 years.

It is interesting to note that the U. S. Treasury has indicated that it intends to obtain legislation to close this estate tax loophole which would require the principal of the trust to be taxed at the death of the beneficiary of each generation. However, present law permits generation-skipping.

There are innumerable types of trusts.

The *management trust* (living and revocable) has as its purpose the management and investment of property by trustees, usually a bank, in behalf of its creator. He receives the income but is relieved of day-to-day management of the principal.

The *estate administration trust* (living and revocable) avoids the probate of property and the attendant bother and costs of court proceedings. This trust is used for the owner's benefit during his lifetime but at his death it becomes irrevocable and continues on to carry out his testamentary objectives. In effect, it takes the place of his will in transferring the trust property and can contain all the terms commonly included in testamentary trusts. It not only saves probate and executor's costs, but provides continuity of management of property before, at, and after the owner's death. It also permits secrecy as to the extent of a man's fortune or how he has distributed it, and if an estate consists of real estate located in several states, it avoids the need for separate probate in each state.

Life insurance trusts (living and usually revocable) are established to receive the proceeds of life policies at the insured's death at which time it becomes irrevocable. It avoids probating and can carry out all the owner's testamentary objectives.

The *marital deduction trust* (usually testamentary but sometimes part of a living trust which continues to operate after the owner's death) is used to provide property management for a widow who has had little experience in handling money. Generally speaking, it consists of the marital-deduction half of the husband's estate which is not taxed when he dies. In order to qualify for the deduction, the trust must pay all of its income to the wife, and she must have the right during her lifetime or at death to dispose of the principal to anyone she wishes. Property in the trust at the time of the wife's death is taxable in her estate.

The *residuary trust* (usually testamentary but, like the marital deduction trust, sometimes part of a living trust) consists of the residue of the estate *after* taxes. It has three major purposes: to provide trust management, to distribute income and principal payments to the family, and to avoid estate taxation of principal as it passes to the beneficiaries to whom it is ultimately distributed. This has special significance where the widow is primary beneficiary. The surviving wife can have all the benefits of the property during her lifetime, yet when she dies, it is *not* taxed again as a part of her estate.

The *short-term trust*. This has been a popular way of deflecting for a limited period of time taxable income from a high-bracket owner to a lower-bracket dependent. Minimum time is 10 years. Lately, some tax services have reported that changes in the law have undermined the tax-shelter value. That's not necessarily so.

Up to now, one of the advantages of getting family income to a child this way was that, besides his lower tax bracket, he also had his own personal exemption, a $100 dividend exclusion and low-income allowance. The first $1,750 of his income was free of tax. For 1972 and hereafter, however, the low-income allowance can no longer be used by a dependent child to offset *unearned* income. But where the beneficiary of the trust is other than a dependent child, the low-income allowance still obtains for any type of income. The obvious conclusion: The short-term trust is still a useful device in tax planning, though its effectiveness is somewhat reduced in the case of a dependent child.

A more serious problem is the increased gift tax values which are now attributed to the transfer of property income into the trust. Up to Dec. 31, 1970, the gift tax value of the transferred income for the term of the trust was based on a 3½% discount table. Thus, if property assigned to a 10-year trust was worth $50,000, the gift tax value of the income right would be $14,500. The Treasury has since substituted a 6% discount table. Today, a similar income assignment has a gift tax value of $22,000.

—ROBERT BROSTERMAN

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Treasury's bite: prime reason for estate plans

Behind all the concern over estate planning lies one inexorable item—the estate tax itself. At the low end of the scale, it's modest enough, a mere 3%, and estates valued at less than $60,000 aren't taxed at all. But then it shoots up fast. The bite on a $100,000 taxable estate is $20,700. On one of $200,000, the rate is 25%. Ultimately the tax bite reaches 77%.

Whatever property a man has goes into his taxable estate at its value as of the day he dies. This includes life insurance proceeds, if he has kept ownership of the policy. It also includes the value of jointly held property. It can even include property he thought he had given away. A gift made within three years of death may be taxed if the Treasury determines it was made "in contemplation of death." Property set up in trust for children can also go into the taxable column, when the donor has retained the right to revoke.

The Treasury, however, does not win them all. A family is allowed four chief deductions: expenses and debts (lawyers' fees, executor's commission, funeral costs, and decedent's personal debts); charitable contributions and bequests; a maximum 50% marital deduction, and the flat $60,000 exemption.

How it all works is best told by example. Say a family man has a total estate of $370,000, including $100,000 in life insurance, and $70,000 in property held jointly with his wife. His will leaves all this in equal shares to his wife and their two children. If he dies tomorrow, debts and expenses might account for $25,000; the marital deduction would be $115,000 (one-third of the adjusted gross of $345,000), and there would be the $60,000 exemption. That leaves a taxable estate of $170,000. The tax: about $40,000.

With minimum planning, he could have given the $100,000 policy to his children, and taken full advantage of the marital deduction by leaving his wife one-half instead of one-third. His gross estate then would have come to just $270,000. His tax: $10,000. And, if he had followed a yearly program of gifts to his children he could have avoided even that. Under present rules, Smith and his wife could together have given a total of $12,000 yearly to their two children tax-free.

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Joint ownership: short-cut to woe

"THE HITCH IS, THE IDEA LOOKS SO DAMNED ATTRACTIVE"

Joint ownership of property, which fills one of the dustier manila folders in the corner cabinet marked "estates," is long overdue for a complete examination. A new U. S. Tax Court case warns, in effect, caveat emptor; and estate planners are reminding their clients that if they want to provide maximum protection for their families, they will heed the caution without delay.

"The difficulty with husband-wife joint ownership is that the idea looks so damned attractive at first glance," says a partner in a prominent Washington law firm. "But the attractions are mostly short-term and short-sighted, too, when you get down to cases."

The experts readily admit that joint ownership (simply listing yourselves as co-owners) is a convenient and harmless way to handle a family checking account. Also—though here the lawyers bristle a bit because they would as soon forget it—joint ownership can sometimes be used to direct the inheritance of property. If a man buys shares of stock "jointly" with his wife, the stock passes to her automatically if he dies. There is a dollar advantage here because the stock goes to the widow "outside the will"; thus it skips around the often expensive and time-consuming probate routine which helps keep numerous attorneys occupied at the county courthouse.

There is even a possible income-tax break that now and again is latched to joint ownership. If, for example, a block of stock pays dividends, each joint owner can report his (or her) share on a separate tax return—so, sometimes, the income is split apart and falls into lower tax brackets.

But for all of this, the estate lawyers win their case. Joint ownership, unless given micrometer-like attention, can set many traps for the unwary. This holds, especially, when a husband uses the idea to the hilt and substitutes it for the drawing of an adequate will and a sensible plan for his estate.

Says a Manhattan lawyer whose estate work is known to the carriage-trade: "In a typical joint ownership situation, the husband's death puts the burden of managing his property suddenly into his wife's hands. She may be a babe in the woods at this job, particularly where a range of investments is involved." Often, he explains, the widow will get a lot of well-intentioned but frequently ill-informed advice from relatives and friends. And all too often she will attract a rash of outside advice that is "thoughtless and designed mainly to churn up commissions and fees for 'services' presumably rendered."

Another danger of joint ownership, though a less apparent one, is that a man's property may even wind up wholly or partly in the wrong hands. In a recent case, a man had put his property into joint ownership with his wife; they had no children, but the husband had an aged parent still living, and the wife had two brothers. He died unexpectedly, and a short time later his wife died without having made a will. Since the property was wholly the wife's at her death, her brothers inherited all (under state law). Both husband and wife, it was shown, actually had wanted to provide for the husband's parent.

Here the result of joint ownership was illogical, unfair, and undesired—by all but the two brothers. Estate lawyers in practically any locality can cite similar woeful examples.

There are some sizable tax disadvantages, too. When a man uses his funds to create a joint ownership with his wife, he may end up owing the government a gift tax, especially in a case where the wife exercises some control; for example, if she, as well as he, deals with a professional investment adviser or manager of their portfolio. (Real estate is an exception—there is no danger of gift tax complications.)

But the biggest tax drawback—and this comes as a shock to many heirs of estates—is that, in effect, all the property that a man and his wife own jointly at the time of his death becomes part of his taxable estate. It is not just half, as many people imagine. In an estate of, say, $300,000, the ultimate *difference* in tax bills ultimately paid by the heirs might easily be as high as $30,000.

With all this in mind, though, a hasty re-transfer of property back out of joint ownership would be a blunder—because of gift-tax possibilities. What is needed is some professional guidance on how to handle such give-backs.

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More blessed to give than to bequeath?

IT CERTAINLY SAVES ON ESTATE TAXES, EXPERTS POINT OUT

In their ceaseless maneuvering with the tax collectors, U.S. taxpayers have rarely found a better way to beat a levy. The tax in question is the federal impost on estates. The antidote: judiciously planned use of the more generous tax law on gifts, reducing one's taxable estate through piecemeal giving to prospective heirs during one's lifetime. Not only are the gift tax rates 25% lower than the federal estate tax, but exemptions are broad enough to eliminate the gift tax entirely in most cases.

Here is how it can be done. Under the law, a donor can annually make gifts of up to $3,000 each to any number of persons without incurring any gift tax. In addition, he can give away $30,000 over his lifetime, free of tax. If he is married and his wife consents to the gifts, he may give up to $6,000 to each person every year and $60,000 over his lifetime, free of gift tax. Thus, a married man can give one person up to $66,000 tax free in one year (where neither he nor his wife has previously used the lifetime exemption). In other years, he and his wife may continue to give that person and any others $6,000 without incurring gift tax.

Marital deduction provisions particularly encourage gifts to a spouse. For example, a husband can give his wife up to $6,000 in any year without taking into account any part of his lifetime gift tax exemption. The gift is eliminated from tax by the 50% marital deduction (50% of $6,000, or $3,000) plus the $3,000 annual exclusion.

A systematic program of annual gifts of $3,000 each to children and grandchildren can avoid gift tax entirely. The installment gifts can be $6,000 a year where each parent is treated as giving half. For example, where annual gifts are made to four children, a couple could give up to $24,000 a year, tax free. Over several years, gifts at that rate could appreciably reduce a sizable estate.

Even where a gift tax may be incurred, the lower level of the graduated rates provides an overall saving over potential estate taxes. Take the case of a single person who has used up his lifetime exemption in making prior gifts, and has a net estate of $200,000. On a gift of $50,000, he will incur a gift tax of $4,755, but will reduce the potential estate tax by $14,000, a net reduction of $9,245.

As for the kind of property best used for such gifts, it is generally preferable to use non-appreciated, income-producing property rather than that which has appreciated or depreciated in value since the donor acquired it.

Property which has depreciated in value should generally not be given because the donor loses the opportunity to deduct the loss. He might better sell the property, take the loss, and give the proceeds to the donee.

Regardless of the type of property or the donee, a gift made within three years of the donor's death faces the Treasury's charge of having been made "in contemplation of death." If the Treasury proves its case, the gift is included in the donor's taxable estate. To help his estate rebut such a presumption, the donor should leave evidence of a "life motive" for making the gift. Proof of good health at the time of the gift, a pattern of gift giving (such as on birthdays), making a gift for a specific purpose (such as buying a house), or having an established year-to-year gift program can serve to rebut the Treasury's claim.

The advantages anticipated from a gift program may not materialize unless and until a gift is legally completed. Here are some common problems:

To make a gift of U.S. Treasury bonds, they must be reissued by a bank or other transfer agent in the sole name of the donee. Savings bonds, incidentally, are not negotiable, so that an owner cannot give them away by just delivering them to the donee.

A person who opens a joint bank account for himself and someone else has not made a gift. There is a completed gift only at the time the other joint tenant makes a withdrawal from the account.

Similarly, no gift has been made when a bank account is opened "in trust for" a child. The practical result of opening such an account is that, upon the parent's death, the funds will immediately belong to the children named.

Setting up a joint account in a "street name" is not an effective transfer for gift tax purposes. Securities are held in a street name—that is, the name of the broker—when a margin or cash account is set up to facilitate trading. The gift is completed only when the other party draws on the account without any obligation to account for the proceeds. The Treasury contends that an account in a street name is like a joint bank account.

—BERNARD GREISMAN

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Life insurance is the cornerstone of the estates of most U.S. breadwinners. Yet few realize what a versatile tool a life insurance policy can be. "If you are like most people," a recent statement from the Institute of Life Insurance declares, "you probably never read it all the way through." Implicit is the warning that what you don't know *can* hurt you—or your dependents—later on.

Non-taxable dividends, for instance, can be allowed merely to accumulate. But they can also be used to reduce premium payments or to buy more coverage. Even within that latter choice there are three options for the policyholder: For greater current protection, he can spend the dividends on term coverage. Or, he can apply them to paid-up insurance—in a smaller amount, but in a form requiring no further premium payments. Or, he could buy a combination of the two.

Older persons, of course, find that as their children mature their insurance needs are less. An obvious move at that time is to surrender their policies at cash value. But industry statistics show that most people prefer to continue some life insurance into retirement years. There are several alternatives open to them. One favorite: Exchanging cash value of current policies for paid-up coverage in a lesser amount—the advantage being that such an exchange is made at *net* rates that provide more insurance than if the insured cashed-in his old insurance and bought a new paid-up policy.

Life insurance certainly should not be thought of solely as "death" insurance. It can be easily tied in with retirement plans. A policy originally bought to protect against the effects of premature death can be converted in later years to a paid-up annuity for the policyholder.

In any review of life insurance, taxes should be considered. While the amount received by a beneficiary escapes income tax, it can, as part of one's taxable estate, be hit by the federal estate tax. An insured can free it from that tax, too, by making a gift of his life policy to his intended beneficiary during his lifetime.

It is little realized by the millions who are now insured under group term policies provided through their places of employment that this coverage, too, can be made a gift in many instances.

—JOHN D. CUNNION

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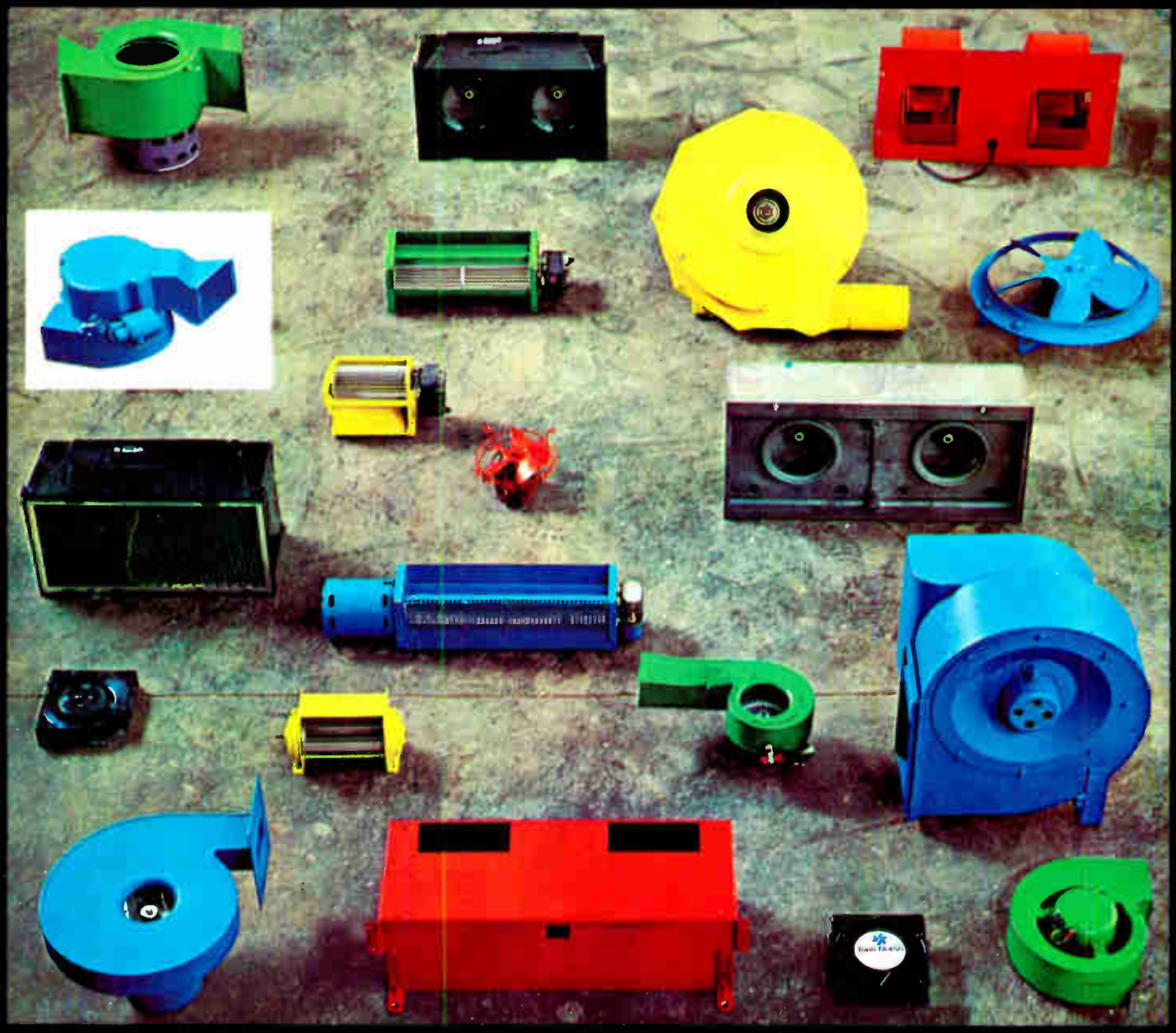

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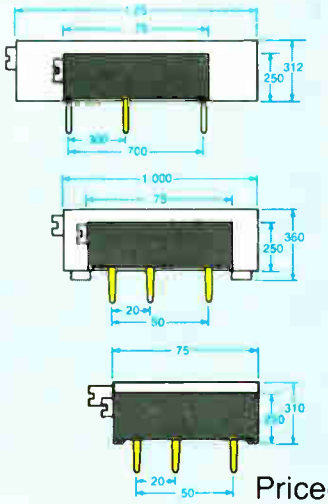

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